NRC·CNRC Administrative Services and Property Management

SPECIFICATIONS

SOLICITATION #: 15-22004

BUILDING: M-22
1200 Montreal Road Campus
Ottawa, Ontario

PROJECT: M-22 Aircraft Cabin Comfort
and Environment Research Facility

PROJECT #: M22-3788

Date: June 2015

National Research Council Canada | Conseil national de recherches Canada

Canada

SPECIFICATION

TABLE OF CONTENTS

National Research Council Canada	Conseil national de recherches Canada
Administrative Services & Property management Branch (ASPM)	Direction des services administratif et gestion de l'immobilier (SAGI)

Construction Tender Form

Project Identification **M-22 Aircraft Cabin Comfort and Environment Research Facility**

Tender No.: **15-22004**

1.2 **Business Name and Address of Tenderer**

Name_____

Address_____

_____

Contact Person(Print Name)_____

Telephone (_____) _____ **Fax**: (_____) _____

1.3 Offer

I/We the Tenderer, hereby offer to Her Majesty the Queen in Right of Canada (hereinafter referred to as "Her Majesty") represented by the National Research Council Canada to perform and complete the work for the above named project in accordance with the Plans and Specifications and other Tender Documents, at the place and in the manner set out therein for the Total Tender Amount (to be expressed in numbers only) of**: $_____. _____ in lawful money of Canada (excluding GST/HST)**

The above amount is inclusive of all applicable (*) Federal, Provincial and Municipal taxes except that in the event of a change in any tax imposed under the Excise Act, the Excise Tax Act, the Old Age Security Act, the Customs Act, the Customs Tariff or any provincial sales tax legislation imposing a retail sales tax on the purchase of tangible personal property incorporated into Real Property, that occurs

.1 after the date this tender was mailed or delivered, or
.2 if this tender is revised, after the date of the last revision

the amount of this offer shall be decreased or decreased in the manner provided for in GC22 of the General Conditions of the Contract Documents.

1.3.1 Offer (continued)

(*) For the purpose of this tender, the Goods and Services Tax (GST) is not to be considered as an applicable tax.

In the province of Quebec, the Quebec Sales Tax is not to be included in the tender amount because the Federal Government is exempt from this tax. Tenderers shall make arrangements directly with the provincial Revenue Department to recover any tax they may pay on good and servives acquired in the performance of this contract. However, tenderers should include in their tender amount Quebec Sales Tax for which an Input Tax Refund is not available.

1.4 Acceptance and Entry into Contract

I/We undertake, within fourteen (14) days of notification of acceptance of my/our offer, to sign a contract for the performance of the work provided I/we are notified, by the Department, of the acceptance of my/our offer within 30 days of the tender closing date.

1.5 Construction Time

I/We Agree to complete the work within the time stipulated in the specification from the date of notification of acceptance of my/our offer.

1.6 Bid Security

I/We herewith enclose tender security in accordance with Article 5 of the General Instruction to Tenderers.

I/We understand that if a security deposit is furnished as tender security and if I/we refuse to enter into a contract when called upon to do so, my/our security deposit shall be forfeited but the Minister may, if it is in the public interest, waive the right of Her Majesty to forfeit the security deposit.

I/We understand that if the security furnished is not in the approved from as described in Article 5 of the General Instructions to Tenderers, my/our tender is subject to disqualification.

1.7 Contract Security

Within fourteen (14) days after receipt of written notification of the acceptance of my/our offer, I/we will furnish contract security in accordance with the Contract Conditions "F" of the Contract Documents.

I/We understand that the contract security referred to herein, if provided in the form of a bill of exchange, will be deposited into the Consolidated Revenue Fund of Canada.

1.8 Appendices

This Tender Form includes Appendix No. _____"A" _____.

1.9 Addenda

The Total Tender Amount provides for the Work described in the following Addenda:

NUMBER	DATE	NUMBER	DATE

(Tenderers shall enter numbers and dates of addenda)

1.10 Execution of Tender

The Tenderer shall refer to Article 2 of the General Instructions to Tenderers.

SIGNED, ATTESTED TO AND DELIVERED on the _____day of _____on behalf of

_____

(Type or print the business name of the Tenderer)

AUTHORIZED SIGNATORY (IES)

_____

(Signature of Signatory)

_____

(Print name & Title of Signatory)

_____

(Signature of Signatory)

_____

(Print name & Title of Signatory)

SEAL

National Research Council Canada | Conseil national de recherches Canada

Administrative Services and Property Management Branch (ASPM) | Direction des services administratifs et de la gestion de l'immobilier (SAGI)

Construction Tender Form
Appendix 'A'

Project Identification M-22 Aircraft Cabin Comfort and Environment Research Facility

Tender No.: 15-22004

Separate price for painting walls and ceiling of room 137 in accordance with note on drawing no. 3788-A11: $_____.____ (excluding GST/HST)

BUY AND SELL NOTICE

M-22 Aircraft Cabin Comfort and Environment Research Facility

The National Research Council Canada, 1200 Montreal Road Campus, Ottawa, ON has a requirement for a project that includes:

Renovate the interior and construct additions to the exterior of NRC building M22 to house a new research facility. Construct specialized heating, ventilating and air conditioning systems for the research apparatus.

1. GENERAL

Questions regarding any aspect of the project are to be addressed to and answered only by the Departmental Representative (or his designate) or the Contracting Authority.

Any information received other than from the Departmental Representative (or his designate) or the Contracting Authority will be disregarded when awarding the contract and during construction.

Firms intending to submit tenders on this project should obtain tender documents through the Buyandsell.gc.ca TMA services provider. Addenda, when issued, will be available from the Buyandsell.gc.ca TMA service provider. Firms that elect to base their bids on tender documents obtained from other sources do so at their own risk and will be solely responsible to inform the tender calling authority of their intention to bid. Tender packages are not available for distribution on the actual day of tender closing.

2. MANDATORY SITE VISIT

It is mandatory that the bidder attends one of the site visits at the designated date and time. At least one representative from proponents that intend to bid must attend.

The site visits will be held on June 23rd and June 25th , 2015 at **9:00** . Meet Maurice Richard at Building M-22, Main Entrance, 1200 Montreal Road Campus , Ottawa, ON. Bidders who, for any reason, cannot attend at the specified date and time will not be given an alternative appointment to view the site and their tenders, therefore, will be considered as non-responsive. **NO EXCEPTIONS WILL BE MADE.**

As proof of attendance, at the site visit, the Contracting Authority will have an Attendance Form which MUST be signed by the bidder's representative. It is the responsibility of all bidders to ensure they have signed the Mandatory Site Visit Attendance form prior to leaving the site. Proposals submitted by bidders who have not attended the site visit or failed to sign the Attendance Form will be deemed non-responsive.

3. TENDER CLOSING DATE

Tender closing date is July 10th , 2015 at 14:00.

4. TENDER RESULTS

Following the Tender closing, the tender results will be sent by facsimile to all Contractors who submitted a tender.

5. SECURITY REQUIREMENT FOR CANADIAN CONTRACTORS

5.1 MANDATORY SECURITY REQUIREMENT:

This procurement contains a mandatory security requirement as follows:

1 The Contractor must, at all times during the performance of the Contract, hold a valid Designated Organization Screening (DOS), issued by the Canadian Industrial Security Director (CISD), Public Works Government Services Canada.

2 The Contractor personnel requiring access to sensitive work site(s) must EACH hold a valid RELIABILITY STATUS, granted or approved by CISD/PWGSC.

3 The Contractor must comply with the provisions of the:
   a. Security Requirements Checklist attached at Appendix "D"
   b. Industrial Security Manual (Latest Edition) available at: http://ssi-iss.tpsgc-pwgsc.gc.ca/msi-ism/msi-ism-eng.html

5.2 VERIFICATION OF SECURITY CLEARANCE AT BID CLOSING

1 The Bidder must hold a valid Designated Organization Screening (DOS) issued by the Canadian Industrial Security Directorate (CISD), Public Works and Government Services Canada (PWGSC), TO BE INCLUDED WITH THEIR TENDER OR PROVIDED WITHIN 48 HOURS FROM THE DATE AND TIME OF TENDER CLOSING. Verifications will be made through CISD to confirm the security clearance status of the Bidder. Failure to comply with this requirement will render the bid non-compliant and no further consideration will be given to the bid.

2 Within 72 hours of tender closing, the General Contractor must name all of his sub-contractors, each of whom must hold a valid RELIABILITY STATUS, granted or approved by CISD/PWGSC, or any other Federal Department or Agency along with the names and birthdates or security clearance certificate numbers of all personnel who will be assigned to the project.

3 It is to be noted that any subcontractor required to perform any part of the work during the performance of the subsequent contract must also adhere to the mandatory security requirement of the contract. As well, no personnel without the required level of security will be allowed on site. It will be the responsibility of the successful bidder to ensure that the security requirement is met throughout the performance of the contract. The Crown will not be held liable or accountable for any delays or additional costs associated with the contractor's non-compliance to the mandatory security requirement. Failure to comply with the mandatory security requirement will be grounds for being declared in default of contract.

4 For any enquiries concerning the project security requirement during the bidding period, the Bidder/Tenderer must contact the Security Officer @ 613-993-8956.

6.0 WSIB (WORKPLACE SAFETY AND INSURANCE BOARD)

1 All Bidders must provide a valid WSIB certificate with their Tender or prior to contract award.

7.0 OFFICE OF THE PROCUREMENT OMBUDSMAN

1 Dispute Resolution Services
The parties understand that the Procurement Ombudsman appointed pursuant to Subsection 22.1(1) of the *Department of Public Works and Government Services Act* will, on request or consent of the parties to participate in an alternative dispute resolution process to resolve any dispute between the parties respecting the interpretation or application of a term and condition of this contract and their consent to bear the cost of such process, provide to the parties a proposal for an alternative dispute resolution process to resolve their dispute. The Office of the Procurement Ombudsman may be contacted by telephone at 1-866-734-5169 or by e-mail at boa.opo@boa-opo.gc.ca.

2 Contract Administration
The parties understand that the Procurement Ombudsman appointed pursuant to Subsection 22.1(1) of the *Department of Public Works and Government Services Act* will review a complaint filed by [*the supplier or the contractor or the name of the entity awarded this contract*] respecting administration of this contract if the requirements of Subsection 22.2(1) of the *Department of Public Works and Government Services Act* and Sections 15 and 16 of the *Procurement Ombudsman Regulations* have been met, and the interpretation and application of the terms and conditions and the scope of the work of this contract are not in dispute. The Office of the Procurement Ombudsman may be contacted by telephone at 1-866-734-5169 or by e-mail at boa.opo@boa-opo.gc.ca.

3 The Office of the Procurement Ombudsman (OPO) was established by the Government of Canada to provide an independent avenue for suppliers to raise complaints regarding the award of contracts under $25,000 for goods and under $100,000 for services. You have the option of raising issues or concerns regarding the solicitation, or the award resulting from it, with the OPO by contacting them by telephone at 1-866-734-5169 or by e-mail at boa.opo@boa-opo.gc.ca. You can also obtain more information on the OPO services available to you at their website at www.opo-boa.gc.ca.

The Departmental Representative or his designate for this project is: **Maurice Richard**
Telephone: **613 993-9299**

Contracting Authority for this project is: **Marc Bédard marc.bedard@nrc-cnrc.gc.ca**
Telephone**: 613 993-2274**

INSTRUCTIONS TO BIDDERS

Article 1 – Receipt of Tender

1a) Tenders must be received not later than the specified tender closing time. Tenders received after this time are invalid and shall not be considered, regardless of any reason for their late arrival.

1b) A letter of printed telecommunication from a bidder quoting a price shall not be considered as a valid tender unless a formal tender has been received on the prescribed Tender Form.

1c) Bidders may amend their tenders by letter or printed telecommunication provided that such amendments are received not later than the specified tender closing time.

1d) Any amendments to the tender which are transmitted by telefax must be signed and must clearly identify the tenderer.

All such amendments are to be addressed to:
National Research Council of Canada
Marc Bedard, Senior Contracting Officer
Building M-22
Montreal Road, Ottawa, Ontario
K1A 0R6

Fax: (613) 991-3297

Article 2 – Tender Form & Qualifications

1) All tenders must be submitted on the Construction Tender Form and the tender must be signed in compliance with the following requirements:

a) Limited Company: The full names of the Company and the name(s) and status of the authorized signing officer(s) must be printed in the space provided for that purpose. The signature(s) of the authorized officer(s) and the corporate seal must be affixed.

b) Partnership: The firm name and the name(s) of the person(s) signing must be printed in the space provided. One or more of the partners must sign in the presence of a witness who must also sign. An adhesive coloured seal must be affixed beside each signature.

c) Sole Proprietorship : The business name and the name of the sole proprietor must be printed in the space provided. The sole proprietor must sign in the presence of a witness who must also sign. An adhesive coloured seal must be affixed beside each signature.

2) Any alterations in the printed part of the Construction Tender Form or failure to provide the information requested therein, may render the tender invalid.

3) All space in the Construction Tender Form must be completed and any handwritten or typewritten corrections to the parts so completed must be initialed immediately to the side of the corrections by the person or persons executing the tender on behalf of the the tenderer.

4) Tenders must be based on the plans, specifications and tender documents provided.

Article 3 - Contract

1) The Contractor will be required to sign a contract similar to the Standard Contract Form for Fixed Price Construction Contracts, a blank specimen of which is enclosed in the package for reference purposes.

Article 4 – Tender Destination

1a) Tenders are to be submitted in sealed envelopes to:
National Research Council Canada
Administrative Services and Property Management Branch
1200 Montreal Road
Building M-22
Ottawa, ON
K1A 0R6

Endorsed "Tender for (insert title of work as it appears in the drawings and specifications)" and must bear the name and address of the tenderer.

1b) Unless otherwise specified, the only documents required to be submitted with the tender are the Tender form and the Bid Security.

Article 5 - Security

1a) Bid Security is required and must be submitted in one of the following forms:

i) a certified cheque payable to the Receiver General for Canada and drawn on a member of the Canadian Payments Association or a local cooperative credit society that is a member of a central cooperative credit society having membership in the Canadian Payments Association; **OR**

ii) bonds of the Government of Canada, or bonds unconditionally guaranteed as to principal and interest by the Government of Canada; **OR**

iii) a bid bond.

1b) Regardless of the Bid Security submitted, it should never be more than $250,000 maximum, calculated at 10% of the first $250,000 of the tendered price, plus 5% of any amount in excess of $250,000.

2a) Bid Security shall accompany each tender or, if forwarded separately from the tender, shall be provided not later than the specified tender closing time. Bid Security must be in the ORIGINAL form. Fax or photocopies and NOT acceptable. FAILURE TO PROVIDE THE REQUIRED BID SECURITY SHALL INVALIDATE THE TENDER.

2b) If the tender is not accepted, the Bid Security submitted pursuant to Article 8 shall be returned to the tenderer.

3a) The successful tenderer is required to provide security within 14 days of receiving notice of tender acceptance. The tenderer must furnish EITHER:

i) a Security Deposit as described in 1(b) above together with a Labour and Material Payment Bond in the amount of at least 50% of the amout payable under the contract, OR

ii) a Performance Bond and a Labour and Material Payment Bond – each in the amount of 50% of the amount payable under the contract.

3b) Should it not be possible to obtain a Labour Material Payment Bond as required under 3(a) above, on making application thereof to at least two acceptable Bonding Companies, an additional Security Deposit of a straight 10% of the amount payable under the contract must be furnished.

3c) Where a tender has been accompanied by a Security Deposit, as described in 1(b) above, the amount of the Security Deposit required under 3(a) above may be reduced by the amount of the Security Deposit which accompanied the tender.

3d) Bonds must be in an approved form and from the companies whose

bonds are acceptable to the Government of Canada. Samples of the approved form of Bid Bond, Performance Bond and Labour and Material Payment Bond and a list of acceptable Bonding Companies may be obtained from the Contracting Officer, National Research Council, Building M-22, Montreal Road, Ottawa, Ontario, K1A 0R6.

Article 6 – Interest On Security Deposits

1) Tenderers are notified that they must make their own arrangements with their bankers as to the interest, if any, on the amount of the certified cheque accompanying their tender. The Council will not pay interest on said cheque pending the awarding of the contract nor be responsible for the payments of interest under any arrangement made by the tenderers.

Article 7 – Sales Tax

1) The amount of the tender shall include all taxes as levied under the Excise Act, the Excise Tax Act, the Old Age Security Act, the Customs Act or the Customs Tariff, in force or applicable at the time.

2) In Quebec, the Provincial Sales Tax should not be included in the Tender Price as the Federal Government is exempt. Tenderers should contact the Provincial Revenue Minister to recover all taxes paid for goods and services rendered under this contract.

Tenderers must include in their Tender Price the amount of Provincial Sales Tax for which the exemption does not apply.

Article 8 – Examination of Site

1) All parties tendering shall examine the sites of the proposed work before sending in their tender and make themselves thoroughly acquainted with the same and obtain for themselves any and all information that may be necessary for the proper carrying out of the Contract. No after claim will be allowed or entertained for any work or material that may be requisite and necessary for the proper execution and completion of this Contract with the exception of that provided for under GC 35 in the General Conditions of the General Specification.

Article 9 – Discrepancies, Omissions, Etc.

1a) Bidders finding discrepancies in, or omissions from, drawings, specifications or other documents, or having any doubt as to the meaning or intent of any part thereof, should at once notify the Engineer who will send written instructions or explanation to all bidders.

1b) Neither the Engineer nor the Council will be responsible for oral instructions.

1c) Addenda or corrections issued during the time of the bidding shall be covered in the proposal. However, the contract supersedes all communications, negotiations and agreements, either written or oral, relating to the work and made prior to the date of the contract.

Article 10 – No additional Payments for Increased Costs

1) The only other adjustments in the contract price allowed are those specified in the General Conditions of the General Specification. The contract price will not be amended for change in freight rates, exchange rates, wage rates or cost of materials, plant or services.

Article 11 – Awards

1a) The Council reserves the power and right to reject tenders received from parties who cannot show a reasonable acquaintance with and preparation for the proper performance of the class of work herein specified and shown on plans. Evidence of such competence must be furnished by the tenderers if required to do so.

1b) A tenderer may be required to furnish to the Contracting Office, National Research Council of Canada, Building M-22, 1200 Montreal Road, Ottawa, Ontario, K1A 0R6, Canada, unsigned copies of the insurance requirements as covered by the Insurance Conditions of the General Specification.

1c) The Council does not bind itself to accept the lowest or any tender.

Article 12 – Harmonized Sales Tax

1) The Harmonized Sales Tax (HST) which in now in effect shall be considered an applicable tax for the purpose of this tender. However, the bidder shall NOT include any amount in the bid price for said HST. The successful contractor will indicate on each application for payment as a separate amount the appropriate HST the Owner is legally obliged to pay. This amount will be paid to the Contractor in addition to the amount certified for payment under the Contract in addition to the amount certified for payment under the Contract and will therefore not affect the Contract Price. The Contractor agrees to remit any HST collected or due to Revenue Canada.

Non-resident contractors

RST guide 804
Published August 2006
ISBN: 1-4249-2007-8 (Print), **1-4249-2009-4 (PDF), 1-4249-2008-6 (HTML)**

Publication Archived

Notice to the reader: For Retail Sales Tax (RST) – On July 1, 2010 the 13 per cent Harmonized Sales Tax (HST) took effect in Ontario replacing the existing provincial Retail Sales Tax (RST) and combining it with the federal Goods and Services Tax (GST). As a result, RST provisions described on this page and in other publications ended on June 30, 2010.

Effective July 1, 2010 this publication was archived for RST purposes **only**. Use caution when you refer to it, since it reflects the law in force for RST at the time it was released and may no longer apply.

- The information in this Guide explains the Retail Sales Tax (RST) responsibilities of a non-resident contractor who is awarded a construction contract to perform work in Ontario and their Ontario customers. Please note that this Guide replaces the previous version dated March 2001.

Non-Resident Contractor Defined

A non-resident contractor is a contractor located outside Ontario who has been awarded a construction contract to perform work in Ontario, and who has not maintained a permanent place of business in Ontario continuously for twelve months immediately prior to signing the contract, or which is not a company incorporated under the laws of Ontario. A construction contract is a contract for the erection, remodelling or repair of a building or other structure on land.
A contractor is a person who is in the business of constructing, altering, repairing or improving real property and includes, but is not limited to,

1. a general contractor and subcontractor,
2. a carpenter, bricklayer, stonemason, electrician, plasterer, plumber, painter, decorator, paver, and bridge builder,
3. a sheet metal, tile and terrazzo, heating, air conditioning, insulation, ventilating, papering, road, roofing and cement contractor, who installs or incorporates items into real property. (See RST Guide 206 - Real Property and Fixtures).

Registration and Guarantee Deposit

Non-resident contractors who are awarded a construction contract in Ontario are required to register with the Ministry of Finance (ministry), Centralized Programs Unit and post a guarantee equal to 4 per cent of the total of each Ontario contract. The guarantee can be paid in cash, by certified cheque (payable to the Minister of Finance), letter of credit or by a guarantee bond.

To register with the ministry and to obtain further information on posting a guarantee, contractors should contact the ministry's Centralized Programs Unit, 33 King Street West, PO Box 623, Oshawa, Ontario, L1H 8H7, toll-free 1 866 ONT-TAXS (1 866 668-8297) or fax to 905 435-3617.

Non-resident contractors who sell taxable goods on a supply only basis to Ontario customers, or provide taxable services in Ontario, may obtain a regular Vendor Permit to collect and remit RST on their sales. Non-resident contractors who have been issued a regular Vendor Permit must still register separately with the ministry and post a guarantee if they are awarded a construction contract in Ontario.

Letter of Compliance

After receiving the guarantee, the ministry mails out two copies of a "letter of compliance" to the contractor certifying the Retail Sales Tax (RST) requirements have been met. Contractors must give a copy of the letter to their customers.

If a copy of the compliance letter is not provided, the customer must withhold 4 per cent of all amounts payable to the non resident contractor and pay the withheld amounts to the Minister of Finance (minister). Details relating to the contract should be sent along with the payments to the Centralized Programs Unit. Customers may give the minister a guarantee bond equal to 4 per cent of the total contract price instead of making the 4 per cent payments.

Note: Customers who do not follow these requirements may be held liable for 4 per cent of all amounts payable to the non resident contractor or any other amount that the Ministry deems to be the RST payable resulting from the performance of the contract.

Calculation of RST

Fair Value

RST is payable on the "fair value" of materials, purchased or brought into Ontario, to be used for work performed in Ontario. "Fair value" includes:

- the purchase price in Canadian funds;
- all charges by the supplier for handling and delivery, and
- any federal customs duties and excise taxes paid (but not the federal Goods and Services Tax (GST)).

Contractors are also required to pay RST to Ontario suppliers on the purchase, rental or lease of taxable services, materials, machinery, or equipment.

Machinery and Equipment - Leased

If machinery or equipment is leased from a supplier outside Ontario and brought into the province, RST is payable on the lease payments for the period the machinery or equipment is in Ontario.

Machinery and Equipment - Owned by Contractor

If machinery or equipment is owned by the contractor, RST may be calculated in one of the following ways:

a. If a contractor brings machinery and equipment into Ontario for less than 12 months' use, RST is to be calculated using the following formula:

   1/36 × net book value at date of import × number of months in Ontario × tax rate

   For the purpose of this formula, RST is payable for each month or part of a month that the goods are in Ontario. A month is considered 31 consecutive days and a part month is considered more than 12 days. The RST payable is based on the number of days the machinery and equipment are located in Ontario and not the number of days the items are actually used.

Example: Equipment is brought into Ontario on March 28 and taken out on May 8. The items were in the province for 41 days. RST is payable on the first 31 days' temporary stay in Ontario vs. use of the equipment. Since the remainder (10 days) is not considered part of a month, no RST is payable on this portion.

b. If, at the time the goods are brought into Ontario, it is expected that the machinery or equipment will be in Ontario for more than twelve months, contractors must pay Retail Sales Tax (RST) on the following basis:

   net book value at date of import × tax rate

   If, at the time of import, the length of time is not known, vendors may use the formula under (a). If they later find it necessary to keep the machinery and equipment in Ontario for more than 12 months, the RST paid under (a) may be deducted from the RST payable under (b).

Using formula (a) or (b) above, contractors will calculate and remit the RST payable on the return that is filed when the contract is finished.

(See Completion of Contract section)

Manufacturing for Own Use

Contractors may need to manufacture items, such as doors and windows, for their construction contracts. Manufacturing is work done in a factory away from a construction site, or in a mobile unit or workshop that is on or near the construction site. Manufacturing occurs when raw materials are changed into manufactured goods for use in real property contracts.

Contractors are considered to be manufacturing contractors if they produce goods:
1. for their own use in real property contracts, and
2. the manufactured cost of the goods is more than $50,000 a year.

(See RST Guide 401 - Manufacturing Contractors)

Contracts with the Federal Government

Where a non-resident contractor enters into a construction contract with the federal government, for the construction of a building and/or the installation of equipment, the nature of the equipment will determine whether the contract should be let on a tax-included or tax excluded basis.

Contracts for the construction of a building and the installation of equipment that directly services that building (i.e., elevators, escalators, light fixtures, central heating and air conditioning, etc.) should be tendered on a tax -included basis. Contractors are the consumers of the materials used in fulfilling these contracts and must pay or account for RST on the materials used to complete the contracts. There is NO exemption just because the contract is with the federal government.

Contracts for the installation of equipment that becomes a fixture and does not directly service a building (i.e., material handling equipment, production machinery, communication equipment, training equipment) may be tendered on a tax-excluded basis. Contractors engaged in contracts of this nature are permitted to make tax exempt purchases of such equipment by issuing a valid Purchase Exemption Certificate (PEC) to their supplier. Only non-resident contractors who have registered with the ministry and posted a guarantee may issue a PEC.

Exemptions

Contractors may supply and install equipment or materials for certain customers that may be entitled to an exemption from RST (e.g., manufacturers, Indian band councils, farmers and diplomatic organizations). The equipment or materials, when installed, becomes real property if it is permanently attached to land, or a fixture if it is permanently attached to a building or real property structure. Since

contractors are liable for RST, they should contact the ministry to find out if the customer qualifies for exemption before tendering the contract on a tax-excluded basis.

Status Indians, Indian Bands and Band Councils

Non-resident contractors may purchase building materials exempt from Retail Sales Tax (RST) for certain buildings and structures situated on reserves. The cost of such projects must be paid by the band council, and the buildings must provide a community service for the reserve. Contracts for the construction of an exempt community building project should be made on an RST-excluded basis. Non-resident contractors may purchase the materials exempt from RST by providing suppliers with a valid Purchase Exemption Certificate (PEC). As noted previously, only non-resident contractors who have registered with the ministry and posted a guarantee may issue a PEC. (See RST Guide 204 - Purchase Exemption Certificates).

Non-resident contractors must pay RST on items purchased for incorporation into a building or structure built for individual status Indians on a reserve. (See RST Guide 808 - Status Indians, Indian Bands and Band Councils).

Completion of Contract

When a contract is completed, non-resident contractors who were required to post a guarantee must complete a Non-Resident Contractor Retail Sales Tax Return [PDF - 92 KB] that is provided by the ministry.

If a contractor's guarantee was given in cash or by certified cheque, the amount of the deposit can be deducted from the RST liability owed by the contractor. If the liability is greater than the deposit, the amount remaining must be paid by the contractor. If the deposit is more than the liability, the contractor will receive a refund.

If a guarantee bond was posted instead of cash, the bond will be discharged once the RST liability is paid in full.

All returns are subject to audit.

Legislative References

- Retail Sales Tax Act, Subsections 19(2) and 39(3)(4) and (5)
- Regulation 1012 under the Act, Subsections 15.3(1)(2)(5)(6) and (7)
- Regulation 1013 under the Act, Sections 1 and 3

For More Information

The information contained in this publication is only a guideline. For more information, please contact the Ontario Ministry of Finance at 1 866 ONT-TAXS (1 866 668-8297) or visit our website at ontario.ca/finance.

Acceptable Bonding Companies

Published September 2010

The following is a list of insurance companies whose bonds may be accepted as security by the government.

1. Canadian Companies

- ACE INA Insurance
- Allstate Insurance Company of Canada
- Ascentus Insurance Ltd. (Surety only)
- Aviva Insurance Company of Canada
- AXA Insurance (Canada)
- AXA Pacific Insurance Company
- Canadian Northern Shield Insurance Company
- Certas Direct Insurance Company (Surety only)
- Chartis Insurance Company of Canada (formerly AIG Commercial Insurance Company of Canada)
- Chubb Insurance Company of Canada
- Commonwealth Insurance Company
- Co-operators General Insurance Company
- CUMIS General Insurance Company
- The Dominion of Canada General Insurance Company
- Echelon General Insurance Company (Surety only)
- Economical Mutual Insurance Company
- Elite Insurance Company
- Everest Insurance Company of Canada
- Federated Insurance Company of Canada
- Federation Insurance Company of Canada
- Gore Mutual Insurance Company
- Grain Insurance and Guarantee Company
- The Guarantee Company of North America
- Industrial Alliance Pacific General Insurance Corporation
- Intact Insurance Company
- Jevco Insurance Company (Surety only)
- Lombard General Insurance Company of Canada
- Lombard Insurance Company
- Markel Insurance Company of Canada
- The Missisquoi Insurance Company
- The Nordic Insurance Company of Canada
- The North Waterloo Farmers Mutual Insurance Company (Fidelity only)
- Novex Insurance Company (Fidelity only)
- The Personal Insurance Company
- Pilot Insurance Company
- Quebec Assurance Company
- Royal & Sun Alliance Insurance Company of Canada
- Saskatchewan Mutual Insurance Company
- Scottish & York Insurance Co. Limited
- The Sovereign General Insurance Company
- TD General Insurance Company
- Temple Insurance Company
- Traders General Insurance Company

- Travelers Guarantee Company of Canada
- Trisura Guarantee Insurance Company
- The Wawanesa Mutual Insurance Company
- Waterloo Insurance Company
- Western Assurance Company
- Western Surety Company

2. Provincial Companies

Surety bonds issued by the following companies may be accepted provided that the contract of suretyship was executed in a province in which the company is licensed to do business as indicated in brackets.

- AXA Boreal Insurance Company (P.E.I., N.B., Que., Ont., Man., B.C.)
- AXA Boreal Insurance Company (P.E.I., N.B., Que., Ont., Man., B.C.)
- ALPHA, Compagnie d'Assurances Inc. (Que.)
- Canada West Insurance Company (Ont., Man., Sask, Alta., B.C., N.W.T.) (Surety only)
- The Canadian Union Assurance Company (Que.)
- La Capitale General Insurance Inc. (Nfld. & Lab., N.S., P.E.I., Que.(Surety only), Man., Sask., Alta., B.C., Nun., N.W.T., Yuk.)
- Coachman Insurance Company (Ont.)
- Continental Casualty Company (Nfld. & Lab., N.S., P.E.I., N.B., Que., Ont., Man., Sask., Alta., B.C., Nun., N.W.T., Yuk.)
- GCAN Insurance Company (Nfld. & Lab., N.S., P.E.I., N.B., Que., Ont., Man., Sask., Alta., B.C., Nun., N.W.T., Yuk.)
- The Insurance Company of Prince Edward Island (N.S., P.E.I., N.B.)
- Kingsway General Insurance Company (N.S., N.B., Que., Ont., Man., Sask., Alta., and B.C.)
- Liberty Mutual Insurance Company (Nfld. & Lab., N.S., P.E.I., N.B., Que., Ont., Man., Sask., Alta., B.C., Nun., N.W.T., Yuk.)
- Manitoba Public Insurance Corporation (Man.)
- Norgroupe Assurance Générales Inc.
- Orleans General Insurance Company (N.B., Que., Ont.)
- Saskatchewan Government Insurance Office (Sask.)
- SGI CANADA Insurance Services Ltd. (Ont., Man., Sask., Alta.)
- L'Unique General Insurance Inc. (Nfld. & Lab., N.S., P.E.I., N.B., Que.(Surety only), Ont.(Surety only), Man., Sask., Alta., B.C.(Surety only), Nun., N.W.T., Yuk.)

3. Foreign Companies

- Aspen Insurance UK Limited
- Compagnie Française d'Assurance pour le Commerce Extérieur (Fidelity only)
- Eagle Star Insurance Company Limited
- Ecclesiastical Insurance Office Public Limited Company (Fidelity only)
- Lloyd's Underwriters
- Mitsui Sumitomo Insurance Company, Limited
- NIPPONKOA Insurance Company, Limited
- Sompo Japan Insurance Inc.
- Tokio Marine & Nichido Fire Insurance Co., Ltd.
- XL Insurance Company Limited (Surety only)
- Zurich Insurance Company Ltd

Standard Construction Contract – Articles of Agreement
(23/01/2002)

A1 Contract Documents

A2 Date of Completion of Work and Description of Work

A3 Contract Amount

A4 Contractor's Address

A5 Unit Price Table

A r t i c l e s o f A g r e e m e n t

These Articles of Agreement made in duplicate this day of .

Between

Her Majesty the Queen, in right of Canada (referred to in the contract documents as " Her Majesty") represented by the National Research Council Canada (referred to in the contract documents as the "Council")

and

(referred to in the contract documents as the "Contractor")

Witness that in consideration for the mutual promises and obligations contained in the contract, Her Majesty and the Contractor covenant and agree as follows:

A1 Contract Documents

(23/01/2002)

1.1 Subject to A1.4 and A1.5, the documents forming the contract between Her Majesty and the Contractor, referred to herein as the contract documents, are

1.1.1 these Articles of Agreement,

1.1.2 the document attached hereto, marked "A" and entitled "Plans and Specifications", referred to herein as the Plans and Specifications,

1.1.3 the document attached hereto, marked "B" and entitled "Terms of Payment", referred to herein as the Terms of Payment,

1.1.4 the document attached hereto, marked "C" and entitled "General Conditions", referred to herein as the General Conditions,

1.1.5 the document attached hereto, marked "D" and entitled "Labour Conditions", referred to herein as the Labour Conditions,

1.1.6 the document attached hereto, marked "E" and entitled "Insurance Conditions", referred to herein as the Insurance Conditions,

1.1.7 the document attached hereto, marked "F" and entitled "Contract Security Conditions", referred to herein as the Contract Security Conditions, and

1.1.8 any amendment or variation of the contract documents that is made in accordance with the General Conditions.

1.1.9 the document entitled Fair Wage Schedules for Federal Construction Contracts referred to herein as Fair Wage Schedules

1.1.10

The Council hereby designates of
of the Government of Canada as the Engineer for the purposes of the contract, and for all purposes of or incidental to the contract, the Engineer's address shall be deemed to be:

1.2 **In the contract**

1.3.1 " Fixed Price Arrangement" means that part of the contract that prescribes a lump sum as payment for performance of the work to which it relates; and

1.3.2 " Unit Price Arrangement" means that part of the contract that prescribes the product of a price multiplied by a number of units of measurement of a class as payment for performance of the work to which it relates.

1.3 Any of the provisions of the contract that are expressly stipulated to be applicable only to a Unit Price Arrangement are not applicable to any part of the work to which a Fixed Price Arrangement is applicable.

1.4 Any of the provisions of the contract that are expressly stipulated to be applicable only to a Fixed Price Arrangement are not applicable to any part of the work to which a Unit Price Arrangement is applicable.

A2 Date of Completion of Work and Description of Work

(23/01/2002)

2.1 The contractor shall, between the date of these Articles of Agreement and the **,** , in the careful and workmanlike manner, diligently perform and complete the following work:

which work is more particularly described in the Plans and Specifications.

A3 Contract Amount

(23/01/2002)

3.1 Subject to any increase, decrease, deduction, reduction or set-off that may be made under the Contract, Her Majesty shall pay the Contractor at the times and in the manner that is set out or referred to in the Terms of Payment

3.1.1 the sum of (GST/HST extra), in consideration for the performance of the work or the part thereof that is subject to Fixed Price Arrangement, and

3.1.2 a sum that is equal to the aggregate of the products of the number of units of Measurement of each class of labour, plant and material that is set out in a Final Certificate of Measurement referred to in GC44.8 multiplied in each case by the appropriate unit price that is set out in the Unit Price Table in consideration for the performance of the work or the part thereof that is subject to a Unit Price Arrangement.

3.2 For the information and guidance of the Contractor and the persons administering the contract on behalf of Her Majesty, but not so as to constitute a warranty , representation or undertaking of any nature by either party, it is estimated that the total amount payable by Her Majesty to the Contractor for the part of the work to which a Unit Price Arrangement is applicable will be approximately $N/A

3.3 A3.1.1 is applicable only to a Fixed Price Arrangement.

3.4 A3.1.2 and A3.2 applicable only to a Unit Price Arrangement.

A4 Contractor's Address

(23/01/2002)

4.1 For all purposes of or incidental to the contract, the Contractor's address shall be deemed to be:

A5 Unit Price Table

(23/01/2002)

5.1 Her Majesty and the Contractor agree that the following table is the Unit Price Table for the purposes of the contract.

Column 1 Item	**Column 2** Class of Labour Plant Or Material	**Column 3** Unit of Measurement	**Column 4** Estimated Total Quantity	**Column 5** Price per Unit	**Column 6** Estimated Total Price
		N/A			

5.2 The Unit Price Table that is set out in A5.1 designates the part of the work to which a Unit Price Arrangement is applicable.

5.3 The part of the work that is not designated in the Unit Price Table referred to in A5.2 is the part of the work to which a Fixed Price Arrangement is applicable.

Articles of Agreement

Signed on behalf of Her Majesty by

_____

as Senior Contracting Officer

and_____

as_____

of the **National Research Council Canada**

on the_____

day of _____

Signed, sealed and delivered by

_____

as_____and
Position

by_____

as_____
Position

Seal

of

on the_____

day of_____

SPECIFICATIONS

Division 06 - Wood, Plastics, and Composites

Division 07 - Thermal and Moisture Protection

Division 08 - Openings

Division 09 - Finishes

Division 10 - Specialties

Division 11 - Equipment

Division 12 - Furnishings

Division 21 - Fire Suppression

Division 22 - Plumbing

Division 23 - Heating, Ventilating and Air-Conditioning (HVAC)

Division 31 – Earthwork

Division 32 – Exterior Improvements

Division 33 – Utilities

Drawing Index

Architectural

A00 FRONT COVER
A01 ASSEMBLIES & FIRE SEPARATION PLANS
A02 WINDOW & DOOR SCHEDULES
A03 SITE PLAN & ENTRANCE DETAILS
A04 ROOF PLAN, MAIN LEVEL PLAN, LOWER LEVEL PLAN
A05 DEMOLITION PLANS
A06 BUILDING ELEVATIONS & SECTIONS
A07 STAIR PLANS, SECTIONS & DETAILS
A08 WASHROOM PLANS & ELEVATIONS & MILLWORK
A09 EXTERIOR DETAILS
A10 PLAN DETAILS
A11 REFLECTED CEILING PLANS & FINISHES PLANS
A12 MILLWORK PLANS, SECTIONS & ELEVATIONS
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Structural

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S01 TYPICAL DETAILS 1
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S05 SECTIONS & DETAILS 1
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Mechanical

M01 MECHANICAL LEGEND
M02 PLUMBING LAYOUT

M03 HVAC LAYOUT
M04 PIPING LAYOUT
M05 BASEMENT AND FIRST FLOOR STEAM PIPING
M06 MECHANICAL DEMOLITION
M07 MECHANICAL SCHEMATIC
M08 MECHANICAL SCHEDULES
M09 MECHANICAL DETAILS
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M11 ENLARGED MECHANICAL ROOM PLANS

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E01 ELECTRICAL DEMOLITION
E02 POWER, FIRE ALARM & MISC SYSTEMS
E03 POWER, FIRE ALARM & MISC SYSTEMS
E04 COMMUNICATION & SECURITY SYSTEMS
E05 COMMUNICATION & SECURITY SYSTEMS
E06 LIGHTING
E07 SINGLE LINE
E08 PANEL & SCHEDULES
E09 ELECTRICAL DETAILS

Civil
C01 REMOVALS, SITE SERVICING & GRADING PLAN
C02 GEOMETRY LAYOUT & AUTOTURN PLAN
C03 DETAILS

1. SCOPE OF WORK

.1 Work under this contract covers renovations and additions to Building M22 of the National Research Council.

2. DRAWINGS

.1 The drawings listed in the index illustrate the work and form part of the contract documents:

3. COMPLETION

.1 Complete all work within (42) weeks after receipt of notification of acceptance of tender.

4. GENERAL

.1 The word "provide" in this Specification means to supply and install.

.2 Provide items mentioned in either the drawings or the specification.

5. SPECIFIED ACCEPTABLE & ALTERNATIVE EQUIPMENT & MATERIALS

.1 Materials and equipment scheduled and/or specified on the drawings or in the specifications have been selected to establish a performance and quality standard. In most cases, acceptable manufacturers are stated for any material or equipment specified by manufacturer's name and model number. Contractors may base their tender price on materials and equipment supplied by any of the manufacturers' names as acceptable for the particular material or equipment.

.2 In addition to the manufacturers specified or named as acceptable, you may propose alternative manufacturers of materials or equipment to the Departmental Representative for acceptance. For a product to be considered as an alternative product substitute, make a written application to the Departmental Representative during the tender period, not later than ten (10) working days before tender closing.

.3 Certify in writing that the alternative meets all requirements of the specified material or equipment. In addition, it shall be understood that all costs required by or as a result of acceptance or proposed alternatives, will be borne by the contractor.

.4 Approval of alternatives will be signified by issue of an Addendum to the Tender Documents.

.5 Any alternative manufacturers or materials submitted which are incomplete and cannot be evaluated, or are later than ten (10) working days before tender closing date or after the tender period, will not be considered.

6. MINIMUM STANDARDS

.1 Conform to or exceed minimum acceptable standards of the various applicable federal, provincial and municipal codes such as The National Building Code, The National Fire Code, Canadian Plumbing Code, Canadian Electrical Code, Canadian Code for Construction Safety and the Provincial Construction Safety Act.

.2 Work to conform to referenced standards and codes as reaffirmed or revised to date of specification.

7. WORKPLACE HAZARDOUS MATERIAL INFORMATION SYSTEM (WHMIS)

.1 The general contractor shall comply with Federal and Provincial legislation regarding the WHMIS. The contractor's responsibilities include, but are not limited to the following:

.1 To ensure that any controlled product brought on site by the contractor or sub-contractor is labeled;

.2 To make available to the workers and the Departmental Representative, Material Safety Data Sheets (MSDS) for these controlled products;

.3 To train own workers about WHMIS, and about the controlled products that they use on site;

.4 To inform other contractors, sub-contractors, the Departmental Representative, authorized visitors and outside inspection agency personnel about the presence and use of such products on the site.

.5 The site foreman or superintendent must be able to demonstrate, to the satisfaction of the Departmental Representative, that he/she has had WHMIS training and is knowledgeable in its requirements. The Departmental Representative can require replacement of this person if this condition or implementation of WHMIS is not satisfactory.

8. REQUIREMENTS OF BILL 208, SECTION 18(a)

Under the requirements of Bill 208 of the Ontario Ministry of Labour Occupational Health & Safety Act, the following designated substances may be encountered while performing the work described in these contract documents:

.1 Lead, Asbestos, Mercury, Silica

.1 It is the responsibility of the general contractor to ensure that each prospective subcontractor for this project has received a copy of the above list.

.2 The general contractor is advised to take the following precautions when dealing with the above substances:
Refer to the Designated Substances Report

9. COST BREAKDOWN

.1 Submit, for approval by the Departmental Representative, a cost breakdown of tender 72 hours after the contract is awarded.

.2 Use the approved cost breakdown as the basis for submitting all claims.

.3 Request Departmental Representative's verbal approval to amount of claim prior to preparing and submitting the claim in its final form.

10. SUB-TRADES

.1 Submit no later than 72 hours after tender closing, a complete list of sub trades for the Departmental Representative's review.

11. PERSONNEL SECURITY AND IDENTIFICATION

.1 All persons employed by the contractor, or by any subcontractor and present on the site must be security cleared in accordance with the requirements of the Section entitled Special Instructions to Tenderers.

.2 All such persons must wear and keep visible identification badges as issued by the Security Office of NRC.

12. WORKING HOURS AND SECURITY

.1 Normal working hours on the NRC property are from 8:00 a.m. until 4:30 p.m., Monday to Friday inclusive, except statutory holidays.

.2 At all other times, special written passes are required for access to the building site.

~~.3~~ Before scheduling any work outside normal working hours, obtain permission from the Departmental Representative to perform the specific tasks.

.4 An escort may be required whenever working outside normal hours. Contractor to bear the associated costs.

13. SCHEDULE

.1 The contractor shall prepare a detailed schedule, fixing the date for commencement and completion of the various parts of the work and update the said schedule. Such schedule shall be made available to the Departmental Representative not later than two weeks after the award of the contract and prior to commencement of any work on site.

.2 Notify Departmental Representative in writing of any changes in the schedule.

.3 (21) days before the scheduled completion date, arrange to do an interim inspection with the Departmental Representative.

14. PROJECT MEETINGS

.1 Hold regular project meetings at times and locations approved by the Departmental Representative.

.2 Notify all parties concerned of meetings to ensure proper coordination of work.

.3 Departmental Representative will set times for project meetings and assume responsibility for recording and distributing minutes.

15. SHOP DRAWINGS

.1 Submit to Departmental Representative for review, shop drawings, product data and samples specified within (3) week(s) after contract award.

.2 Submit to Departmental Representative for review a complete list of all shop drawings, product data and samples specified and written confirmation of corresponding delivery dates within one (1) week after shop drawings, product data and samples approval date. This list shall be updated on a (2) week basis and any changes to the list shall be immediately notified in writing to the Departmental Representative.

.3 Review shop drawings, data sheets and samples prior to submission.

.4 Submit electronic copy of all shop drawings and product data and samples for review, unless otherwise specified.

.5 Review of shop drawings and product data by the Departmental Representative does not relieve the contractor of the responsibility for errors and omissions and for the conformity with contract documents.

16. SAMPLES AND MOCK-UPS

.1 Submit samples in sizes and quantities as specified.

.2 Where colour, pattern or texture is criterion, submit full range of samples.

.3 Construct field samples and mock-ups at locations acceptable to Departmental Representative.

.4 Reviewed samples or mock-ups will become standards of workmanship and material against which installed work will be checked on the project.

17. MATERIALS AND WORKMANSHIP

.1 Install only new materials on this project unless specifically noted otherwise.

.2 Only first class workmanship will be accepted, not only with regard to safety, efficiency, durability, but also with regard to neatness of detail and performance.

18. WORK & MATERIALS SUPPLIED BY OWNER

.1 Work and materials not included in this contract are described on drawings and in this specification.

.2 Deliver to a storage place, as directed by the Departmental Representative, all materials returned to the Owner.

.3 Unless otherwise specified, accept owner-supplied materials at their storage location and provide all transportation as required.

.4 General Contractor's duties:

.1 Unload at site.

.2 Promptly inspect products and report damaged or defective items.

.3 Give written notification to the Departmental Representative for items accepted in good order.

.4 Handle at site, including uncrating and storage.

.5 Repair or replace items damaged on site.

.6 Install, connect finished products as specified.

19. SITE ACCESS

.1 Make prior arrangements with the Departmental Representative before starting work or moving materials and equipment on site.

.2 Obtain approval of Departmental Representative for regular means of access during the construction period.

.3 Obtain approval of Departmental Representative before temporarily suspending operations on site; before returning to the site and before leaving the site at the end of the job.

.4 Provide and maintain access to site.

.5 Build and maintain temporary roads and provide snow removal during period of work.

.6 Make good any damage and clean up dirt, debris, etc., resulting from contractor's use of existing roads.

20. USE OF SITE

.1 Restrict operations on the site to the areas approved by the Departmental Representative

.2 Locate all temporary structures, equipment, storage, etc., to the designated areas.

.3 Restrict parking to the designated areas.

21. ACCEPTANCE OF SITE

.1 Inspect the site before commencing work, review any unexpected conditions with the Departmental Representative.

.2 Commencement of work will imply acceptance of existing conditions.

22. SITE OFFICE & TELEPHONE

.1 Contractor to erect a temporary site office at his own expense.

.2 Install and maintain a telephone, if necessary.

.3 Use of NRC phones is not permitted unless in the case of an emergency.

23. SANITARY FACILITIES

.1 Provide sanitary facilities, and bear all associated costs.

24. TEMPORARY SERVICES

.1 A source of temporary power will be made available in the area. Bear all costs to make connections to the power source and perform distribution on site.

.2 Provide all load centres, breakers, conduit, wiring, disconnects, extension cords, transformers, as required from the source of power.

.3 Power is to be used only for power tools, lighting, controls, motors, and not for space heating.

.4 A source of temporary water will be made available if required.

.5 Bear all costs associated with distributing the water to the required locations.

.6 Comply with NRC requirements when connecting to existing systems in accordance with the articles entitled "Co-operation" and "Service Interruptions" of this section.

25. DOCUMENTS REQUIRED AT WORK SITE

.1 The contractor shall keep on the site, one (1) up-to-date copy of all contract documents, including specifications, drawings, addenda, shop drawings, change notices, schedule and any reports or bulletins pertaining to the work, in good order, available to the Departmental Representative and to his / her representatives at all times.

.2 At least one (1) copy of specifications and drawings shall be marked by the contractor to show all work "As Built" and shall be provided to the Departmental Representative with the Application for Payment and for the Final Certificate of Completion.

26. CO-OPERATION

.1 Co-operate with NRC staff in order to keep disruption of normal research work to an absolute minimum.

.2 Work out in advance, a schedule for all work which might disrupt normal work in the building.

.3 Have schedule approved by the Departmental Representative.

.4 Notify the Departmental Representative in writing, 72 hours prior to any intended interruption of facilities, areas, corridors, mechanical or electrical services and obtain requisite permission.

27. PROTECTION AND WARNING NOTICES

.1 Provide all materials required to protect existing equipment.

.2 Erect dust barriers to prevent dust and debris from spreading through the building.

.3 Place dust protection in the form of cover sheets over equipment and furniture and tape these sheets to floors, to ensure no dust infiltration.

.4 Repair or replace any and all damage to Owner's property caused during construction, at no cost to the Owner and to the satisfaction of the Departmental Representative.

.5 Protect the buildings, roads, lawns, services, etc. from damage which might occur as a result of this work.

.6 Plan and co-ordinate the work to protect the buildings from the leakage of water, dust, etc.

.7 Ensure that all doors, windows, etc., that could allow transfer of dust, noise, fumes, etc., to other areas of the building are kept closed.

.8 Be responsible for security of all areas affected by the work under the Contract until acceptance by NRC. Take all necessary precautions to prevent entry to the work area by unauthorized persons and guard against theft, fire and damage by any cause. Secure working area at the end of each day’s work and be responsible for same.

.9 Provide and maintain adequate safety barricades around the work sites to protect NRC personnel and the public from injury during the construction.

.10 Post warnings, in all instances where possible injury could occur such as Work Overhead, Hard Hat Areas, etc. or as required by the Departmental Representative.

.11 Provide temporary protective enclosures over building entrances and exits to protect pedestrians. All enclosures to be structurally sound against weather and falling debris.

28. BILINGUALISM

.1 Ensure that all signs, notices, etc. are posted in both official languages.

.2 Ensure that all identification of services called for by under this contract are bilingual.

29. LAYOUT OF WORK

.1 Location of equipment, fixtures, outlets and openings indicated on drawings or specified are to be considered as approximate.

.2 Locate equipment, fixtures and distribution systems to provide minimum interference and maximum usable space and in accordance with the manufacturer’s recommendations for safety, access and maintenance.

.3 Employ competent person to lay out work in accordance with the contract documents.

30. DISCREPANCIES & INTERFERENCES

.1 Prior to the start of the work, examine drawings and specifications. Report at once to the Departmental Representative, any defects, discrepancies, omissions or interferences affecting the work.

.2 Contractor to immediately inform the Departmental Representative in writing, of any discrepancies between the plans and the physical conditions so the Departmental Representative may promptly verify same.

.3 Any work done after such a discovery, until authorized, is at the contractor's risk.

.4 Where minor interferences as determined by the Departmental Representative are encountered on the job and they have not been pointed out on the original tender or on the plans and specifications, provide offsets, bends or reroute the services to suit job conditions at no extra cost.

.5 Arrange all work so as not to interfere in any way with other work being carried out.

31. MANUFACTURER'S INSTRUCTIONS

.1 Unless otherwise specified, comply with manufacturer's latest printed instructions for materials and installation methods.

.2 Notify the Departmental Representative in writing of any conflict between these specifications and manufacturer's instruction. Departmental Representative will designate which document is to be followed.

32. TEMPORARY HEATING AND VENTILATING

.1 Bear the costs of temporary heat and ventilation during construction including costs of installation, fuel, operation, maintenance, and removal of equipment.

.2 Use of direct-fired heaters discharging waste products into the work areas will not be permitted unless prior approval is given by the Departmental Representative.

.3 Furnish and install 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 Reduce moisture condensation on surfaces to an acceptable level.

.4 Provide ambient temperature and humidity levels for storage, installation and curing of materials.

.5 Provide adequate ventilation to meet health regulations for a safe working environment.

.4 Maintain minimum temperature of 10 ^{o}C (50 ^{o}F) or higher where specified as soon as finishing work is commenced and maintain until acceptance by the Departmental Representative. Maintain ambient temperature and humidity levels as required for comfort of NRC personnel.

.5 Prevent hazardous or unhealthy accumulations of dust, fumes, mists, vapours or gases in areas occupied during construction including also, storage areas and sanitary facilities.

.1 Dispose of exhaust materials in a manner that will not result in a harmful or unhealthy exposure to persons.

.6 Maintain strict supervision of operation of temporary heating and ventilating equipment.

.1 Enforce conformance with applicable codes and standards.

.2 Comply with instructions of the Departmental Representative including provision of full-time watchman services when directed.

.3 Enforce safe practices.

.4 Vent direct-fired combustion units to outside.

.7 Submit tenders assuming existing or new equipment and systems will not be used for temporary heating and ventilating.

.8 After award of contract, Departmental Representative may permit use of the permanent system providing agreement can be reached on:

.1 Conditions of use, special equipment, protection, maintenance, and replacement of filters.

.2 Methods of ensuring that heating medium will not be wasted and in the case of steam, agreement on what is to be done with the condensate.

.3 Saving on contract price.

.4 Provisions relating to guarantees on equipment.

33. CONNECTIONS TO AND INTERRUPTIONS TO EXISTING SERVICES

.1 Where work involves breaking into or connecting to existing services, carry out work at times and in the manner agreed to by the Departmental Representative and by authorities having jurisdiction, with minimum disruption to NRC Personnel and vehicular traffic and minimum service interruption. Do not operate any NRC equipment or plant.

.2 Before commencing work, establish location and extent of service lines in area of work and notify Departmental Representative of findings.

.3 Submit a schedule to and obtain approval from the Departmental Representative for any shut-down or closure of active service or facility; allow minimum 72 hours notice. Adhere to approved schedule and provide notice to the Departmental Representative.

.4 Where unknown services are encountered, immediately advise Departmental Representative and confirm findings in writing.

.5 Provide detours, bridges, alternate feeds, etc., as required to minimize disruptions.

.6 Protect existing services as required and immediately make repairs if damage occurs.

.7 Remove any abandoned service lines as indicated on the contract documents and as approved by the Departmental Representative; cap or otherwise seal lines at cut-off points. Record and provide a copy to the Departmental Representative of locations of maintained, re-routed and abandoned service lines.

34. CUTTING AND PATCHING

.1 Cut existing surfaces as required to accommodate new work.

.2 Remove all items as shown or specified.

.3 Patch and make good with identical materials, the surfaces that have been disturbed, cut or damaged, to the satisfaction of the Departmental Representative.

.4 Where new pipes pass through existing construction, core drill an opening. Size openings to leave 12mm (1/2") clearance around the pipes or pipe insulation. Do not drill or cut any surface without the approval of the Departmental Representative.

.5 Obtain written approval of the Departmental Representative before cutting openings through existing or new structural members.

.6 Seal all openings where cables, conduits or pipes pass through walls with an acoustic sealant conforming to CAN/CGSB-19.21-M87.

.7 Where cables, conduits and pipes pass through fire rated walls and floors, pack space between with compressed glass fibres and seal with fire stop caulking in accordance with CAN/CGSB-19.13-M87 AND NBC 3.1.7.

35. FASTENING DEVICES

.1 Do not use explosive actuated tools, without first obtaining permission from the Departmental Representative.

.2 Comply with the requirements of CSA A-166 (Safety Code for Explosive Actuated Tools).

.3 Do not use any kind of impact or percussion tool without first obtaining permission from the Departmental Representative.

36. OVERLOADING

.1 Ensure that no part of the building or work is subjected to a load which will endanger safety or cause permanent deformation or structural damage.

37. DRAINAGE

.1 Provide temporary drainage and pumping as required to keep excavations and site free of water.

38. ENCLOSURE OF STRUCTURES

.1 Construct and maintain all temporary enclosures as required to protect foundations, sub-soil, concrete, masonry, etc., from frost penetration or damage.

.2 Maintain in place until all chances of damage are over and proper curing has taken place.

.3 Provide temporary weather tight enclosures for exterior openings until permanent sash and glazing and exterior doors are installed.

.4 Provide lockable enclosures as required to maintain the security of NRC facilities and be responsible for the same.

.5 Provide keys to NRC security personnel when required.

.6 Lay out the work carefully and accurately and verify all dimensions and be responsible for them. Locate and preserve general reference points.

.7 Throughout the course of construction, keep continuously acquainted with field conditions, and the work being developed by all trades involved in the project. Maintain an awareness of responsibility to avoid space conflict with other trades.

.8 Conceal all services, piping, wiring, ductwork, etc., in floors, walls or ceilings except where indicated otherwise.

39. STORAGE

.1 Provide storage as required to protect all tools, materials, etc., from damage or theft and be responsible for the same.

.2 Do not store flammable or explosive materials on site without the authorization of the Departmental Representative.

40. GENERAL REVIEW

.1 Periodic review of the contractor's work by the Departmental Representative does not relieve the contractor of the responsibility of making the work in accordance with contract documents. Contractor shall carry out his own quality control to ensure that the construction work is in accordance with contract documents.

.2 Inform the Departmental Representative of any impediments to the installation and obtain his / her approval for actual location.

41. INSPECTION OF BURIED OR CONCEALED SERVICES

.1 Prior to concealing any services that are installed, ensure that all inspection bodies concerned, including NRC, have inspected the work and have witnessed all tests. Failure to do so may result in exposing the services again at the contractor's expense.

42. TESTING

.1 On completion, or as required by local authority inspectors and/or Departmental Representative during progress of work and before any services are covered up and flushing is complete, test all installations in the presence of the Departmental Representative.

.2 Obtain and hand to the Departmental Representative all acceptance certificates or test reports from authority having jurisdiction. The project will be considered incomplete without the same.

43. PARTIAL OCCUPANCY

.1 NRC may request partial occupancy of the facility if the contract extends beyond the expected completion date.

.2 Do not restrict access to the building, routes, and services.

.3 Do not encumber the site with materials or equipment.

44. DISPOSAL OF WASTES

.1 Dispose of waste materials including volatiles, safely off NRC property. Refer to the section entitled "General and Fire Safety Requirements" included as part of this specification.

45. CLEAN-UP DURING CONSTRUCTION

.1 On a daily basis, maintain project site and adjacent area of campus including roofs, free from debris and waste materials.

.2 Provide on-site dump containers for collection of waste materials and rubbish.

46. FINAL CLEAN-UP

.1 Upon completion do a final clean-up to the satisfaction of the Departmental Representative.

.2 Clean all new surfaces, lights, existing surfaces affected by this work, replace filters, etc.

.3 Clean all resilient flooring and prepare to receive protective finish. Protective finish applied by NRC

47. WARRANTY AND RECTIFICATION OF DEFECTS IN WORK

.1 Refer to General Conditions "C", section GC32.

.2 Ensure that all manufacturers' guarantees and warranties are issued in the name of the **General** Contractor and the National Research Council.

48. MAINTENANCE MANUALS

.1 Provide three (3) bilingual copies of maintenance manuals or two English and two French maintenance manuals, and one English digital copy, immediately upon completion of the work and prior to release of holdbacks.

.2 Manuals to be neatly bound in hard cover loose leaf binders.

.3 Manuals to include operating and maintenance instructions, all guarantees and warranties, shop drawings, technical data, etc., for the material and apparatus supplied under this contract.

END OF SECTION

1. GENERAL CONSTRUCTION SAFETY REQUIREMENTS

.1 The Contractor shall take all necessary steps to protect personnel (workers, visitors, general public, etc.) and property from any harm during the course of the contract.

.2 The Contractor shall be solely responsible for the construction safety of both its employees and those of its sub-contractors at the work site, and for initiating, maintaining and supervising safety precautions, programs and procedures in connection with the performance of the work.

.3 The Contractor shall comply with all Federal, Provincial and Municipal safety codes and regulations and the Occupational Health and Safety Act and the Workplace Safety and Insurance Board. In the event of any conflict between any provisions in legislation or codes, the most stringent provisions shall apply.

.4 Periodic review of the contractor's work by the Departmental Representative, using the criteria of the contract documents, does not relieve the contractor of his safety responsibilities in carrying out the work in accordance with the contract documents. The contractor shall consult with the Departmental Representative to ensure that this responsibility is carried out.

.5 The Contractor shall ensure that only competent personnel are permitted to work on site. Throughout the term of the contract, any person will be removed from the site who is not observing or complying with the safety requirements.

.6 All equipment shall be in safe operating condition and appropriate to the task.

.7 Following a project and site hazard assessment, the Contractor shall develop a Site Specific Safety Plan based on the following minimum requirements:

- .1 Provide a safety board mounted in a visible location on the project site, with the following information included thereon:
  - .1 Notice of Project
  - .2 Site specific Safety Policy
  - .3 Copy of Ontario Health and Safety Act
  - .4 Building Schematic showing emergency exits
  - .5 Building emergency procedures
  - .6 Contact list for NRC, Contractor and all involved sub-contractors
  - .7 Any related MSDS sheets
  - .8 NRC Emergency phone number

.8 The Contractor shall provide competent personnel to implement its safety program and those of any Health and Safety Act legislation applicable at this project location, and to ensure they are being complied with.

.9 The Contractor shall provide safety orientation to all its employees as well as those of any subcontractors under its jurisdiction.

.10 The Departmental Representative will monitor to ensure that safety requirements are met and that safety records are properly kept and maintained. Continued disregard for safety standards can cause the contract to be cancelled and the Contractor or sub-contractors removed from the site.

.11 The Contractor will report to the Departmental Representative and jurisdictional authorities, any accident or incident involving Contractor or NRC personnel or the public and/or property arising from the Contractor's execution of the work.

.12 If entry to a laboratory is required as part of the work of the Contractor, a safety orientation shall be provided to all his employees as well as those of any subcontractors regarding lab safety requirements and procedures, as provided by the Researcher or the Departmental Representative.

2. FIRE SAFETY REQUIREMENTS

.1 Authorities

1. The Fire Commissioner of Canada (FC) is the authority for fire safety at NRC.
2. For the purpose of this document, "Departmental Representative" will be deemed as the NRC person in charge of the project and who will enforce these Fire Safety Requirements.
3. Comply with the following standards as published by the Office of the Fire Commissioner of Canada:
    a. Standard No. 301 - June 1982 "Standard for Construction Operations";
    b. Standard No. 302 - June 1982 "Standard for Welding and Cutting".

.2 Smoking

.1 Smoking is prohibited inside all NRC buildings, as well as roof areas.

.2 Obey all "NO SMOKING" signs on NRC premises.

.3 Hot Work

.1 Prior to commencement of any "Hot Work" involving welding, soldering, burning, heating, use of torches or salamanders or any open flame, obtain a Hot Work Permit from the Departmental Representative.

.2 Prior to commencement of "Hot Work", review the area of hot work with the Departmental Representative to determine the level of fire safety precautions to be taken.

.4 Reporting Fires

.1 Know the exact location of the nearest Fire Alarm Pull Station and telephone, including the emergency phone number.

.2 REPORT immediately, all fire incidents as follows:

.1 Activate nearest fire alarm pull station and;

.2 Telephone the following emergency phone number as appropriate:

FROM AN NRC PHONE	**333**
FROM ANY OTHER PHONE	**(613) 993-2411**

4. When reporting a fire by phone, give the location of fire, building number and be prepared to verify location.
5. The person activating fire alarm pull station must remain at a safe distance from the scene of the fire but readily available to provide information and direction to the Fire Department personnel.

.5 Interior and Exterior Fire protection & Alarm Systems

.1 DO NOT OBSTRUCT OR SHUT OFF FIRE PROTECTION EQUIPMENT OR SYSTEMS, INCLUDING BUT NOT LIMITED TO FIRE ALARM SYSTEMS, SMOKE/HEAT DETECTORS, SPRINKLER SYSTEM, PULL STATIONS, EMERGENCY CALL BUTTONS AND PA SYSTEMS, WITHOUT AUTHORIZATION FROM THE DEPARTMENTAL REPRESENTATIVE.

.2 WHEN ANY FIRE PROTECTION EQUIPMENT IS TEMPORARILY SHUT DOWN, ALTERNATIVE MEASURES AS PRESCRIBED BY THE DEPARTMENTAL REPRESENTATIVE SHALL BE TAKEN TO ENSURE THAT FIRE PROTECTION IS MAINTAINED.

.3 DO NOT LEAVE FIRE PROTECTION OR ALARM SYSTEMS INACTIVE AT THE END OF A WORKING DAY WITHOUT NOTIFICATION AND AUTHORISATION FROM THE DEPARTMENTAL REPRESENTATIVE. THE DEPARTMENTAL REPRESENTATIVE WILL ADVISE THE (FPO) OF THE DETAILS OF ANY SUCH EVENT.

.4 DO NOT USE FIRE HYDRANTS, STANDPIPES AND HOSE SYSTEMS FOR OTHER THAN FIRE FIGHTING PURPOSES UNLESS AUTHORISED BY DEPARTMENTAL REPRESENTATIVE.

.6 Fire Extinguishers

.1 Provide a minimum of 1-20 lb. ABC Dry Chemical Fire Extinguisher at each hot work or open flame location.

.2 Provide fire extinguishers for hot asphalt and roofing operations as follows:

a. Kettle area - 1-20 lb. ABC Dry Chemical;
b. Roof - 1-20 lb. ABC Dry Chemical at each open flame location.

.3 Provide fire extinguishers equipped as below:

c. Pinned and sealed;
d. With a pressure gauge;
e. With an extinguisher tag signed by a fire extinguisher servicing company.

.4 Carbon Dioxide (C02) extinguishers will not be considered as substitutes for the above.

.7 Roofing Operations

.1 Kettles:

.1 Arrange for the location of asphalt kettles and material storage with the Departmental Representative before moving on site. Do not locate kettles on any roof or structure and keep them at least 10m (30 feet) away from a building.

.2 Equip kettles with 2 thermometers or gauges in good working order; a hand held and a kettle-mounted model.

.3 Do not operate kettles at temperatures in excess of 232^{o}C (450 ^{o}F).

.4 Maintain continuous supervision while kettles are in operation and provide metal covers for the kettles to smother any flames in case of fire. Provide fire extinguishers as required in article 2.6.

.5 Demonstrate container capacities to Departmental Representative prior to start of work.

.6 Store materials a minimum of 6m (20 feet) from the kettle.

.2 Mops:

.1 Use only glass fibre roofing mops.

.2 Remove used mops from the roof site at the end of each working day.

.3 Torch Applied Systems:

.1 DO NOT USE TORCHES NEXT TO WALLS.

.2 DO NOT TORCH MEMBRANES TO EXPOSED WOOD OR CAVITY

.3 Provide a Fire Watch as required by article 2.9 of this section.

.4 Store all combustible roofing materials at least 3m (10 feet) away from any structure.

.5 Keep compressed gas cylinders a minimum of 6m (20 feet) away from the kettle, protected from mechanical damage and secured in an upright position.

.8 Welding / Grinding Operations

.1 Contractor to provide fire blankets, portable fume extraction devices, screens or similar equipment to prevent exposure to welding flash, or sparks from grinding.

.9 **Fire Watch**

.1 Provide a fire watch for a minimum of one hour after the termination of any hot work operation.

.2 For temporary heating, refer to General Instructions Section 00 010 00.

.3 Equip fire watch personnel with fire extinguishers as required by article 2.6.

.10 Obstruction of access/egress routes-roadways, halls, doors, or elevators

.1 Advise the Departmental Representative in advance of any work that would impede the response of Fire Department personnel and their apparatus. This includes violation of minimum overhead clearance, erection of barricades and the digging of trenches.

.2 Building exit routes must not be obstructed in any way without special permission from the Departmental Representative, who will ensure that adequate alternative routes are maintained.

.3 The Departmental Representative will advise the FPO of any obstruction that may warrant advanced planning and communication to ensure the safety of building occupants and the effectiveness of the Fire Department.

.11 Rubbish and Waste Materials

.1 Keep rubbish and waste materials to a minimum and a minimum distance of 6m (20 feet) from any kettle or torches.

.2 Do not burn rubbish on site.

.3 Rubbish Containers

.1 Consult with the Departmental Representative to determine an acceptable safe location for any containers and the arrangement of chutes etc. prior to bringing the containers on site.

.2 Do not overfill the containers and keep area around the perimeter free and clear of any debris.

.4 Storage

.1 Exercise extreme care when storing combustible waste materials in work areas. Ensure maximum possible cleanliness, ventilation and that all safety standards are adhered to when storing any combustible materials.

.2 Deposit greasy or oily rags or materials subject to spontaneous combustion in CSA or ULC approved receptacles and remove at the end of the work day or shift, or as directed.

.12 Flammable Liquids

.1 The handling, storage and use of flammable liquids is governed by the current National Fire Code of Canada.

.2 Flammable Liquids such as gasoline, kerosene and naphtha may be kept for ready use in quantities not exceeding 45 litres (10 imp gal), provided they are stored in approved safety cans bearing the ULC seal of approval and kept away from buildings, stockpiled combustible materials etc. Storage of quantities of flammable liquids exceeding 45 litres (10 imp gal) for work purposes, require the permission of the Departmental Representative.

.3 Flammable liquids are not to be left on any roof areas after normal working hours.

.4 Transfer of flammable liquids is prohibited within buildings.

.5 Do not transfer flammable liquids in the vicinity of open flames or any type of heat producing device.

.6 Do not use flammable liquids having a flash point below 38 ^{o}C (100 ^{o}F) such as naphtha or gasoline as solvents or cleaning agents.

.7 Store flammable waste liquids for disposal in approved container located in a safe, ventilated area. Waste flammable liquids are to be removed from the site on a regular basis.

.8 Where flammable liquids, such as lacquers or urethane are used, ensure proper ventilation and eliminate all sources of ignition. Inform the Departmental Representative prior to, and at the cessation of such work.

3. Questions and/or clarifications

.1 Direct any questions or clarification on Fire or General Safety, in addition to the above requirements, to the Departmental Representative.

END OF SECTION

NOTE: The application / location for the materials indicated is not limited to the list below and is to be used in conjunction with and may be supplemented by, the Specifications, Schedules and Drawings. Refer to Specifications, Schedules and Drawings for full extent of material application and additional material types.

CODE	ITEM	DESCRIPTION	APPLICATION / LOCATION
DIVISION 03 – CONCRETE			
AS-1	Tactile Walking Surface	Manufacturer: Kinesik or equal and approved Product: Access Tile Colour: Contrasting TBC	Stairs
AS-2	Anti-Slip Inserts	Manufacturer: Balco or equal and approved Product: Stair Nosing Type: H225 Size: 57mm D x 6 mm H Color: Extruded Aluminum with colour contrasted slip resistant strips Fixing: Continuous ball anchor	Stairs
DIVISION 06 – WOOD, PLASTICS AND COMPOSITES			
PLAM1	Plastic Laminate	Manufacturer: Arborite Product: P-352 CA Color: Sahara Eclipse Finish: Matte finish	Countertops
PLAM2	Plastic Laminate	Manufacturer: Arborite Product: W-461-EV Color: Sulawesi Dunes Finish: Matte finish	Millwork
PLAM3	Plastic Laminate	Manufacturer: Arborite Product: W-456-EV Color: Silvered Crossfire Pear Finish: Matte finish	Closet doors laminate

NOTE: The application / location for the materials indicated is not limited to the list below and is to be used in conjunction with and may be supplemented by, the Specifications, Schedules and Drawings. Refer to Specifications, Schedules and Drawings for full extent of material application and additional material types.

CODE	ITEM	DESCRIPTION	APPLICATION / LOCATION
PLAM4	Plastic Laminate	Manufacturer: Wilsonart Product: 7945K-18 Color: Xanadu Finish: Matte finish	Airport lounge millwork
WD-1	Solid Wood	Material: Maple Thickness :19mm Finish: Stained	Window sill
HW1	Hardware pull	Product: Richelieu Name: Contemporary Antibacterial Stainless Steel Pull - 348 Product no: BP3487105170AB Length: 185mm Material: Stainless Steel	Lower and upper cabinets/drawers

DIVISION 07 – THERMAL & MOISTURE PROTECTION

INS-1	Insulation	Polyiso Insulation (avg 150mm thk)	Insulation- Roof (min R-30)
INS-2	Insulation	Mineral Fibre Insulation (Roxul Cavity rock or similar) See drawings for thickness	Insulation- Exterior Walls (min R-value/inch = 4.0)
INS-3	Insulation	Mineral Fibre Insulation (Roxul AFB or similar) See drawings for thickness	Insulation- Interior Walls
INS-4	Insulation	75mm Rigid extruded polystyrene foam insulation 50mm Rigid extruded polystyrene foam insulation	Insulation – below slab on grade for distance of 600mm from perimeter foundation walls (min R-15) Insulation – below grade at perimeter foundation walls (min R-10) Refer to drawings for coverage
R-1	SBS Modified Roofing	Cap Sheet on Base Sheet on Tapered insulation to roof drains	

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CODE	ITEM	DESCRIPTION	APPLICATION / LOCATION
		2nd Layer Insulation INS-1 1st Layer Insulation INS-1 Vapour Barrier 13mm sheathing Reinforced concrete deck or steel deck with concrete infill (refer to structural)	
PNL-1	Steel cladding Wall Panel	Manufacturer: Vicwest or equal and approved Product: Prefinished Metal sheet siding CL 5022-SR or similar to match existing Color: White to match existing Fasteners: Exposed	Exterior Wall Finish
PNL-2	Steel cladding Wall Panel	Manufacturer: Vicwest or equal and approved Product: Prefinished AD300 Vertical Color: White to match existing Size: 300mm x 40mm Fasteners: Hidden	Exterior Wall Finish

DIVISION 08 – OPENINGS

G.W.G	Interior Fire Rated –Wired Glass	Rating: 45min.	Doors in Rated Walls – See A02
GL-1	Sidelights	Glass: Clean Tempered glass Color: Clear Size: 12 mm glass	Sidelights, interior screens & glazed doors, and vestibule screen & doors.
GL-2	Door panels	Glass: Clean Laminate glass Color: Clear Size: 6 mm glass	Door panels (non-fire rated)
GL-3	Millwork glazing	Glass: Frosted & textured Laminate glass Effect: Rain	Airport lounge millwork

NOTE: The application / location for the materials indicated is not limited to the list below and is to be used in conjunction with and may be supplemented by, the Specifications, Schedules and Drawings. Refer to Specifications, Schedules and Drawings for full extent of material application and additional material types.

CODE	ITEM	DESCRIPTION	APPLICATION / LOCATION
		Color: Clear Size: 6 mm glass	
MIR	Mirror	Custom size mirrors	Washrooms
WI-1	Curtain wall system	Manufacturer: Model 1600UT by Kawneer or approved equal Glass Clean Laminate glass Color: Clear Anodised Size: 6 mm glass with 12mm airspace Low emissivity coating: Solarban 60 by PPG on surface no2 Pilkington Energy Advantage on surface no 4 Spandrel Panel: Opaque matt finished coloured aluminium panel (Reynobond 6mm or 6mm) with insulated back frame. Colour: Mid Grey -TBC	Main entrance glazing
WI-2	High performance window	Manufacturer: Model Isoport by Kawneer or approved equal Glass: As WI-1 Colour: As WI-1 Integral flashing: Reynobond 6mm panel or similar. Colour: to match WI-1 spandrel panel	All other windows

DIVISION 09 – FINISHES

TRM-1	Trim	Manufacture: Johnsonite finishing accessories tool Product: CTA-XX-H 1/4" to 1/8" material	Trim between VCT and Carpet tiles
TRM-2	Trim	Manufacture: Johnsonite finishing accessories tool	Trim between Concrete and VCT

NOTE: The application / location for the materials indicated is not limited to the list below and is to be used in conjunction with and may be supplemented by, the Specifications, Schedules and Drawings. Refer to Specifications, Schedules and Drawings for full extent of material application and additional material types.

CODE	ITEM	DESCRIPTION	APPLICATION / LOCATION
		Product: RRD-XX-C 1/8" material to floor Color: TBD	
TRM-3	Trim	Manufacture: Johnsonite finishing accessories tool Product: SSR-XX-D 1/8" material to 0.080" flooring Color: TBD	Trim between VCT and homogenous vinyl tile
TRM-4	Trim	Manufacture: Johnsonite finishing accessories tool Product: EG-XX-J 3/16" material Color: 44 – dark brown	For carpet edge (to wall) profile in the lower level office rooms.
WB1	Rubber Base	Manufacturer: Johnsonite Style Name: Rubber base Style: Reveal Color: 107 - neutrality Size: 3mm x 100mm	Throughout
WB2	Paint Existing wall base	Product: Sherwin Williams Code: SW6991 Color: Black Magic Sheen: Eggshell	Lower floor offices on existing wall
CONC	Sealed Concrete	On-site Untreated/ unpainted & sealed	Mechanical [029], Electrical [028], IT [027], Janitor's room [030], Staircase C (lower level), Receiving area, Flexible cabin lab, Flight Simulation Lab Stair A (main level)
SLCT	Self Levelling Concrete Topping/Floor Underlayment	Untreated	Mechanical [025],Flight simulation lab – lower level [137], Staircase A, Vibration lab [024], FSL observation [026], Laboratory workshops 1 and 2 [033 & 034], Lower level corridor.

NOTE: The application / location for the materials indicated is not limited to the list below and is to be used in conjunction with and may be supplemented by, the Specifications, Schedules and Drawings. Refer to Specifications, Schedules and Drawings for full extent of material application and additional material types.

CODE	ITEM	DESCRIPTION	APPLICATION / LOCATION
VCT1	Vinyl Composite Tile	Manufacturer: Johnsonite Style Name: Azrock Collection Color: V-224 Stonework Size: 304mm x 304mm Installation: Random	Corridor [124], FCL observation Corridor [022] & [023]
VCT2	Vinyl Composite Tile – premium	Manufacturer: Johnsonite Style Name: Azrock Textile Color: V-281 Warm Wool Size: 304mm x 610mm Installation: Brick	Universal washroom [128]
VIN1	Homogenous Vinyl Tiles	Manufacturer: Johnsonite Style Name: iQ Optima Color: 821 Frothy Latte CB Size: 304mm x 304mm tiles Installation: TBD Seam color: TBD	Vestibule, entrance & main floor corridors, washrooms, exam rooms.
CPT1	Carpet Tiles (Main levels)	Manufacturer: Tandus Style: Change II 03747 Color: Venus in Furs 10807 Size: 610mm x 610mm Installation: random	Waiting Lounge, Screening, Interview rooms, And Airport Terminal room
CPT2	Carpet Tiles (Offices)	Manufacturer: Tandus Style: Street Life 03973 Color: Brown Derby 36112 Size: 610mm x 610mm Installation: Horizontal ashlar	Lower level offices only
PT1	Paint General	Product: Sherwin Williams Code: SW7003 Color: Toque White	General wall finish

NOTE: The application / location for the materials indicated is not limited to the list below and is to be used in conjunction with and may be supplemented by, the Specifications, Schedules and Drawings. Refer to Specifications, Schedules and Drawings for full extent of material application and additional material types.

CODE	ITEM	DESCRIPTION	APPLICATION / LOCATION
		Sheen: Eggshell	
PT2	Paint Accent	Product: Sherwin Williams Code: SW7502 Color: Dry Dock LRV Sheen: Semi-gloss	Accent paint
PT3	Paint Door	Product: Sherwin Williams Code: SW7031 Color: Mega Greige Sheen: Semi-gloss	Door paint
PT4	Paint Frame	Product: Sherwin Williams Code: SW7545 Color: Pier LRV Sheen: high-gloss	Door frame paint
PT5	Painted exposed steel deck/beams/ mech equip	Product: Sherwin Williams Code: SW7003 Color: Toque White Sheen: Eggshell	General exposed ceiling paint
PT6	Painted exposed steel deck/beams/ mech equip	Product: Sherwin Williams Code: SW7020 Color: Black Fox Sheen: Eggshell	Painted black in waiting lounge and airport terminal

NOTE: The application / location for the materials indicated is not limited to the list below and is to be used in conjunction with and may be supplemented by, the Specifications, Schedules and Drawings. Refer to Specifications, Schedules and Drawings for full extent of material application and additional material types.

CODE	ITEM	DESCRIPTION	APPLICATION / LOCATION
C-1	Acoustical Ceiling Tile	Manufacturer: Armstrong or equal and approved Product: Cortega Lay-in 769 Color: White Edge Detail: Square Lay in Size: 610mm x 1220mm x 15.8mm Grid: Prelude ML 15/16" Exposed Tee NRC: 0.55	General ceiling tiles
C-2	Suspended Gypsum Drywall		
C-3	Suspended acoustical ceiling (accent)	Manufacturer: Rockfon or equal and approved Product: Rockfon island 8100 Color: White Edge Detail: DMT Size: 1160mm x 1160mm x 40mm	Waiting lounge and airport terminal

DIVISION 10 – SPECIALTIES

PTN1	Washroom Partitions	Manufacturer: Bobrick or equal and approved Product: High Pressure Laminate Classic Series 1541 Mounting: floor anchored Finish: Arborite P-271 CA Colour: Fresh Mist	Toilet Compartments
PTN2	Urinal Partitions	Manufacturer: Bobrick or equal and approved	Urinals

NOTE: The application / location for the materials indicated is not limited to the list below and is to be used in conjunction with and may be supplemented by, the Specifications, Schedules and Drawings. Refer to Specifications, Schedules and Drawings for full extent of material application and additional material types.

CODE	ITEM	DESCRIPTION	APPLICATION / LOCATION
		Product: High Pressure Laminate Classic Series 1545 Mounting: Wall hung Finish: Arborite P-271 CA Colour: Fresh Mist	
WG1	Wall Guard	Manufacturer: Richelieu or equal and approved Product: Nelplas Wall protection System – 470 series Code: 470 Accessory: 470E end cap Size: 4” high Finish: Aluminum	Around high traffic areas: corridors, washroom, and entrance.
FG	Foot grille	Manufacturer: CSgroup Product: PEDIGRID-SA G8 Deep frame with drain and Pan.	Main entrance vestibule

END OF SECTION

Part 1 General

1.1 ADMINISTRATIVE

.1 Submit to NRC 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 NRC 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 NRC 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 is co-ordinated.

.8 Contractor's responsibility for errors and omissions in submission is not relieved by NRC Departmental Representative's review of submittals.

.9 Contractor's responsibility for deviations in submission from requirements of Contract Documents is not relieved by NRC 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 shop drawings bearing stamp and signature of qualified professional engineer registered or licensed in Province of Ontario, 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 14 days for NRC Departmental Representative's review of each submission.

.5 Adjustments made on shop drawings by NRC Departmental Representative are not intended to change Contract Price. If adjustments affect value of Work, state such in writing to NRC Departmental Representative prior to proceeding with Work.

.6 Make changes in shop drawings as NRC Departmental Representative may require, consistent with Contract Documents. When resubmitting, notify NRC Departmental Representative in writing of revisions other than those requested.

.7 Accompany submissions with transmittal letter, in duplicate, 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 NRC Departmental Representative's review, distribute copies.

.10 Submit 6 prints of shop drawings for each requirement requested in specification Sections and as NRC Departmental Representative may reasonably request.

.11 Submit 6 print copies of product data sheets or brochures for requirements requested in specification Sections and as requested by NRC Departmental Representative where shop drawings will not be prepared due to standardized manufacture of product.

.12 Submit 6 copies of test reports for requirements requested in specification Sections and as requested by NRC 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.

.13 Submit 6 copies of certificates for requirements requested in specification Sections and as requested by NRC 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 6 copies of manufacturers instructions for requirements requested in specification Sections and as requested by NRC 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 6 print copies of Manufacturer's Field Reports for requirements requested in specification Sections and as requested by NRC 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 6 copies of Operation and Maintenance Data for requirements requested in specification Sections and as requested by NRC Departmental Representative.

.17 Delete information not applicable to project.

.18 Supplement standard information to provide details applicable to project.

.19 If upon review by NRC Departmental Representative, no errors or omissions are discovered or if only minor corrections are made, transparency 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 NRC Departmental Representative is for sole purpose of ascertaining conformance with general concept.

.1 This review shall not mean that NRC 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 triplicate as requested in respective specification Sections. Label samples with origin and intended use.

.2 Deliver samples prepaid to NRC Departmental Representative's business address site office.

.3 Notify NRC 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 NRC Departmental Representative are not intended to change Contract Price. If adjustments affect value of Work, state such in writing to NRC Departmental Representative prior to proceeding with Work.

.6 Make changes in samples which NRC 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.

1.5 PHOTOGRAPHIC DOCUMENTATION

.1 Submit electronic and hard copy of colour digital photography in jpg format, standard resolution monthly with progress statement and as directed by NRC Departmental Representative.

.2 Project identification: name and number of project and date of exposure indicated.

.3 Number of viewpoints: 4 locations.

.1 Viewpoints and their location as determined by NRC Departmental Representative.

.4 Frequency of photographic documentation: weekly as directed by NRC Departmental Representative.

1.6 CERTIFICATES AND TRANSCRIPTS

.1 Immediately after award of Contract, submit Workers' Compensation Board status.

.2 Submit transcription of insurance immediately after award of Contract.

Part 2 Products

Not Used.

Part 3 Execution

Not Used.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 Canada Labour Code, Part 2, and Canada Occupational Safety and Health Regulations 2002.

.2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

.3 Province of Ontario

.1 Occupational Health and Safety Act, R.S.O. 1990, as amended.

.4 PWGSC/RPB NRC Departmental Policy DP 073 - Occupational Health and Safety - Construction.

1.2 SUBMITTALS

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

.2 Submit site-specific Health and Safety Plan: Within 14 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 one copy of Contractor's authorized representative's work site health and safety inspection reports to NRC Departmental Representative and authority having jurisdiction, weekly.

.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 in accordance with Section 01 47 15 - Sustainable Requirements: Construction.

.7 NRC Departmental Representative will review Contractor's site-specific Health and Safety Plan and provide comments to Contractor within 14 days after receipt of plan. Revise plan as appropriate and resubmit plan to NRC Departmental Representative within 5 days after receipt of comments from NRC Departmental Representative.

.8 NRC 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 NRC Departmental Representative.

.10 On-site Contingency and Emergency Response Plan: address standard operating procedures to be implemented during emergency situations.

1.3 SAFETY ASSESSMENT

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

1.4 MEETINGS

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

1.5 CONSTRUCTOR AND EMPLOYER

.1 Sign-of and comply with the health and safety policies of the Constructor.

.2 Provide all reports to the Constructor as required.

1.6 PROJECT/SITE CONDITIONS

.1 Work at site will involve contact with:

.1 Asbestos.
.2 Lead
.3 PCB’s
.4 Silica
.5 Ozone Depleting Substances (OSD)
.6 Mercury
.7 Coal tar

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 NRC Departmental Representative or Constructor 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 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 Ontario Health and Safety Act, R.S.O. 1990, and the regulations for Construction Projects 213/91, as amended.

.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 NRC 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 site-related working experience specific to activities associated with demolition, abatement, and new construction.

.2 Have working knowledge of occupational safety and health regulations.

.3 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.

.4 Be responsible for implementing, enforcing daily and monitoring site-specific Contractor's Health and Safety Plan.

.5 Be on site during execution of Work.

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 NRC Departmental Representative.

1.13 CORRECTION OF NON-COMPLIANCE

.1 Immediately address health and safety non-compliance issues identified by authority having jurisdiction or by NRC Departmental Representative.

.2 Provide NRC Departmental Representative with written report of action taken to correct non-compliance of health and safety issues identified.

.3 NRC Departmental Representative may stop Work if non-compliance of health and safety regulations is not corrected.

1.14 BLASTING

.1 Blasting or other use of explosives is not permitted.

1.15 POWDER ACTUATED DEVICES

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

1.16 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.

Part 3 Execution

3.1 Not used.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 Definitions:

.1 Environmental Pollution and Damage: presence of chemical, physical, biological elements or agents which adversely affect human health and welfare; unfavourably alter ecological balances of importance to human life; affect other species of importance to humans; or degrade environment aesthetically, culturally and/or historically.

.2 Environmental Protection: prevention/control of pollution and habitat or environment disruption during construction.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Submit 2 copies of WHMIS MSDS.

.2 Environmental Protection Plan must include comprehensive overview of known or potential environmental issues to be addressed during construction.

.3 Address topics at level of detail commensurate with environmental issue and required construction tasks.

.4 Include in Environmental Protection Plan:

.1 Names of persons responsible for ensuring adherence to Environmental Protection Plan.

.2 Names and qualifications of persons responsible for manifesting hazardous waste to be removed from site.

.3 Names and qualifications of persons responsible for training site personnel.

.4 Descriptions of environmental protection personnel training program.

.5 Erosion and sediment control plan identifying type and location of erosion and sediment controls to be provided including monitoring and reporting requirements to assure that control measures are in compliance with erosion and sediment control plan, Federal, Provincial, and Municipal laws and regulations.

.6 Drawings indicating locations of proposed temporary excavations or embankments for haul roads, material storage areas, structures, sanitary facilities, and stockpiles of excess or spoil materials including methods to control runoff and to contain materials on site.

.7 Traffic Control Plans including measures to reduce erosion of temporary roadbeds by construction traffic, especially during wet weather.

.1 Plans to include measures to minimize amount of material transported onto paved public roads by vehicles or runoff.

.8 Work area plan showing proposed activity in each portion of area and identifying areas of limited use or non-use.

.1 Plan to include measures for marking limits of use areas and methods for protection of features to be preserved within authorized work areas.

.9 Spill Control Plan to include procedures, instructions, and reports to be used in event of unforeseen spill of regulated substance.

.10 Non-Hazardous solid waste disposal plan identifying methods and locations for solid waste disposal including clearing debris.

.11 Air pollution control plan detailing provisions to assure that dust, debris, materials, and trash, are contained on project site.

.12 Contaminant Prevention Plan identifying potentially hazardous substances to be used on job site; intended actions to prevent introduction of such materials into air, water, or ground; and detailing provisions for compliance with Federal, Provincial, and Municipal laws and regulations for storage and handling of these materials.

.13 Waste Water Management Plan identifying methods and procedures for management and or discharge of waste waters which are directly derived from construction activities, such as concrete curing water, clean-up water, dewatering of ground water, disinfection water, hydrostatic test water, and water used in flushing of lines.

1.3 FIRES

.1 Fires and burning of rubbish on site is not permitted.

1.4 DRAINAGE

.1 Develop and submit erosion and Sediment Control Plan (ESC) identifying type and location of erosion and sediment controls provided. Plan to include monitoring and reporting requirements to assure that control measures are in compliance with erosion and sediment control plan, Federal, Provincial, and Municipal laws and regulations.

.2 Storm Water Pollution Prevention Plan (SWPPP) to be substituted for erosion and sediment control plan.

.3 Provide temporary drainage and pumping required to keep excavations and site free from water.

.4 Ensure pumped water into waterways, sewer or drainage systems is free of suspended materials.

.5 Control disposal or runoff of water containing suspended materials or other harmful substances in accordance with local authority requirements.

1.5 SITE CLEARING AND PLANT PROTECTION

.1 Protect trees and plants on site and adjacent properties as indicated.

.2 Protect trees and shrubs adjacent to construction work, storage areas and trucking lanes, and encase with protective wood framework from grade level to height of 2 m minimum.

.3 Protect roots of designated trees to dripline during excavation and site grading to prevent disturbance or damage.

.1 Avoid unnecessary traffic, dumping and storage of materials over root zones.

.4 Minimize stripping of topsoil and vegetation.

.5 Restrict tree removal to areas indicated or designated by NRC Departmental Representative.

1.6 POLLUTION CONTROL

.1 Maintain temporary erosion and pollution control features installed under this Contract.

.2 Control emissions from equipment and plant in accordance with local authorities' emission requirements.

.3 Prevent sandblasting and other extraneous materials from contaminating air and waterways beyond application area.

.1 Provide temporary enclosures.

.4 Cover or wet down dry materials and rubbish to prevent blowing dust and debris. Provide dust control for temporary roads.

1.7 NOTIFICATION

.1 NRC Departmental Representative will notify Contractor in writing of observed noncompliance with Federal, Provincial or Municipal environmental laws or regulations, permits, and other elements of Contractor's Environmental Protection plan.

.2 Contractor: after receipt of such notice, inform NRC Departmental Representative of proposed corrective action and take such action for approval by NRC Departmental Representative.

.1 Take action only after receipt of written approval by NRC Departmental Representative.

.3 NRC Departmental Representative will issue stop order of work until satisfactory corrective action has been taken.

.4 No time extensions granted or equitable adjustments allowed to Contractor for such suspensions.

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 CLEANING

.1 Progress Cleaning:

.1 Leave Work area clean at end of each day.

.2 Ensure public waterways, storm and sanitary sewers remain free of waste and volatile materials disposal.

.3 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.

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

.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

Part 1 General

1.1 INSPECTION

.1 Allow NRC 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 NRC 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 NRC 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.

1.2 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 NRC 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 NRC 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 NRC Departmental Representative.

1.3 REPORTS

.1 Submit 4 copies of inspection and test reports to NRC Departmental Representative.

.2 Provide copies to subcontractor of work being inspected or tested, manufacturer or fabricator of material being inspected or tested.

1.4 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 NRC Departmental Representative and may be authorized as recoverable.

1.5 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 NRC Departmental Representative.

.3 Prepare mock-ups for NRC Departmental Representative's 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, NRC Departmental Representative will assist in preparing schedule fixing dates for preparation.

.6 Specification section identifies whether mock-up may remain as part of Work or if it is to be removed and when.

1.6 MILL TESTS

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

1.7 EQUIPMENT AND SYSTEMS

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

Part 2 Products

2.1 NOT USED

Part 3 Execution

3.1 NOT USED

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 Canadian General Standards Board (CGSB)

.1 CAN/CGSB 1.189-00, Exterior Alkyd Primer for Wood.

.2 CGSB 1.59-97, Alkyd Exterior Gloss Enamel.

.2 Canadian Standards Association (CSA International)

.1 CSA-A23.1/A23.2-04, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.

.2 CSA-0121-M1978(R2003), Douglas Fir Plywood.

.3 CAN/CSA-S269.2-M1987(R2003), Access Scaffolding for Construction Purposes.

.4 CAN/CSA-Z321-96(R2001), Signs and Symbols for the Occupational Environment.

1.2 INSTALLATION AND REMOVAL

.1 Prepare site plan indicating proposed location and dimensions of area to be fenced and used by Contractor, number of trailers to be used, avenues of ingress/egress to fenced area and details of fence installation.

.2 Identify areas which have to be gravelled to prevent tracking of mud.

.3 Indicate use of supplemental or other staging area.

.4 Provide construction facilities in order to execute work expeditiously.

.5 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, swing staging, platforms temporary stairs.

1.4 HOISTING

.1 Provide, operate and maintain hoists, cranes required for moving of workers, materials and equipment. Make financial arrangements with Subcontractors for their use of hoists.

.2 Hoists, cranes to be operated by qualified operator.

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.

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 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.

1.9 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 When permanent water and drain connections are completed, provide temporary water closets and urinals complete with temporary enclosures, inside building. Permanent facilities may be used on approval of NRC Departmental Representative.

1.10 CONSTRUCTION SIGNAGE

.1 No other signs or advertisements, other than warning signs, are permitted on site.

.2 Signs and notices for safety and instruction in both official languages Graphic symbols to CAN/CSA-Z321.

1.11 PROTECTION AND MAINTENANCE OF TRAFFIC

.1 Provide access and temporary relocated roads as necessary to maintain traffic.

.2 Maintain and protect traffic on affected roads during construction period except as otherwise specifically directed by NRC Departmental Representative .

.3 Provide measures for protection and diversion of traffic, including provision of watch-persons and flag-persons, erection of barricades, placing of lights around and in front of equipment and work, and erection and maintenance of adequate warning, danger, and direction signs

.4 Protect travelling public from damage to person and property.

.5 Contractor's traffic on roads selected for hauling material to and from site to interfere as little as possible with public traffic.

.6 Verify adequacy of existing roads and allowable load limit on these roads. Contractor: responsible for repair of damage to roads caused by construction operations.

.7 Provide necessary lighting, signs, barricades, and distinctive markings for safe movement of traffic.

.8 Dust control: adequate to ensure safe operation at all times.

.9 Lighting: to assure full and clear visibility for full width of work areas during night work operations.

.10 Provide snow removal during period of Work.

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

Part 3 Execution

3.1 TEMPORARY EROSION AND SEDIMENTATION CONTROL

.1 Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to requirements of authorities having jurisdiction.

.2 Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.

.3 Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 Canadian General Standards Board (CGSB)

.1 CGSB 1.59-97, Alkyd Exterior Gloss Enamel.

.2 CAN/CGSB 1.189-00, Exterior Alkyd Primer for Wood.

.2 Canadian Standards Association (CSA International)

.1 CSA-O121-M1978(R2003), Douglas Fir Plywood.

1.2 INSTALLATION AND REMOVAL

.1 Provide temporary controls in order to execute Work expeditiously.

.2 Remove from site all such work after use.

1.3 HOARDING

.1 Erect temporary site enclosures using 38 x 89 mm construction grade lumber framing at 600 mm centres and 1200 x 2400 x 13 mm exterior grade fir plywood to CSA O121.

.2 Apply plywood panels vertically, flush and butt jointed.

.3 Provide one lockable truck entrance gate and at least one pedestrian door as directed and conforming to applicable traffic restrictions on adjacent streets. Equip gates with locks and keys.

.4 Erect and maintain pedestrian walkways including roof and side covers, complete with signs and electrical lighting as required by law.

.5 Paint public side of site enclosure in selected colours with one coat primer to CAN/CGSB 1.189 and one coat exterior paint to CGSB 1.59. Maintain public side of enclosure in clean condition.

.6 Erect temporary site enclosure using new 1.2 m high snow fence wired to rolled steel "T" bar fence posts spaced at 2.4 m on centre. Provide one lockable truck gate. Maintain fence in good repair.

.7 Provide barriers around trees and plants designated to remain. Protect from damage by equipment and construction procedures.

1.4 GUARD RAILS AND BARRICADES

.1 Provide secure, rigid guard rails and barricades around deep excavations, open shafts, open stair wells, open edges of floors and roofs.

1.5 WEATHER ENCLOSURES

.1 Provide weather tight closures to unfinished door and window openings, tops of shafts and other openings in floors and roofs.

.2 Close off floor areas where walls are not finished; seal off other openings; enclose building interior work for temporary heat.

.3 Design enclosures to withstand wind pressure and snow loading.

1.6 DUST TIGHT SCREENS

.1 Provide dust tight screens or insulated partitions to localize dust generating activities, and for protection of workers, finished areas of Work and public.

.2 Maintain and relocate protection until such work is complete.

1.7 PUBLIC TRAFFIC FLOW

.1 Provide and maintain competent signal flag operators, traffic signals, barricades and flares, lights, or lanterns as required to perform Work and protect public.

1.8 FIRE ROUTES

.1 Maintain access to property including overhead clearances for use by emergency response vehicles.

1.9 PROTECTION FOR OFF-SITE AND PUBLIC PROPERTY

.1 Protect surrounding private and public property from damage during performance of Work.

.2 Be responsible for damage incurred.

1.10 PROTECTION OF BUILDING FINISHES

.1 Provide protection for finished and partially finished building finishes and equipment during performance of Work.

.2 Provide necessary screens, covers, and hoardings.

.3 Confirm with NRC Departmental Representative locations and installation schedule 3 days prior to installation.

.4 Be responsible for damage incurred due to lack of or improper protection.

1.11 WASTE MANAGEMENT AND DISPOSAL

.1 Separate waste materials for reuse and recycling.

Part 2 Products

2.1 NOT USED

Part 3 Execution

3.1 NOT USED

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 Conform to these reference standards, in whole or in part as specifically requested in specifications.

.2 If there is question as to whether products or systems are in conformance with applicable standards, NRC Departmental Representative reserves right to have such products or systems tested to prove or disprove conformance.

.3 Cost for such testing will be born by NRC 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 NRC 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.

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 cementitious products clear of earth or concrete floors, and away from walls.

.5 Keep sand, when used for grout or mortar materials, clean and dry. Store sand on wooden platforms and cover with waterproof tarpaulins during inclement weather.

.6 Store sheet materials and lumber on flat, solid supports and keep clear of ground. Slope to shed moisture.

.7 Store and mix paints in heated and ventilated room. Remove oily rags and other combustible debris from site daily. Take every precaution necessary to prevent spontaneous combustion.

.8 Remove and replace damaged products at own expense and to satisfaction of NRC Departmental Representative.

.9 Touch-up damaged factory finished surfaces to NRC 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.

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 NRC Departmental Representative in writing, of conflicts between specifications and manufacturer's instructions, so that NRC Departmental Representative will establish course of action.

.3 Improper installation or erection of products, due to failure in complying with these requirements, authorizes NRC 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 NRC 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. NRC 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 NRC 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 NRC Departmental Representative if there is interference. Install as directed by NRC 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 NRC 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 NRC 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 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

Not Used.

Part 3 Execution

Not Used.

END OF SECTION

Part 1 General

.1 Owner's identification of existing survey control points and property limits.

1.2 QUALIFICATIONS OF SURVEYOR

.1 Qualified registered land surveyor, licensed to practice in Place of Work, acceptable to NRC Departmental Representative.

1.3 SURVEY REFERENCE POINTS

.1 Existing base horizontal and vertical control points are designated on drawings.

.2 Locate, confirm and protect control points prior to starting site work. Preserve permanent reference points during construction.

.3 Make no changes or relocations without prior written notice to NRC Departmental Representative.

.4 Report to NRC Departmental Representative when reference point is lost or destroyed, or requires relocation because of necessary changes in grades or locations.

.5 Require surveyor to replace control points in accordance with original survey control.

1.4 SURVEY REQUIREMENTS

.1 Establish two permanent bench marks on site, referenced to established bench marks by survey control points. Record locations, with horizontal and vertical data in Project Record Documents.

.2 Establish lines and levels, locate and lay out, by instrumentation.

.3 Stake for grading, fill and topsoil placement and landscaping features.

.4 Stake slopes and berms.

.5 Establish pipe invert elevations.

.6 Stake batter boards for foundations.

.7 Establish foundation column locations and floor elevations.

.8 Establish lines and levels for mechanical and electrical work.

1.5 EXISTING SERVICES

.1 Before commencing work, establish location and extent of service lines in area of Work and notify NRC Departmental Representative of findings.

.2 Remove abandoned service lines within 2m of structures. Cap or otherwise seal lines at cut-off points as directed by NRC Departmental Representative.

1.6 LOCATION OF EQUIPMENT AND FIXTURES

.1 Location of equipment, fixtures and outlets indicated or specified are to be considered as approximate.

.2 Locate equipment, fixtures and distribution systems to provide minimum interference and maximum usable space and in accordance with manufacturer's recommendations for safety, access and maintenance.

.3 Inform NRC Departmental Representative of impending installation and obtain approval for actual location.

.4 Submit field drawings to indicate relative position of various services and equipment when required by NRC Departmental Representative.

1.7 RECORDS

.1 Maintain a complete, accurate log of control and survey work as it progresses.

.2 On completion of foundations and major site improvements, prepare a certified survey showing dimensions, locations, angles and elevations of Work.

.3 Record locations of maintained, re-routed and abandoned service lines.

1.8 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit name and address of Surveyor to NRC Departmental Representative.

.2 On request of NRC Departmental Representative, submit documentation to verify accuracy of field engineering work.

.3 Submit certificate signed by surveyor certifying and noting those elevations and locations of completed Work that conform and do not conform with Contract Documents.

1.9 SUBSURFACE CONDITIONS

.1 Promptly notify Consultant in writing if subsurface conditions at Place of Work differ materially from those indicated in Contract Documents, or a reasonable assumption of probable conditions based thereon.

.2 After prompt investigation, should NRC Departmental Representative determine that conditions do differ materially, instructions will be issued for changes in Work as provided in Changes and Change Orders.

Part 2 Products

2.1 NOT USED

Part 3 Execution

3.1 NOT USED

END OF SECTION

Part 1 General

1.1 ACTION AND INFORMATIONAL SUBMITTALS

.1 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 Visual qualities of sight-exposed elements.

.5 Work of Owner or separate contractor.

.2 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 00 10 00 General Instructions.

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.

.5 Provide protection from elements for areas which are to be exposed by uncovering work; maintain excavations free of water.

1.4 EXECUTION

.1 Execute cutting, fitting, and patching including excavation and fill, to complete Work.

.2 Fit several parts together, to integrate with other Work.

.3 Uncover Work to install ill-timed Work.

.4 Remove and replace defective and non-conforming Work.

.5 Remove samples of installed Work for testing.

.6 Provide openings in non-structural elements of Work for penetrations of mechanical and electrical Work.

.7 Execute Work by methods to avoid damage to other Work, and which will provide proper surfaces to receive patching and finishing.

.8 Employ original installer to perform cutting and patching for weather-exposed and moisture-resistant elements, and sight-exposed surfaces.

.9 Cut rigid materials using masonry saw or core drill. Pneumatic or impact tools not allowed on masonry work without prior approval.

.10 Restore work with new products in accordance with requirements of Contract Documents.

.11 Fit Work airtight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.

.12 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.

.13 Refinish surfaces to match adjacent finishes: Refinish continuous surfaces to nearest intersection. Refinish assemblies by refinishing entire unit.

.14 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

Part 3 Execution

3.1 NOT USED

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 Public Works Government Services Canada (PWGSC) Standard Acquisition Clauses and Conditions (SACC)-ID: R0202D, Title: General Conditions "C", In Effect as Of: May 14, 2004.

1.2 PROJECT CLEANLINESS

.1 Maintain Work in tidy condition, free from accumulation of waste products and debris, other than that caused by NRC Departmental Representative or other Contractors.

.2 Remove waste materials from site at daily regularly scheduled times or dispose of as directed by NRC Departmental Representative. Do not burn waste materials on site, unless approved by NRC Departmental Representative.

.3 Clear snow and ice from loading dock ramp, staging area, roof, and all access points to building, and remove from site.

.4 Make arrangements with and obtain permits from authorities having jurisdiction for disposal of waste and debris.

.5 Provide on-site containers for collection of waste materials and debris.

.6 Provide and use marked separate bins for recycling. Refer to Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

.7 Dispose of waste materials and debris off site.

.8 Clean interior areas prior to start of finishing work, and maintain areas free of dust and other contaminants during finishing operations.

.9 Store volatile waste in covered metal containers, and remove from premises at end of each working day.

.10 Provide adequate ventilation during use of volatile or noxious substances. Use of building ventilation systems is not permitted for this purpose.

.11 Use only cleaning materials recommended by manufacturer of surface to be cleaned, and as recommended by cleaning material manufacturer.

.12 Schedule cleaning operations so that resulting dust, debris and other contaminants will not fall on wet, newly painted surfaces nor contaminate building systems.

1.3 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 NRC Departmental Representative or other Contractors.

.5 Remove waste materials from site at regularly scheduled times or dispose of as directed by NRC Departmental Representative. Do not burn waste materials on site, unless approved by NRC Departmental Representative.

.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 and sweep roofs, gutters, areaways, and sunken wells.

.16 Sweep and wash clean paved areas.

.17 Clean equipment and fixtures to sanitary condition; clean or replace filters of mechanical equipment.

.18 Clean roofs, downspouts, and drainage systems.

.19 Remove debris and surplus materials from crawl areas and other accessible concealed spaces.

.20 Remove snow and ice from access to building.

1.4 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

Not Used.

Part 3 Execution

Not Used.

END OF SECTION

Part 1 General

1.1 WASTE MANAGEMENT GOALS

.1 Accomplish maximum control of solid construction waste.

.2 Preserve environment and prevent pollution and environment damage.

1.2 DEFINITIONS

.1 Class III: non-hazardous waste - construction renovation and demolition waste.

.2 Inert Fill: inert waste - exclusively asphalt and concrete.

.3 Recyclable: ability of product or material to be recovered at end of its life cycle and re-manufactured into new product for reuse.

.4 Recycle: process by which waste and recyclable materials are transformed or collected for purpose of being transferred into new products.

.5 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.

.6 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.

.7 Salvage: removal of structural and non-structural materials from deconstruction/disassembly projects for purpose of reuse or recycling.

.8 Separate Condition: refers to waste sorted into individual types.

.9 Source Separation: acts of keeping different types of waste materials separate beginning from first time they became waste.

1.3 STORAGE, HANDLING AND PROTECTION

.1 Store, materials to be reused, recycled and salvaged in locations as directed by NRC Departmental Representative.

.2 Unless specified otherwise, materials for removal become 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 for demolition from movement or damage.

.6 Support affected structures. If safety of building is endangered, cease operations and immediately notify NRC Departmental Representative.

.7 Protect surface drainage, mechanical and electrical from damage and blockage.

.8 Separate and store materials produced during dismantling of structures in designated areas.

.9 Prevent contamination of materials to be salvaged and recycled and handle materials in accordance with requirements for acceptance by designated facilities.

.1 On-site source separation is recommended.

.2 Remove co-mingled materials to off-site processing facility for separation.

.3 Provide waybills for separated materials.

1.4 DISPOSAL OF WASTES

.1 Do not bury rubbish or waste materials.

.2 Do not dispose of waste, volatile materials, mineral spirits, oil, paint thinner into waterways, storm, or sanitary sewers.

.3 Remove materials from deconstruction as deconstruction/disassembly Work progresses.

.4 Prepare project summary to verify destination and quantities on a material-by-material basis as identified in pre-demolition material audit.

1.5 USE OF SITE AND FACILITIES

.1 Execute work with least possible interference or disturbance to normal use of premises.

.2 Maintain security measures established by existing facility provide temporary security measures approved by NRC Departmental Representative.

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

Part 3 Execution

3.1 CLEANING

.1 Remove tools and waste materials on completion of Work, and leave work area in clean and orderly condition.

.2 Clean-up work area as work progresses.

.3 Source separate materials to be reused/recycled into specified sort areas.

END OF SECTION

Part 1 General

1.1 ADMINISTRATIVE REQUIREMENTS

.1 Pre-warranty Meeting:

.1 Convene meeting one week prior to contract completion with contractor's representative and NRC Departmental Representative to:

.1 Verify Project requirements.

.2 Review manufacturer's installation instructions and warranty requirements.

.2 NRC Departmental Representative to establish communication procedures for:

.1 Notifying construction warranty defects.

.2 Determine priorities for type of defects.

.3 Determine reasonable response time.

.3 Contact information for bonded and licensed company for warranty work action: provide name, telephone number and address of company authorized for construction warranty work action.

.4 Ensure contact is located within local service area of warranted construction, is continuously available, and is responsive to inquiries for warranty work action.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Section 00 10 00 General Instructions.

.2 Two weeks prior to Substantial Performance of the Work, submit to the NRC Departmental Representative, four final copies of operating and maintenance manuals in English and French.

.3 Provide spare parts, maintenance materials and special tools of same quality and manufacture as products provided in Work.

.4 Provide evidence, if requested, for type, source and quality of products supplied.

1.3 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.

.1 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.

.1 Bind in with text; fold larger drawings to size of text pages.

1.4 CONTENTS - PROJECT RECORD DOCUMENTS

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

.1 Date of submission; names.

.2 Addresses, and telephone numbers of Consultant 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.

1.5 AS -BUILT DOCUMENTS AND SAMPLES

.1 Maintain, in addition to requirements in General Conditions, at site for NRC 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.

.1 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.

.1 Label each document "PROJECT RECORD" in neat, large, printed letters.

.4 Maintain record documents in clean, dry and legible condition.

.1 Do not use record documents for construction purposes.

.5 Keep record documents and samples available for inspection by NRC Departmental Representative.

1.6 RECORDING INFORMATION ON PROJECT RECORD DOCUMENTS

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

.1 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 horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.

.3 Measured locations of internal utilities and appurtenances, referenced to visible and accessible features of construction.

.4 Field changes of dimension and detail.

.5 Changes made by change orders.

.6 Details not on original Contract Drawings.

.7 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.

1.7 FINAL SURVEY

.1 Submit final site survey certificate in accordance with Section 01 71 00 - Examination and Preparation, certifying that elevations and locations of completed Work are in conformance, or non-conformance with Contract Documents.

1.8 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 Additional requirements: as specified in individual specification sections.

1.9 MATERIALS AND FINISHES

.1 Building products, applied materials, and finishes: include product data, with catalogue number, size, composition, and colour and texture designations.

.1 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.

1.10 MAINTENANCE MATERIALS

.1 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 NRC Departmental Representative .

.2 Include approved listings in Maintenance Manual.

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

.2 Extra Stock 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 NRC Departmental Representative.

.2 Include approved listings in Maintenance Manual.

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

.3 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 NRC 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 NRC 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 NRC Departmental Representative approval.

.3 Warranty management plan to include required actions and documents to assure that NRC 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 NRC 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 NRC 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: roofs, HVAC balancing, pumps, motors, transformers, and 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 NRC 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 NRC 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

Part 3 Execution

3.1 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.

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 NRC Departmental Representative will issue Interim Acceptance Certificate when:

.1 Completed Cx documentation has been received, reviewed for suitability and approved by NRC 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 NRC 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 NRC 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, 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 NRC 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 NRC Departmental Representative for review and approval.

.10 Ensure "As-Built" system schematics are available.

.4 Inform NRC Departmental Representative in writing of discrepancies and deficiencies on finished works.

1.6 CONFLICTS

.1 Report conflicts between requirements of this section and other sections to NRC 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 NRC 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 NRC 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 NRC Departmental Representative.

1.8 COMMISSIONING DOCUMENTATION

.1 Prepare Commissioning (Cx) Forms: Installation Check Lists and Product Information (PI) / Performance Verification (PV) Forms as required for organizing and recording data.

.2 NRC Departmental Representative to review and approve Cx documentation.

.3 Provide completed and approved Cx documentation to NRC Departmental Representative.

1.9 COMMISSIONING SCHEDULE

.1 Provide detailed Cx schedule as part of construction schedule.

.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: 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. NRC 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 NRC Departmental Representative, 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 NRC 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 NRC Departmental Representative.

.3 Arrange for NRC Departmental Representative to witness tests.

.4 Obtain written approval of test results and documentation from NRC 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 NRC 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 NRC 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 NRC 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 NRC Departmental Representative.

.2 Major equipment/systems: if evaluation report concludes that damage is minor, implement corrective measures approved by NRC Departmental Representative.

.3 If evaluation report concludes that major damage has occurred, NRC 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 NRC 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 NRC 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 NRC 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 NRC 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 NRC 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 or 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 NRC 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 NRC 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 NRC 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 Laboratory areas:

.1 Provide manpower and instrumentation to verify up to 100 % of reported results.

.2 Elsewhere:

.1 Provide manpower and instrumentation to verify up to 30 % of reported results, unless specified otherwise in other sections.

.3 Number and location to be at discretion of NRC Departmental Representative.

.4 Conduct tests repeated during verification under same conditions as original tests, using same test equipment, instrumentation.

.5 Review and repeat commissioning of systems if inconsistencies found in more than 20% of reported results.

.6 Perform additional commissioning until results are acceptable to NRC Departmental Representative.

1.26 REPEAT VERIFICATIONS

.1 Assume costs incurred by NRC Departmental Representative for third and subsequent verifications where:

.1 Verification of reported results fail to receive NRC Departmental Representative's approval.

.2 Repetition of second verification again fails to receive approval.

.3 NRC 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 NRC Departmental Representative.

.2 Report problems, faults or defects affecting Cx to NRC Departmental Representative in writing. Stop Cx until problems are rectified. Proceed with written approval from NRC 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 NRC 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 NRC 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 NRC 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 NRC 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

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 National Fire Protection Association (NFPA)

.1 NFPA-13-02, Installation of Sprinkler Systems Handbook.

.2 NFPA-14-02, Automatic Sprinkler Systems Handbook.

.3 NFPA-20-03, Standard for the Installation of Stationary Fire Pumps for Fire Protection.

.3 Underwriters' Laboratories of Canada (ULC)

1.3 GENERAL

.1 Provide a fully functional facility:

.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’s 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 100% completed within 12 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-contractors, suppliers' requirements.

.6 Project construction team's and Cx team's requirements.

.2 Submit completed Cx Plan to NRC 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 months during construction phase. At each revision, indicate revision number and date.

.3 Submit each revised Cx Plan to NRC 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 NRC 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 NRC Departmental Representative is responsible for:

.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.

.6 Organizing Cx.

.7 Monitoring operations Cx activities.

.8 Witnessing, certifying accuracy of reported results.

.9 Witnessing and certifying TAB and other tests.

.10 Developing BMM.

.11 Ensuring implementation of final Cx Plan.

.12 Performing verification of performance of installed systems and equipment.

.13 Implementation of Training Plan.

.2 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 NRC Departmental Representative for administrative and coordination purposes.

.3 Contractor's Cx agent implements specified Cx activities including:

.1 Demonstrations.

.2 Updating commissioning plan

.3 Commissioning Forms – submit for approval

.4 Training.

.5 Oversee Testing and Commissioning.

.6 Preparation, submission of test reports.

.4 Consultant shall:

.1 Respond to any design issues or queries identified

.2 Assist as necessary

.5 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 NRC 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 EXTENT OF CX

.1 Cx Structural and Architectural Systems:

.1 Architectural and structural:

.1 Equipment: Dock levellers

.2 Commission mechanical systems and associated equipment:

.1 Plumbing systems:

.1 Domestic CWS and HWS.

.2 Regular sanitary waste systems.

.3 Sewage pumps

.4 Storm water systems.

.5 Sump pumps

.2 HVAC and exhaust systems:

.1 HVAC systems

.2 General exhaust systems

.3 Exhaust systems and related systems

.4 Laboratory fume hoods and related systems.

.5 Heat recovery systems

.6 Smoke control systems installed is contract.

.3 Fire and life safety systems:

.1 Special fire suppression systems:

.2 Wet pipe sprinkler systems.

.3 Dry pipe sprinkler systems.

.4 Standpipe and hose systems.

.5 Total flooding fire extinguishing systems.

.6 Fire extinguishers.

.4 Noise and vibration control systems for mechanical systems.

.5 Seismic restraint and control measures.

.6 IAQ environmental control systems:

.1 Indoor conditions

.2 Indoor air quality (IAQ)

.3 Environmental control systems

.7 EMCS:

.8 Energy metering systems for steam, chilled water, electricity.

.3 Commission electrical systems and equipment:

.1 Low voltage below 750 V:

.1 Low voltage equipment.

.2 Low voltage distribution systems.

.3 Central clock systems.

.4 Voice communications systems.

.5 Audio/visual systems

.6 Electronic data and communications information systems.

.2 Emergency power generation systems.

.3 Lighting systems:

.1 Lighting equipment.

.2 Distribution systems.

.3 Emergency lighting systems, including battery packs.

.4 Fire exit emergency signage.

.4 Fire alarm systems, equipment:

.1 Annunciators.

.2 Control panels.

.3 Fire alarm battery banks.

1.9 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.

1.10 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 witnessed by NRC Departmental Representative:

.10 Tests performed by Owner.

.11 Training Plans.

.12 Cx Reports.

.13 Prescribed activities during warranty period.

.4 NRC Departmental Representative to witness and certify tests and reports of results provided to NRC Departmental Representative.

.5 NRC Departmental Representative to participate.

1.11 PRE-CX ACTIVITIES AND RELATED DOCUMENTATION

.1 Items listed in this Cx Plan include the following:

.1 Pre-Start-Up inspections: by NRC Departmental Representative prior to permission to start up and rectification of deficiencies to NRC Departmental Representative's satisfaction.

.2 NRC Departmental Representative to use approved check lists.

.3 NRC Departmental Representative will monitor all 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 NRC Departmental Representative and does not form part of Cx specifications.

.6 NRC Departmental Representative will monitor these inspections and tests.

.7 Include completed documentation in Cx report.

.2 Pre-Cx activities - MECHANICAL:

.1 Plumbing systems:

.1 "Bump" each item of equipment in its "stand-alone" mode.

.2 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.

.2 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 NRC Departmental Representative.

.3 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 NRC 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.

.2 Reports of test results to be witnessed and certified by NRC 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 Emergency power generation systems

.3 Lighting systems:

.1 Emergency lighting systems:

.1 Tests to include verification of lighting levels and coverage, initially by disrupting normal power.

.4 Fire alarm systems: test after other safety and security systems are completed. Testing to include a complete verification in accordance with ULC requirements. NRC Departmental Representative has witnessed and certified report, demonstrate devices and zones to NRC Departmental Representative.

.5 Low voltage systems: these include:

.1 Clock, communications, low voltage lighting control systems and data communications systems.

.2 Special systems such as Simultaneous Translation systems, MPs Call systems, Messenger Call systems, Division Bell systems.

.6 Security, surveillance and intrusion alarm systems: to include verification by NRC Departmental Representative.

.7 Lightning protection systems.

.8 Watchman's tour systems.

1.12 START-UP

.1 Start-up components, equipment and systems.

.2 Equipment manufacturer, supplier, installing specialist sub-contractor, as appropriate, to start-up, under Contractor's direction, all equipment, systems:

.3 NRC Departmental Representative to monitor all of these start-up activities.

.1 Rectify start-up deficiencies to satisfaction of NRC Departmental Representative.

.4 Performance Verification (PV):

.1 Approved Cx Agent to perform.

.1 Repeat when necessary until results are acceptable to NRC Departmental Representative.

.2 Use procedures modified generic procedures to suit project requirements.

.3 NRC Departmental Representative to witness and certify reported results using approved PI and PV forms.

.4 NRC Departmental Representative to approve completed PV reports and provide to NRC Departmental Representative.

.5 NRC Departmental Representative reserves right to verify reported results at random.

.6 Failure of randomly selected item shall result in rejection of PV report or report of system start up and testing.

1.13 CX ACTIVITIES AND RELATED DOCUMENTATION

.1 Perform Cx by specified Cx agency using procedures developed by NRC Departmental Representative and approved by NRC Departmental Representative.

.2 NRC Departmental Representative to monitor Cx activities.

.3 Upon satisfactory completion, Cx agency performing tests to prepare Cx Report using approved PV forms.

.4 NRC Departmental Representative to witness, certify reported results of, Cx activities and forward to NRC Departmental Representative.

.5 NRC Departmental Representative reserves right to verify a percentage of reported results at no cost to contract.

1.14 CX OF INTEGRATED SYSTEMS AND RELATED DOCUMENTATION

.1 Cx to be performed by specified Cx specialist, using procedures developed by NRC Departmental Representative and approved by NRC Departmental Representative.

.2 Tests to be witnessed by NRC Departmental Representative and documented on approved report forms.

.3 Upon satisfactory completion, Cx specialist to prepare Cx Report, to be certified by NRC Departmental Representative and submitted to NRC Departmental Representative for review.

.4 NRC Departmental Representative reserves right to verify percentage of reported results.

.5 Integrated systems to include:

.1 HVAC and associated systems forming part of integrated HVAC systems.

.2 Smoke control systems.

.3 Stair shaft pressurization systems.

.4 Indoor air quality.

.5 Environmental space conditions.

.6 Fire alarm systems.

.7 Fire pumps and controllers.

.8 Voice communications systems.

.9 Emergency power generator.

.10 Transfer switch and controllers.

.11 Emergency lighting systems.

.6 Identification:

.1 In later stages of Cx, before hand-over and acceptance, Contractor, Property Manager and Cx Manager to co-operate to complete inventory data sheets and provide assistance in full implementation of MMS identification system of components, equipment, sub-systems, systems.

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 NRC 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: 3 months after award of contract.

.5 Cx Report format: 3 months after contract award.

.6 Discussion of heating/cooling loads for Cx: 3 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 of smoke management/control systems: after Cx of related systems is completed and 7 days before proposed date of Cx these systems.

.15 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 NRC Departmental Representative will monitor progress of Cx against this schedule.

1.20 CX REPORTS

.1 Submit reports of tests, witnessed and certified by NRC Departmental Representative to NRC Departmental Representative 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 NRC Departmental Representative.

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 NRC Departmental Representative lock control devices in their final positions, indelibly mark settings marked and include in Cx Reports.

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 NRC 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 NRC 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 NRC 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 NRC Departmental Representative's approval.

1.5 COMMISSIONING FORMS

.1 Use Commissioning forms to verify installation and record performance when starting equipment and systems.

.2 Cx Agent will develop required project-specific Commissioning forms in electronic format complete with specification data and submit to NRC Departmental Representative for approval.

.3 Strategy for Use:

.1 Contractor will provide required shop drawings information and verify correct installation and operation of items indicated on these forms.

.2 Confirm operation as per design criteria and intent.

.3 Identify variances between design and operation and reasons for variances.

.4 Verify operation in specified normal and emergency modes and under specified load conditions.

.5 Record analytical and substantiating data.

.6 Verify reported results.

.7 Form to bear signatures of recording technician and reviewed and signed off by NRC Departmental Representative.

.8 Submit immediately after tests are performed.

.9 Reported results in true measured SI unit values.

.10 Provide NRC Departmental Representative with originals of completed forms.

.11 Maintain copy on site during start-up, testing and commissioning period.

.12 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).

1.6 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 and applies to all project sections.

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 NRC Departmental Representative 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 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 3 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 NRC Departmental Representative will evaluate training and materials.

.3 Upon completion of training, provide written report, signed by Instructors, witnessed by NRC 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 NRC 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 professional quality.

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 is limited to portions of the Building Management Manual (BMM) provided to NRC 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 NRC Departmental Representative.

1.3 APPROVALS

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

1.4 GENERAL INFORMATION

.1 Provide NRC 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 architectural, structural, fire protection, 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 architectural systems and equipment installed and commissioned - Section 2.0 of BMM.

.6 Information on operation and maintenance of fire protection and life safety systems and equipment installed and commissioned - Section 2.0 of BMM.

.7 Information on operation and maintenance of mechanical systems and equipment installed and commissioned - Section 2.0 of BMM.

.8 Operating and maintenance manual - Section 3.2 of BMM.

.9 Final commissioning plan as actually implemented.

.10 Completed commissioning checklists.

.11 Commissioning test procedures employed.

.12 Completed Product Information (PI) and Performance Verification (PV) report forms, approved and accepted by NRC Departmental Representative.

.13 Commissioning reports.

1.5 CONTENTS OF OPERATING AND MAINTENANCE MANUAL

.1 For detailed requirements refer to Section 01 78 00 - Closeout Submittals.

.2 NRC 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 LIFE SAFETY COMPLIANCE (LSC) MANUAL

.1 Samples of LSC Manual will be available from NRC Departmental Representative.

.2 Content of Manual:

.1 All possible Emergency situations modes including: presence of fire and smoke, power failure, lose of water or pressure, chemical spills and refrigerant release.

.2 Failure of elevators and escalators.

.3 HVAC emergencies and fuel supply failures.

.4 Intrusion and security breach.

.5 Emergency provisions for natural disasters, bomb threats and other disruptive situations.

.6 Dedicated emergency generators for high security projects, medical facilities and computer systems.

.7 Emergency control procedures for fire, power and major equipment failure.

.8 Emergency contacts and numbers.

.9 Manual to be readily available and comprehensible to non- technical readers.

1.7 SUPPORTING DOCUMENTATION FOR INSERTION INTO SUPPORTING APPENDICES

.1 Provide NRC 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 Architectural and structural:

.1 Inspection certificates, construction permits.

.2 Roof anchor log books.

.3 PV reports.

.3 Fire prevention, suppression and protection:

.1 Test reports.

.2 Smoke test reports.

.3 PV reports.

.4 Mechanical:

.1 Installation permits, inspection certificates.

.2 Piping pressure test certificates.

.3 Ducting leakage test reports.
.4 TAB and PV reports.
.5 Charts of valves and steam traps.
.6 Copies of posted instructions.

.5 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 NRC Departmental Representative with preparation of BMM.

1.8 LANGUAGE

.1 English and French Language to be in separate binders.

1.9 IDENTIFICATION OF FACILITY

.1 When submitting information to NRC Departmental Representative for incorporation into BMM, use following system for identification of documentation:

.1 As required by NRC Departmental Representative.

1.10 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 NRC 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

Part 1 General

1.1 REFERENCES

.1 Definitions:

.1 Hazardous Materials: dangerous substances, dangerous goods, hazardous commodities and hazardous products, include but not limited to: poisons, corrosive agents, flammable substances, ammunition, explosives, radioactive substances, or materials that endanger human health or environment if handled improperly.

.2 Reference Standards:

.1 CSA International

.1 CSA S350-M1980(R2003), Code of Practice for Safety in Demolition of Structures.

1.2 ADMINISTRATIVE REQUIREMENTS

.1 Pre-Installation Meetings:

.1 Convene pre-installation meeting 1 week prior to beginning work of this Section and on-site installation, with Contractor's Representative and NRC Departmental Representative to:

.1 Verify project requirements.

.2 Verify existing site conditions adjacent to demolition work.

.3 Co-ordination with other construction subtrades.

1.3 ACTION AND INFORMATIONA SUBMITTALS

.1 Shop Drawings:

.1 Submit for review and approval demolition drawings, diagrams or details showing sequence of demolition work, and supporting structures, shoring and underpinning.

.2 Submit demolition drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.

1.4 QUALITY ASSURANCE

.1 Regulatory Requirements: Ensure Work is performed in compliance with Provincial and Municipal regulations.

1.5 SITE CONDITIONS

.1 Environmental protection:

.1 Ensure Work does not adversely affect adjacent watercourses, groundwater and wildlife, or contribute to excess air and noise pollution.

.2 Fires and burning of waste or materials is not permitted on site.

.3 Do not bury rubbish waste materials.

.4 Do not dispose of waste or volatile materials including but not limited to: mineral spirits, oil, petroleum based lubricants, or toxic cleaning solutions into watercourses, storm or sanitary sewers.

.1 Ensure proper disposal procedures are maintained throughout project.

.5 Do not pump water containing suspended materials into watercourses, storm or sanitary sewers, or onto adjacent properties.

.6 Control disposal or runoff of water containing suspended materials or other harmful substances in accordance with authorities having jurisdiction.

.7 Protect trees, plants and foliage on site and adjacent properties where indicated.

.8 Prevent extraneous materials from contaminating air beyond application area, by providing temporary enclosures during demolition work.

.9 Cover or wet down dry materials and waste to prevent blowing dust and debris. Control dust on all temporary roads.

1.6 EXISTING

.1 Structures to be demolished are based on their condition on date that tender is accepted, and at time of examination prior to tendering.

.1 Remove, protect and store salvaged items as directed by NRC Departmental Representative. Deliver to NRC Departmental Representative as directed.

Part 2 Products

2.1 EQUIPMENT

.1 Leave machinery running only while in use, except where extreme temperatures prohibit shutting machinery down.

Part 3 Execution

3.1 PREPARATION

.1 Temporary Erosion and Sedimentation Control:

.1 Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to: requirements of authorities having jurisdiction.

.2 Inspect, repair, and maintain erosion and sedimentation control measures during demolition.

.3 Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal after completion of demolition work.

.2 Protection of in-place conditions:

.1 Prevent movement, settlement or damage of adjacent structures, services, walks, paving, trees, landscaping, adjacent grades properties parts of existing building to remain.

.1 Provide bracing, shoring and underpinning as required.

.2 Repair damage caused by demolition as directed by NRC Departmental Representative.

.2 Support affected structures and, if safety of structure being demolished or adjacent structures or services appears to be endangered, take preventative measures, stop Work and immediately notify NRC Departmental Representative.

.3 Prevent debris from blocking surface drainage system, mechanical and electrical systems which must remain in operation.

.3 Surface Preparation:

.1 Disconnect and re-route electrical and telephone service lines entering buildings to be demolished.

.1 Post warning signs on electrical lines and equipment which must remain energized to serve other properties during period of demolition.

.2 Do not disrupt active or energized utilities traversing premises designated to remain undisturbed.

3.2 DEMOLITION

.1 Do demolition work in accordance with Section 01 56 00 - Temporary Barriers and Enclosures.

.2 Blasting operations not permitted during demolition.

.3 Remove contaminated or dangerous materials as defined by authorities having jurisdiction, relating to environmental protection, from site and dispose of in safe manner to minimize danger at site or during disposal.

.4 Demolish parts of structure structures.

.5 To permit construction of addition and as indicated.

.6 Remove existing equipment, services, and obstacles where required for refinishing or making good of existing surfaces, and replace as work progresses.

.7 At end of each day's work, leave Work in safe and stable condition.

.1 Protect interiors of parts not to be demolished from exterior elements at all times.

.8 Demolish to minimize dusting.

.9 Remove and dispose of demolished materials except where noted otherwise and in accordance with authorities having jurisdiction.

.10 Use natural lighting to do Work where possible.

.1 Shut off lighting except those required for security purposes at end of each day.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 Definitions:

.1 Dangerous Goods: product, substance, or organism specifically listed or meets hazard criteria established in Transportation of Dangerous Goods Regulations.

.2 Hazardous Material: product, substance, or organism used for its original purpose; and is either dangerous goods or material that will cause adverse impact to environment or adversely affect health of persons, animals, or plant life when released into the environment.

.3 Hazardous Waste: hazardous material no longer used for its original purpose and that is intended for recycling, treatment or disposal.

.2 Reference Standards:

.1 Canadian Environmental Protection Act,1999 (CEPA 1999)

.1 Export and Import of Hazardous Waste and Hazardous Recyclable Material Regulations (SOR/2005-149).

.2 Department of Justice Canada (Jus)

.1 Transportation of Dangerous Goods Act, 1992 (TDG Act) 1992, (c.34).

.2 Transportation of Dangerous Goods Regulations (T-19.01-SOR/2001-286).

.3 Green Seal Environmental Standards (GS)

.1 GS-11-2008, 2nd Edition, Paints and Coatings.

.2 GS-36-00, Commercial Adhesives.

.4 Health Canada / Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

.5 National Research Council Canada Institute for Research in Construction (NRC-IRC)

.1 National Fire Code of Canada-2005.

.3 South Coast Air Quality Management District (SCAQMD), California State, Regulation XI. Source Specific Standards

.1 SCAQMD Rule 1113-A2007, Architectural Coatings.

.2 SCAQMD Rule 1168-A2005, Adhesive and Sealant Applications.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for hazardous materials and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Submit two copies of WHMIS MSDS to NRC Departmental Representative for each hazardous material required prior to bringing hazardous material on site.

.3 Submit hazardous materials management plan to NRC Departmental Representative that identifies hazardous materials, usage, location, personal protective equipment requirements, and disposal arrangements.

1.3 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance 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 Transport hazardous materials and wastes in accordance with Transportation of Dangerous Goods Act, Transportation of Dangerous Goods Regulations, and applicable provincial regulations.

.4 Storage and Handling Requirements:

.1 Co-ordinate storage of hazardous materials with NRC Departmental Representative and abide by internal requirements for labelling and storage of materials and wastes.

.2 Store and handle hazardous materials and wastes in accordance with applicable federal and provincial laws, regulations, codes, and guidelines.

.3 Store and handle flammable and combustible materials in accordance with National Fire Code of Canada requirements.

.4 Keep no more than 45 litres of flammable and combustible liquids such as gasoline, kerosene and naphtha for ready use.

.1 Store flammable and combustible liquids in approved safety cans bearing the Underwriters' Laboratory of Canada or Factory Mutual seal of approval.

.2 Storage of quantities of flammable and combustible liquids exceeding 45 litres for work purposes requires the written approval of the NRC Departmental Representative.

.5 Transfer of flammable and combustible liquids is prohibited within buildings.

.6 Transfer flammable and combustible liquids away from open flames or heat-producing devices.

.7 Solvents or cleaning agents must be non-flammable or have flash point above 38 degrees C.

.8 Store flammable and combustible waste liquids for disposal in approved containers located in safe, ventilated area. Keep quantities to minimum.

.9 Observe smoking regulations, smoking is prohibited in areas where hazardous materials are stored, used, or handled.

.10 Storage requirements for quantities of hazardous materials and wastes in excess of 5 kg for solids, and 5 litres for liquids:

.1 Store hazardous materials and wastes in closed and sealed containers.

.2 Label containers of hazardous materials and wastes in accordance with WHMIS.

.3 Store hazardous materials and wastes in containers compatible with that material or waste.

.4 Segregate incompatible materials and wastes.

.5 Ensure that different hazardous materials or hazardous wastes are stored in separate containers.

.6 Store hazardous materials and wastes in secure storage area with controlled access.

.7 Maintain clear egress from storage area.

.8 Store hazardous materials and wastes in location that will prevent them from spilling into environment.

.9 Have appropriate emergency spill response equipment available near storage area, including personal protective equipment.

.10 Maintain inventory of hazardous materials and wastes, including product name, quantity, and date when storage began.

.11 When hazardous waste is generated on site:

.1 Comply with applicable federal, provincial and municipal laws and regulations for generators of hazardous waste.

.2 Use licensed carrier authorized by provincial authorities to accept subject material.

.3 Before shipping material obtain written notice from intended hazardous waste treatment or disposal facility it will accept material and it is licensed to accept this material.

.4 Label containers with legible, visible safety marks as prescribed by federal and provincial regulations.

.5 Only trained personnel handle, offer for transport, or transport dangerous goods.

.6 Report discharge, emission, or escape of hazardous materials immediately to NRC Departmental Representative and appropriate provincial authority. Take reasonable measures to control release.

.12 Ensure personnel have been trained in accordance with Workplace Hazardous Materials Information System (WHMIS) requirements.

.13 Report spills or accidents immediately to NRC Departmental Representative. Submit a written spill report to NRC Departmental Representative

.5 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials.

Part 2 Products

2.1 MATERIALS

.1 Description:

.1 Bring on site only quantities hazardous material required to perform Work.

.2 Maintain MSDS in proximity to where materials are being used. Communicate this location to personnel who may have contact with hazardous materials.

.3 Sustainability Characteristics:

.1 Adhesives and Sealants in accordance with Section 07 92 00 - Joint Sealants.

.1 Adhesives and Sealants: maximum VOC limit to GS-36.

.2 Primers, Paints, Coatings in accordance with manufacturer's recommendations for surface conditions and Section 09 91 23 - Interior Painting, and 09 91 23.01 - Interior Re-Painting.

.1 Primer: maximum VOC limit 250 g/L to GS-11.

.2 Paints: maximum VOC limit 50 g/L to GS-11.

.3 Coatings: maximum VOC limit to SCAQMD Rule 1113.

Part 3 Execution

3.1 CLEANING

.1 Progress Cleaning:

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.

.3 Waste Management: separate waste materials for reuse and recycling.

.1 Dispose of hazardous waste materials in accordance with applicable federal and provincial acts, regulations, and guidelines.

.2 Recycle hazardous wastes for which there is approved, cost effective recycling process available.

.3 Send hazardous wastes to authorized hazardous waste disposal or treatment facilities.

.4 Burning, diluting, or mixing hazardous wastes for purpose of disposal is prohibited.

.5 Disposal of hazardous materials in waterways, storm or sanitary sewers, or in municipal solid waste landfills is prohibited.

.6 Dispose of hazardous wastes in timely fashion in accordance with applicable provincial regulations.

.7 Minimize generation of hazardous waste to maximum extent practicable. Take necessary precautions to avoid mixing clean and contaminated wastes.

.8 Identify and evaluate recycling and reclamation options as alternatives to land disposal, such as:

.1 Hazardous wastes recycled in manner constituting disposal.

.2 Hazardous waste burned for energy recovery.

.3 Lead-acid battery recycling.

.4 Hazardous wastes with economically recoverable precious metals.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 03 20 00, Concrete Reinforcing

.2 Section 03 30 00, Cast-In-Place Concrete

1.2 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CSA-A23.1-09/A23.2-09, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.

.2 CSA-O86S1-05, Supplement No. 1 to CAN/CSA-O86-01, Engineering Design in Wood.

.3 CSA O121-M1978(R2003), Douglas Fir Plywood.

.4 CSA O151-04, Canadian Softwood Plywood.

.5 CSA O153-M1980(R2003), Poplar Plywood.

.6 CAN/CSA-O325.0-92(R2003), Construction Sheathing.

.7 CSA O437 Series-93(R2006), Standards for OSB and Waferboard.

.8 CSA S269.1-1975(R2003), Falsework for Construction Purposes.

.9 CAN/CSA-S269.3-M92(R2003), Concrete Formwork, National Standard of Canada

.2 Underwriters' Laboratories of Canada (ULC)

.1 CAN/ULC-S701-05, Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submittals in accordance with Division 01.

.2 Submit shop drawings for formwork and falsework.

.1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.

.3 Submit WHMIS MSDS - Material Safety Data Sheets in accordance with Section 02 81 01 - Hazardous Materials.

.4 Indicate method and schedule of construction, shoring, stripping and re-shoring procedures, materials, arrangement of joints, special architectural exposed finishes, ties, liners, and locations of temporary embedded parts. Comply with CSA S269.1, for falsework drawings. Comply with CAN/CSA-S269.3 for formwork drawings.

.5 Indicate formwork design data: permissible rate of concrete placement, and temperature of concrete, in forms.

.6 Indicate sequence of erection and removal of formwork/falsework as directed by NRC Departmental Representative.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Store and manage hazardous materials in accordance with Division 01.

.2 Waste Management and Disposal:

.1 Place materials defined as hazardous or toxic in designated containers.

Part 2 Products

2.1 MATERIALS

.1 Materials and resources in accordance with Division 01.

.2 Do verification requirements in accordance with Division 01.

.3 Formwork materials:

.1 For concrete without special architectural features, use wood and wood product formwork materials to CSA-O121, CAN/CSA-O86, CSA O437 Series, CSA-O153.

.2 For concrete with special architectural features, use formwork materials to CSA-A23.1/A23.2.

.3 Rigid insulation board: to CAN/ULC-S701.

.4 Pan forms: as indicated.

.5 Form ties:

.1 For concrete not designated 'Architectural', use removable or snap-off metal ties, fixed or adjustable length, free of devices leaving holes larger than 25 mm diameter in concrete surface.

.2 For Architectural concrete, use snap ties complete with plastic cones and light grey concrete plugs.

.6 Form release agent: non-toxic.

.7 Falsework materials: to CSA-S269.1.

.8 Sealant: to Section 07 92 00 - Joint Sealants.

Part 3 Execution

3.1 FABRICATION AND ERECTION

.1 Verify lines, levels and centres before proceeding with formwork/falsework and ensure dimensions agree with drawings.

.2 Obtain NRC Departmental Representative's approval for use of earth forms framing openings not indicated on drawings.

.3 Hand trim sides and bottoms and remove loose earth from earth forms before placing concrete.

.4 Fabricate and erect falsework in accordance with CSA S269.1.

.5 Refer to architectural drawings for concrete members requiring architectural exposed finishes.

.6 Do not place shores and mud sills on frozen ground.

.7 Provide site drainage to prevent washout of soil supporting mud sills and shores.

.8 Fabricate and erect formwork in accordance with CAN/CSA-S269.3 to produce finished concrete conforming to shape, dimensions, locations and levels indicated within tolerances required by CSA-A23.1/A23.2.

.9 Align form joints and make watertight.

.1 Keep form joints to minimum.

.10 Locate horizontal form joints for exposed columns 2400 mm above finished floor elevation.

.11 Use 25 mm chamfer strips on external corners and/or 25 mm fillets at interior corners, joints, unless specified otherwise.

.12 Form chases, slots, openings, drips, recesses, expansion and control joints as indicated.

.13 Construct forms for architectural concrete, and place ties as indicated.

.1 Joint pattern not necessarily based on using standard size panels or maximum permissible spacing of ties.

.14 Build in anchors, sleeves, and other inserts required to accommodate Work specified in other sections.

.1 Ensure that anchors and inserts will not protrude beyond surfaces designated to receive applied finishes, including painting.

.15 Clean formwork in accordance with CSA-A23.1/A23.2, before placing concrete.

3.2 REMOVAL AND RESHORING

.1 Leave formwork in place for following minimum periods of time after placing concrete.

.1 4 days for walls and sides of beams.

.2 4 days for columns.

.3 21 days for beam soffits, slabs, decks and other structural members, or 7 days when replaced immediately with adequate shoring to standard specified for falsework.

.4 4 days for footings and abutments.

.2 Remove formwork when concrete has reached 75 % of its design strength or minimum period noted above, whichever comes later, and replace immediately with adequate reshoring.

.3 Provide necessary reshoring of members where early removal of forms may be required or where members may be subjected to additional loads during construction as required.

.4 Space reshoring in each principal direction at not more than 3000 mm apart.

.5 Re-use formwork and falsework subject to requirements of CSA-A23.1/A23.2.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 American Concrete Institute (ACI)

.1 SP-66-04, ACI Detailing Manual 2004.

.2 ASTM International

.1 ASTM A82/A82M-07, Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.

.2 ASTM A143/A143M-07, Standard Practice for Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement.

.3 ASTM A185/A185M-07, Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete.

.4 ASTM A775/A775M-07b, Standard Specification for Epoxy-Coated Reinforcing Steel Bars.

.3 CSA International

.1 CSA-A23.1-09/A23.2-09, Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete.

.2 CAN/CSA-A23.3-04(R2010), Design of Concrete Structures.

.3 CSA-G30.18-09, Carbon Steel Bars for Concrete Reinforcement.

.4 CSA-G40.20/G40.21-04(R2009), General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.

.5 CAN/CSA-G164-M92(R2003), Hot Dip Galvanizing of Irregularly Shaped Articles.

.6 CSA W186-M1990(R2007), Welding of Reinforcing Bars in Reinforced Concrete Construction.

.4 Reinforcing Steel Institute of Canada (RSIC)

.1 RSIC-2004, Reinforcing Steel Manual of Standard Practice.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Division 01.

.2 Prepare reinforcement drawings in accordance with RSIC Manual of Standard Practice, SP-66.

.3 Shop Drawings:

.1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.

.1 Indicate placing of reinforcement and:

.1 Bar bending details.

.2 Lists.

.3 Quantities of reinforcement.

.4 Sizes, spacings, locations of reinforcement and mechanical splices if approved by NRC Departmental Representative , with identifying code marks to permit correct placement without reference to structural drawings.

.5 Indicate sizes, spacings and locations of chairs, spacers and hangers.

.2 Detail lap lengths and bar development lengths to CAN/CSA-A23.3, unless otherwise indicated.

.1 Provide type B, unless otherwise indicated.

.4 When Chromate solution is used as replacement for galvanizing non-prestressed reinforcement, provide product description for review by NRC Departmental Representative prior to its use.

1.3 QUALITY ASSURANCE

.1 Submit in accordance with Division 01.

.1 Mill Test Report: upon request, provide NRC Departmental Representative with certified copy of mill test report of reinforcing steel, minimum 4 weeks prior to beginning reinforcing work.

.2 Upon request submit in writing to NRC Departmental Representative proposed source of reinforcement material to be supplied.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Division 01 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 Replace defective or damaged materials with new.

.4 Develop Construction Waste Management Plan or Waste Reduction Workplan related to Work of this Section and in accordance with Division 01.

Part 2 Products

2.1 MATERIALS

.1 Substitute different size bars only if permitted in writing by NRC Departmental Representative.

.2 Reinforcing steel: billet steel, grade 400, deformed bars to CSA-G30.18, unless indicated otherwise.

.3 Reinforcing steel: weldable low alloy steel deformed bars to CSA-G30.18.

.4 Cold-drawn annealed steel wire ties: to ASTM A82/A82M.

.5 Deformed steel wire for concrete reinforcement: to ASTM A82/A82M.

.6 Welded steel wire fabric: to ASTM A185/A185M.

.1 Provide in flat sheets only.

.7 Welded deformed steel wire fabric: to ASTM A82/A82M.

.1 Provide in flat sheets only.

.8 Chairs, bolsters, bar supports, spacers: to CSA-A23.1/A23.2.

.9 Mechanical splices: subject to approval of NRC Departmental Representative .

2.2 FABRICATION

.1 Fabricate reinforcing steel in accordance with CSA-A23.1/A23.2, SP-66 and Reinforcing Steel Manual of Standard Practice by the Reinforcing Steel Institute of Canada.

.1 SP-66 unless indicated otherwise.

.2 Obtain NRC Departmental Representative's written approval for locations of reinforcement splices other than those shown on placing drawings.

.3 Ship bundles of bar reinforcement, clearly identified in accordance with bar bending details and lists.

.1 Ship epoxy coated bars in accordance with ASTM A775A/A775M.

2.3 SOURCE QUALITY CONTROL

.1 Upon request, provide NRC Departmental Representative with certified copy of mill test report of reinforcing steel, showing physical and chemical analysis, minimum 4 weeks prior to beginning reinforcing work.

.2 Upon request inform NRC Departmental Representative of proposed source of material to be supplied.

Part 3 Execution

3.1 PLACING REINFORCEMENT

.1 Place reinforcing steel as indicated on placing drawings in accordance with CSA-A23.1/A23.2.

.2 Use plain round bars as slip dowels in concrete.

.1 Paint portion of dowel intended to move within hardened concrete with one coat of asphalt paint.

.2 When paint is dry, apply thick even film of mineral lubricating grease.

.3 Prior to placing concrete, obtain NRC Departmental Representative's approval of reinforcing material and placement.

.4 Ensure cover to reinforcement is maintained during concrete pour.

.5 Protect epoxy paint coated portions of bars with covering during transportation and handling.

3.2 CLEANING

.1 Progress Cleaning: clean in accordance with Section01 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 Division 01.

.3 Waste Management: separate waste materials for reuse, recycling in accordance with Division 01.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 03 10 00, Concrete Forming and Accessories

.2 Section 03 20 00, Concrete Reinforcing

.3 Section 05 31 00, Steel Decking

1.2 REFERENCES

.1 Abbreviations and Acronyms:

.1 Portland Cement: hydraulic cement, blended hydraulic cement (XXb - b denotes blended) and Portland-limestone cement.

.1 Type GU, GUb and GUL - General use cement.

.2 Fly ash:

.1 Type F - with CaO content less than 15%.

.2 Type CI - with CaO content ranging from 15 to 20%.

.3 Type CH - with CaO greater than 20%.

.3 GGBFS - Ground, granulated blast-furnace slag.

.2 Reference Standards:

.1 ASTM International

.1 ASTM C260/C260M-10a, Standard Specification for Air-Entraining Admixtures for Concrete.

.2 ASTM C309-07, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.

.3 ASTM C494/C494M-10a, Standard Specification for Chemical Admixtures for Concrete.

.4 ASTM C1017/C1017M-07, Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete.

.5 ASTM D412-06ae2, Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers-Tension.

.6 ASTM D624-00(2007), Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomer.

.7 ASTM D1751-04(2008), Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).

.8 ASTM D1752-04a(2008), Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction.

.2 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-37.2-M88, Emulsified Asphalt, Mineral Colloid-Type, Unfilled, for Dampproofing and Waterproofing and for Roof Coatings.

.2 CAN/CGSB-51.34-M86(R1988), Vapour Barrier, Polyethylene Sheet for Use in Building Construction.

.3 Canada Green Building Council (CaGBC)

.1 LEED Canada-NC Version 1.0-2004, LEED (Leadership in Energy and Environmental Design): Green Building Rating System Reference Package For New Construction and Major Renovations (including Addendum 2007).

.2 LEED Canada-CI Version 1.0-2007, LEED (Leadership in Energy and Environmental Design): Green Building Rating System Reference Guide For Commercial Interiors.

.4 CSA International

.1 CSA A23.1/A23.2-09, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.

.2 CSA A283-06, Qualification Code for Concrete Testing Laboratories.

.3 CSA A3000-08, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).

1.3 ADMINISTRATIVE REQUIREMENTS

.1 Pre-installation Meetings: in accordance with Division 01, convene pre-installation meeting one week prior to beginning concrete works.

.1 Ensure key personnel, site supervisor, NRC Departmental Representative speciality contractor - finishing, forming, concrete producer, testing laboratories attend.

.1 Verify project requirements.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Division 01.

.2 At least 4 weeks prior to beginning Work, provide NRC Departmental Representative with samples of materials proposed for use as follows:

.1 5 L of curing compound.

.2 1 m length of each type of joint filler.

.3 0.3 m length of each type of waterstops.

.3 Provide two copies of WHMIS MSDS in accordance with Division 01.

1.5 QUALITY ASSURANCE

.1 Quality Assurance: in accordance with Division 01.

.2 Provide NRC Departmental Representative, minimum 4 weeks prior to starting concrete work, with valid and recognized certificate from plant delivering concrete.

.1 Provide test data and certification by qualified independent inspection and testing laboratory that materials and mix designs used in concrete mixture will meet specified requirements.

.3 Minimum 4 weeks prior to starting concrete work, provide proposed quality control procedures for review by NRC Departmental Representative on following items:

.1 Falsework erection.

.2 Hot weather concrete.

.3 Cold weather concrete.

.4 Curing.

.5 Finishes.

.6 Formwork removal.

.7 Joints.

.4 Quality Control Plan: provide written report to NRC Departmental Representative verifying compliance that concrete in place meets performance requirements of concrete as established in PART 2 - PRODUCTS.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Delivery and Acceptance Requirements:

.1 Concrete hauling time: deliver to site of Work and discharged within 120 minutes maximum after batching.

.1 Do not modify maximum time limit without receipt of prior written agreement from NRC Departmental Representative, laboratory representative and concrete producer as described in CSA A23.1/A23.2.

.2 Deviations to be submitted for review by NRC Departmental Representative.

.2 Concrete delivery: ensure continuous concrete delivery from plant meets CSA A23.1/A23.2.

.2 Packaging Waste Management: remove for reuse of packaging materials in accordance with Division 01.

Part 2 Products

2.1 DESIGN CRITERIA

.1 Alternative 1 - Performance: to CSA A23.1/A23.2, and as described in MIXES of PART 2 - PRODUCTS.

2.2 PERFORMANCE CRITERIA

.1 Quality Control Plan: ensure concrete supplier meets performance criteria of concrete as established by NRC Departmental Representative and provide verification of compliance as described in PART 1 - QUALITY ASSURANCE.

2.3 MATERIALS

.1 Portland Cement: to CSA A3001, Type GU.

.1 Cementing Materials (SCMs) Mix, as percentage.

.2 Aggregates: to CSA A23.1/A23.2.

.3 Admixtures:

.1 Air entraining admixture: to ASTM C260.

.2 Chemical admixture: to ASTM C494 ASTM C1017. NRC Departmental Representative to approve accelerating or set retarding admixtures during cold and hot weather placing.

.3 Viscosity-modifying agent (VMA).

.4 Shrinkage compensating grout: premixed compound consisting of metallic non-metallic aggregate, Portland cement, water reducing and plasticizing agents to CSA A23.1/A23.2.

.1 Compressive strength: 45 MPa at 28 days.

.2 Net shrinkage at 28 days: maximum 0.03 %.

.5 Non premixed dry pack grout: composition of non-metallic aggregate Portland cement with sufficient water for mixture to retain its shape when made into ball by hand and capable of developing compressive strength of 25 MPa at 3 days.

.6 Mechanical waterstops: ribbed extruded PVC Arctic Grade of sizes indicated with prewelded corner and intersecting pieces with legs not less than 500 mm long:

.1 Tensile strength: to ASTM D412, method A, Die "C", minimum 15 MPa.

.2 Elongation: to ASTM D412, method A, Die "C", minimum 275%.

.3 Tear resistance: to ASTM D624, method A, Die "B", minimum 30 kN/m.

.4 For joints between new and recent cast install Dumbbell split flange Labyrinth-932 waterstop 230 mm wide by Sika.

.5 For joints between existing and new cast install speciality shape 667 waterstop of retrofit system by Sika.

.7 Premoulded joint fillers:

.1 Bituminous impregnated fiber board: to ASTM D1751.

.2 Sponge rubber: to ASTM D1752, Type I, flexible grade.

.8 Weep hole tubes: galvanized steel.

.9 Dovetail anchor slots: minimum 0.6 mm thick galvanized steel with insulation filled slots.

.10 Polyethylene film: 0.15 mm thickness to CAN/CGSB-51.34.

.11 XYPEX C-500 NF 1.25% by weight of cement.

2.4 MIXES

.1 Alternative 1 - Performance Method for specifying concrete: to meet NRC Departmental Representative performance criteria to CSA A23.1/A23.2.

.1 Ensure concrete supplier meets performance criteria as established below and provide verification of compliance as in Quality Control Plan.

.2 Provide concrete mix to meet following plastic state requirements:

.1 Uniformity: 30.

.2 Workability: free of surface blemishes loss of mortar colour variations segregation.

.3 Finishability: Minimize amount of bleeding.

.4 Set time: 2 hours maximum.

.3 Provide concrete mix to meet following hard state requirements:

.1 Durability and class of exposure: C-XL, C-1, C-2, F-1, F-2, N.

.2 Compressive strength at 28 age: 35 Mpa shear walls minimum. Refer to drawings

.3 Intended application: Foundations, foundation walls, slab on grade, slab, concrete on deck.

.4 Aggregate size 20 mm maximum.

.4 Provide quality management plan to ensure verification of concrete quality to specified performance.

.5 Concrete supplier's certification: both batch plant and materials meet CSA A23.1 requirements.

Part 3 Execution

3.1 PREPARATION

.1 Obtain NRC Departmental Representative's written approval before placing concrete.

.1 Provide 24 hours minimum notice prior to placing of concrete.

.2 Place concrete reinforcing in accordance with Section 03 20 00 - Concrete Reinforcing.

.3 During concreting operations:

.1 Development of cold joints not allowed.

.2 Ensure concrete delivery and handling facilitates placing with minimum of re-handling, and without damage to existing structure or Work.

.4 Pumping of concrete is permitted only after approval of equipment and mix.

.5 Ensure reinforcement and inserts are not disturbed during concrete placement.

.6 Prior to placing of concrete obtain NRC Departmental Representative's approval of proposed method for protection of concrete during placing and curing.

.7 Protect previous Work from staining.

.8 Clean and remove stains prior to application for concrete finishes.

.9 Maintain accurate records of poured concrete items to indicate date, location of pour, quality, air temperature and test samples taken.

.10 In locations where new concrete is dowelled to existing work, drill holes in existing concrete.

.1 Place steel dowels of deformed steel reinforcing bars and pack solidly with epoxy grout to anchor and hold dowels in positions as indicated.

.11 Do not place load upon new concrete until authorized by NRC Departmental Representative.

3.2 INSTALLATION/APPLICATION

.1 Do cast-in-place concrete work to CSA A23.1/A23.2.

.2 Sleeves and inserts:

.1 Do not permit penetrations, sleeves, ducts, pipes or other openings to pass through joists, beams, column capitals or columns, except where indicated or approved by NRC Departmental Representative.

.2 Where approved by NRC Departmental Representative, set sleeves, ties, pipe hangers and other inserts and openings as indicated or specified elsewhere.

.3 Sleeves and openings greater than 100 x 100 mm not indicated, must be reviewed by NRC Departmental Representative.

.4 Do not eliminate or displace reinforcement to accommodate hardware. If inserts cannot be located as specified, obtain written approval of modifications from NRC Departmental Representative before placing of concrete.

.5 Confirm locations and sizes of sleeves and openings shown on drawings.

.6 Set special inserts for strength testing as indicated and as required by non-destructive method of testing concrete.

.3 Anchor bolts:

.1 Set anchor bolts to templates in co-ordination with appropriate trade prior to placing concrete.

.2 Grout anchor bolts in preformed holes or holes drilled after concrete has set only after receipt of written approval from NRC Departmental Representative.

.1 Formed holes: 100 mm minimum diameter.

.2 Drilled holes: to manufacturers' recommendations.

.3 Protect anchor bolt holes from water accumulations, snow and ice build-ups.

.4 Set bolts and fill holes with shrinkage compensating grout.

.5 Locate anchor bolts used in connection with expansion shoes, rollers and rockers with due regard to ambient temperature at time of erection.

.4 Drainage holes and weep holes:

.1 Form weep holes and drainage holes in accordance with Section 03 10 00 - Concrete Forming and Accessories. If wood forms are used, remove them after concrete has set.

.2 Install weep hole tubes and drains as indicated.

.5 Dovetail anchor slots: in accordance with Section 04 05 00 - Common Work Results for Masonry.

.1 Install continuous vertical anchor slot to forms where masonry abuts concrete wall or columns.

.2 Install continuous vertical anchor slots at 800 mm on centre where concrete walls are masonry faced.

.6 Grout under base plates using procedures in accordance with manufacturer's recommendations which result in 100 % contact over grouted area.

.7 Finishing and curing:

.1 Finish concrete to CSA A23.1/A23.2.

.2 Use procedures as reviewed by NRC Departmental Representative or those noted in CSA A23.1/A23.2 to remove excess bleed water. Ensure surface is not damaged.

.3 Use curing compounds compatible with applied finish on concrete surfaces. Provide written declaration that compounds used are compatible.

.4 Finish concrete floor to CSA A23.1/A23.2. Class B.

.5 Concrete floor to have finish hardness equal to or greater than 6.5 Mohs hardness to CSA A23.1/A23.2.

.6 Provide screed swirl-trowelled scratch finish where bonded topping terrazzo floor tile is to be applied. Provide depression s bonded topping terrazzo floor file.

.7 Provide screed float swirl-trowelled finish unless otherwise indicated.

.8 Rub exposed sharp edges of concrete with carborundum to produce 3 mm minimum radius edges unless otherwise indicated.

.8 Toppings:

.1 Topping mixture to meet minimum requirements as follows: Bonded overlay mm thick: as indicated on drawings

.2 Apply cement/sand grout latex bonding agent modified cement/sand grout epoxy bonding agent to base course to CSA A23.1/A23.2.

.3 Place monolithic bonded topping to CSA A23.1/A23.2 and topping manufacturer's recommendations.

.4 Ensure that joints in topping are of same material as those in base course. Also ensure that their locations precisely match those in base course. Provide dividers edge strips reinforcing mesh as indicated.

.9 Waterstops:

.1 Install waterstops to provide continuous water seal.

.2 Do not distort or pierce waterstop in way as to hamper performance.

.3 Do not displace reinforcement when installing waterstops.

.4 Use equipment to manufacturer's requirements to field splice waterstops.

.5 Tie waterstops rigidly in place.

.6 Use only straight heat sealed butt joints in field.

.7 Use factory welded corners and intersections unless otherwise approved by NRC Departmental Representative.

.10 Joint fillers:

.1 Furnish filler for each joint in single piece for depth and width required for joint, unless otherwise authorized by NRC Departmental Representative.

.2 When more than one piece is required for joint, fasten abutting ends and hold securely to shape by stapling or other positive fastening.

.3 Locate and form construction joints as indicated.

.4 Install joint filler.

.5 Use 12 mm thick joint filler to separate slabs-on-grade from vertical surfaces and extend joint filler from bottom of slab to within 12 mm of finished slab surface unless indicated otherwise.

.11 Dampproof membrane:

.1 Install dampproof membrane under concrete slabs-on-grade inside building.

.2 Lap dampproof membrane minimum 150 mm at joints and seal.

.3 Seal punctures in dampproof membrane before placing concrete.

.4 Use patching material at least 150 mm larger than puncture and seal.

3.3 SURFACE TOLERANCE

.1 Concrete tolerance to CSA A23.1 Straightedge Method FF = 25: FL = 20 Waviness Index Method to tolerance schedule.

3.4 FIELD QUALITY CONTROL

.1 Site tests: conduct tests as follows in accordance with Division 01.

.1 Concrete pours.

.2 Slump.

.3 Air content.

.4 Compressive strength at 7 and 28 days.

.5 Air and concrete temperature.

.2 Inspection and testing of concrete and concrete materials will be carried out by testing laboratory designated by NRC Departmental Representative for review to CSA A23.1/A23.2.

.1 Ensure testing laboratory is certified to CSA A283.

.3 Ensure test results are distributed for discussion at pre-pouring concrete meeting between testing laboratory and NRC Departmental Representative.

.4 NRC Departmental Representative will pay for costs of tests as specified in Division 01.

.5 NRC Departmental Representative will take additional test cylinders during cold weather concreting. Cure cylinders on job site under same conditions as concrete which they represent.

.6 Non-Destructive Methods for Testing Concrete: to CSA A23.1/A23.2.

.7 Inspection or testing by Consultant will not augment or replace Contractor quality control nor relieve Contractor of his contractual responsibility.

3.5 CLEANING

.1 Clean in accordance with Division 01.

END OF SECTION

Part 1 General

1.1 REFERENCES

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

.1 ASTM C109 / C109M - 11b Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or [50-mm] Cube Specimens).

.2 ASTM C348 - 08 Standard Test Method for Flexural Strength of Hydraulic-Cement Mortars.

.3 ASTM E84-11a, Standard Test Method for Surface Burning Characteristics of Building Materials.

1.2 ACTION SUBMITTALS

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

.2 Product Data:

.1 Provide manufacturer's printed product literature, and mixing and application instructions.

1.3 INFORMATION SUBMITTALS

.1 Certificates: provide manufacturer's product certificates certifying materials comply with specified requirements.

1.4 QUALITY ASSURANCE

.1 Applicators: Authorized by the manufacturer using approved mixing and pumping equipment approved.

.2 Pre-installation meeting: Prior to commencing work of this Section, arrange for manufacturer's technical representative to visit the site and review preparatory and installation procedures to be followed, conditions under which the work will be done, and inspect the surfaces to receive the work of this Section. Advise the Departmental Representative of the date and time of the meeting.

.3 Manufacturer’s site inspection: Have the manufacturer’s technical representative inspect the Work at suitable intervals during application and at conclusion of the work of this Section, to ensure the Work is correctly installed. When requested, submit manufacturer’s inspection reports and verification that the work of this Section is correctly installed.

1.5 DELIVERY, STORAGE, AND HANDLING

.1 Deliver materials in their original, unopened packages, and protected from exposure to the elements. Remove damaged or deteriorated materials shall be removed from the premises.

1.6 SITE CONDITIONS

.1 Before, during and after installation of work, ensure building interior is enclosed and maintained at a temperature above 10 degrees C.

Part 2 Products

2.1 MATERIALS

.1 Floor underlayment: Cementitious underlayment, minimum compressive strength after 28 days 38 MPa, meeting the following:

- .1 Dry Density: Approximately 2003 kg/m³
- .2 Compressive Strength (ASTM C109): Typical:
  - .1 20.6 MPa at 3 days
  - .2 31 MPa at 7 days
  - .3 38 MPa at 28 days
- .3 Flexural Strength (ASTM C348): 8.7 MPa at 28 days.
- .4 Surface Burning Characteristics (ASTM E84): Typical:
  - .1 Flame spread - 0
  - .2 Fuel Contribution - 0
  - .3 Smoke Development - 0

.2 Aggregate: Washed masonry, plaster or silica sand meeting requirements of the manufacturer for intended end use.

.3 Mix water: Potable, free from impurities.

.4 Sealer: manufacturer's recommended sealer.

.5 Primer: Ethylene - vinyl acetate copolymer.

.6 Crack filler: Quick setting patching compound, compatible with floor underlayment.

2.2 MIX

.1 Mix proportions and methods shall be in strict accordance with product manufacturer recommendations.

Part 3 Execution

3.1 PREPARATION

.1 Subfloor shall be structurally sound. Shot blast or scarify steel trowel concrete, concrete with sealer or curing compound, slick or smooth concrete. Clean subfloor to remove mud, oil, grease, and other contaminating factors before application of work.

.2 Fill cracks and voids with crack filler where leakage of underlayment could occur.

.3 Prime subfloor in accordance with manufacturer's recommendations.

.4 Expansion Joints: Allow joints to continue through the underlayment at the same width.

3.2 APPLICATION

.1 Do not commence work until the building is enclosed, including roof, windows, doors, and other fenestration.

.2 Spread and screed underlayment to a smooth surface. Except at authorized joints, place underlayment as continuously as possible until application is complete, so that no underlayment slurry is placed against underlayment product that has obtained its initial set.

.3 Provide continuous ventilation and adequate heat to rapidly remove moisture from the area until the underlayment has set and cured.

.4 Apply sealer to underlayment that is to receive glue down floor coverings.

.5 Clean floor areas where the underlayment has been damaged and seal regardless of floor covering to be used. Where floor covering manufacturers require special adhesive or installation systems, their requirements supersede these requirements.

3.3 FIELD QUALITY CONTROL

.1 Slump Test: Test underlayment as it is being pumped using a 50 mm x 100 mm cylinder resulting in a patty size of 225 mm plus or minus 25 mm diameter.

.2 At least one set of 3 molded cube samples shall be taken from each day's application. Cubes shall be tested as recommended by the manufacturer in accordance with modified ASTM C 109. Make test results available to the Departmental Representative.

3.4 PROTECTION

.1 Temporary Bracing During construction, place temporary wood planking over underlayment wherever it will be subject to heavy wheeled or concentrated loads.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 ASTM International

.1 ASTM A 496/A 496M-07, Standard Specification for Steel Wire, Deformed, for Concrete Reinforcement.

.2 CSA International

.1 CAN/CSA-A165 SERIES-04(R2009), CSA Standards on Concrete Masonry Units covers: A165.1, A165.2, A165.3.

.2 CAN/CSA-A179-04(R2009), Mortar and Grout for Unit Masonry.

.3 CAN/CSA-A370-04(R2009), Connectors for Masonry.

.4 CAN/CSA A371-04(R2009), Masonry Construction for Buildings.

.5 CSA G30.18-09, Carbon Steel Bars for Concrete Reinforcement.

.6 CSA S304.1-04(R2009), Design of Masonry Structures.

.3 Green Seal Environmental Standards (GS)

.1 GS-11-2008, 2nd Edition, Paints and Coatings.

.4 Health Canada / Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

1.2 ACTION AND INFORMATION SUBMITTALS

.1 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for masonry products and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Submit 2 copies of WHMIS MSDS.

.1 Indicate VOC's in g/L for epoxy coatings and galvanized protective coatings and touch-up products to be applied within building envelope.

.2 Shop Drawings:

.1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.

.2 Shop drawings consist of bar bending details, lists and placing drawings.

.3 Placing drawings, indicate sizes, spacing, location and quantities of reinforcement and connectors.

.3 Samples:

.1 Submit for review and acceptance of each unit.

.2 Samples will be returned for inclusion into work.

.3 Submit duplicate full size samples of each type masonry units.

1.3 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance 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 masonry products from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

.4 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials.

Part 2 Products

2.1 MASONRY UNITS

.1 Standard concrete block units: to CAN/CSA-A165 Series (CAN/CSA-A165.1).

.1 Size: modular.

.2 Special shapes: provide square bull-nosed units for exposed corners. Provide purpose-made shapes for lintels and bond beams. Provide additional special shapes as indicated.

.2 Special fire resistant concrete block units: to CAN/CSA-A165 Series (CAN/CSA-A165.1) as modified below.

.1 Classification: H/15/B/M except as modified by fire resistance requirements specified below.

.2 Fire resistant characteristics: aggregate used in units and equivalent thickness of units to National Building Code of Canada 2005, for fire-resistance ratings indicated.

.3 Size: modular.

.4 Special shapes: provide square bull- nosed units for exposed corners. Provide purpose-made shapes for lintels and bond beams and provide additional shapes as indicated.

2.2 REINFORCEMENT AND CONNECTORS

.1 Bar reinforcement: to CAN/CSA-A371 and CSA G30.18, Grade 400.

.2 Wire reinforcement: to CAN/CSA-A371 and ASTM A 496/A 496M, truss type.

.3 Connectors shall be corrosion resistant: to CAN/CSA-A370 and CSA S304.1.

2.3 MORTAR AND GROUT

.1 Mortar: to CAN/CSA-A179.

.1 Use aggregate passing 1.18 mm sieve where 6 mm thick joints are indicated.

.2 Colour: ground coloured natural aggregates or metallic oxide pigments.

.2 Mortar Type: S based on property specifications,

.3 Mortar for foundation walls, manholes, sewers, pavements, walks, patios and other exterior masonry at or below grade: type M based on property specifications.

.4 Following applies regardless of mortar types and uses specified above:

.1 Mortar for stonework: type N based on property specifications.

.2 Mortar for grouted reinforced masonry: type S based on property specifications.

.5 Grout: to CAN/CSA-A179, Table 3.

2.4 ACCESSORIES

.1 Nailing Inserts: 0.5 mm minimum thickness, galvanized.

.2 Bolts: 12 mm diameter x 150 mm long with ends bent 50 mm at 90 degrees.

.3 Flashings: copper sheet, 600 g/mý, asphalt laminated to two layers of creped kraft paper, reinforced with 12.7 x 12.7 mm fibreglass scrim.

.4 Primers Paints Coatings: VOC limit to SCAQMD Rule 1113.

.5 Coatings: VOC limit to SCAQMD Rule 1113.

Part 3 Execution

3.1 EXAMINATION

.1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for product installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate in presence of NRC Departmental Representative.

.2 Inform NRC 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 NRC Departmental Representative.

3.2 INSTALLATION

.1 Do masonry work in accordance with CAN/CSA-A371 except where specified otherwise.

.1 Bond: running stretcher bond with vertical joints in perpendicular alignment and centred on adjacent stretchers above and below.

.2 Coursing height: 200 mm for one block and one joint for three bricks and three joints.

.3 Jointing: tool where exposed or where paint or other finish coating is specified to provide smooth compressed concave surface.

.2 Build masonry plumb, level, and true to line, with vertical joints in alignment.

.3 Layout coursing and bond to achieve correct coursing heights, and continuity of bond above and below openings, with minimum of cutting.

3.3 CONSTRUCTION

.1 Exposed masonry:

.1 Remove chipped, cracked, and otherwise damaged units, in exposed masonry and replace with undamaged units.

.2 Cut out for electrical switches, outlet boxes, and other recessed or built-in objects. Make cuts straight, clean, and free from uneven edges.

.2 Building-in:

.1 Install masonry connectors and reinforcement where indicated on drawings.

.2 Build in items required to be built into masonry.

.3 Prevent displacement of built-in items during construction. Check plumb, location and alignment frequently, as work progresses.

.4 Brace door jambs to maintain plumb. Fill spaces between jambs and masonry with mortar.

.5 Install loose steel lintels over openings where indicated.

.3 Concrete block lintels:

.1 Install reinforced concrete block lintels over openings in masonry where steel or reinforced concrete lintels are not indicated.

.2 End bearing: not less than 200 mm and as indicated on drawings.

.4 Support of loads:

.1 Use 21 MPa concrete where concrete fill is used in lieu of solid units.

.2 Use grout to CAN/CSA-A179 where grout is used in lieu of solid units.

.3 Install building paper below voids to be filled with concrete, grout; keep paper 25 mm back from faces of units.

.5 Provision for movement:

.1 Leave 3 mm space below shelf angles.

.2 Leave 6 mm space between top of non-load bearing walls and partitions and structural elements. Do not use wedges.

.3 Built masonry to tie in with stabilizers, with provision for vertical movement.

.6 Interface with other work:

.1 Cut openings in existing work as indicated.

.2 Make good existing work. Use materials to match existing.

.7 Build in flashings in masonry in accordance with CAN/CSA-A371.

.1 Install flashings under exterior masonry bearing on foundation walls, slabs, shelf angles, and steel angles over openings. Install flashings under weep hole courses and as indicated.

.2 In cavity walls and veneered walls, carry flashings from front edge of masonry, under outer wythe, then up backing not less than 150 mm, and as follows:

.1 For masonry backing embed flashing 25 mm in joint.

.2 For concrete backing, insert flashing into reglets.

.3 For wood frame backing, staple flashing to walls behind sheathing paper.

.4 For gypsum board backing, bond to wall using manufacturer's recommended adhesive.

.3 Lap joints 150 mm and seal with adhesive.

.8 Install weep hole vents in vertical joints immediately over flashings, in exterior wythes of cavity wall and masonry veneer wall construction, at maximum horizontal spacing of 600 mm on centre.

3.4 REINFORCING AND CONNECTING

.1 Install masonry connectors and reinforcement in accordance with CAN/CSA-A370, CAN/CSA-A371 and CSA S304.1 unless indicated otherwise.

3.5 BONDING AND TYING

.1 Bond walls of two or more wythes using metal connectors in accordance with CAN/CSA-A371, CSA S304.1 and as indicated.

.2 Tie masonry veneer to backing in accordance with NBC, CAN/CSA-A371, CSA S304.1 and as indicated.

3.6 REINFORCED LINTELS AND BOND BEAMS

.1 Reinforce masonry lintels and bond beams as indicated.

3.7 GROUTING

.1 Grout masonry in accordance with CAN/CSA-A179, CAN/CSA-A371 and CSA S304.1 and as indicated.

3.8 ANCHORS

.1 Supply and install metal anchors as indicated.

3.9 LATERAL SUPPORT AND ANCHORAGE

.1 Supply and install lateral support and anchorage in accordance with CSA S304.1 and as indicated.

3.10 SITE TOLERANCES

.1 Tolerances of CAN/CSA-A371 apply.

3.11 FIELD QUALITY CONTROL

.1 Inspection and testing will be carried out by Testing Laboratory designated by NRC Departmental Representative and paid by Contractor.

3.12 CLEANING

.1 Progress Cleaning:

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.

3.13 PROTECTION

.1 Protect masonry and other work from marking and other damage. Protect completed work from mortar droppings. Use non-staining coverings.

.2 Repair damage to adjacent materials caused by masonry products installation.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 05 31 00, Steel Decking.

1.2 REFERENCES

.1 ASTM International Inc.

.1 ASTM A36/A36M-08, Standard Specification for Carbon Structural Steel.

.2 ASTM A193/A193M-08, Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature or High-Pressure Service and Other Special Purpose Applications.

.3 ASTM A307-07b, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.

.4 ASTM A325-07a, Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.

.5 ASTM A325M-08, Standard Specification for Structural Bolts, Steel, Heat Treated 830 MPa Minimum Tensile Strength Metric.

.6 ASTM A490M-04ae, Standard Specification for High-Strength Steel Structural Bolts, Classes 10.9 and 10.9.3, for Structural Steel Joints Metric.

.2 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-85.10-99, Protective Coatings for Metals.

.3 Canadian Institute of Steel Construction (CISC)/Canadian Paint Manufacturers Association (CPMA).

.1 Handbook of the Canadian Institute of Steel Construction.

.2 CISC/CPMA Standard 2-75, Quick-Drying Primer for use on Structural Steel.

.4 Canadian Standards Association (CSA International)

.1 CSA G40.20/G40.21-04, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.

.2 CAN/CSA-G164-M92(R2003), Hot Dip Galvanizing of Irregularly Shaped Articles.

.3 CAN/CSA-S16-01(R2007), Limit States Design of Steel Structures.

.4 CAN/CSA-S136-07, North American Specifications for the Design of Cold Formed Steel Structural Members.

.5 CSA W47.1-03, Certification of Companies for Fusion Welding of Steel.

.6 CSA W48-06, Filler Metals and Allied Materials for Metal Arc Welding.

.7 CSA W55.3-1965(R2003), Resistance Welding Qualification Code for Fabricators of Structural Members Used in Buildings.

.8 CSA W59-03, Welded Steel Construction (Metal Arc Welding).

.5 Master Painters Institute

.1 MPI-INT 5.1-08, Structural Steel and Metal Fabrications.

.2 MPI-EXT 5.1-08, Structural Steel and Metal Fabrications.

.6 The Society for Protective Coatings (SSPC) and National Association of Corrosion Engineers (NACE) International

.1 NACE No. 3/SSPC SP-6-06, Commercial Blast Cleaning.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Division 01.

.2 Shop Drawings:

.1 Provide drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.

.3 Erection drawings:

.1 Submit erection drawings indicating details and information necessary for assembly and erection purposes including:

.1 Description of methods.

.2 Sequence of erection.

.3 Type of equipment used in erection.

.4 Temporary bracings.

.4 Fabrication drawings:

.1 Submit fabrication drawings showing designed assemblies, components and connections are stamped and signed by qualified professional engineer licensed in the Province of Ontario, Canada.

.5 Samples:

.1 Prepare sample of typical exposed structural connections in accordance with AISC Specifications of Architecturally exposed structural steel for approval of NRC Departmental Representative. Samples to be judged upon alignment of surfaces, uniform contact between surfaces, smoothness and uniformity of finished welds. When approved, sample units will serve as a standard for workmanship, appearance and material acceptable for entire project.

.6 Source Quality Control Submittals:

.1 Submit 3 copies of mill test reports 4 weeks prior to fabrication of structural steel.

.1 Mill test reports to show chemical and physical properties and other details of steel to be incorporated in project.

.2 Provide mill test reports certified by metallurgists qualified to practice in Province of Ontario, Canada.

.7 Fabricator Reports:

.1 Provide structural steel fabricator's affidavit stating that materials and products used in fabrication conform to applicable material and products standards specified and indicated.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Division 01.

.2 Deliver materials in manufacturer's original, undamaged containers with identification labels intact.

.3 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, packaging materials in accordance Division 01.

Part 2 Products

2.1 DESIGN REQUIREMENTS

.1 Design details and connections in accordance with requirements of CAN/CSA-S16 and CAN/CSA-S136, with CSA-S136.1 to resist forces, moments, shears and allow for movements indicated.

.2 Shear connections:

.1 Select framed beam shear connections from an industry accepted publication such as "Handbook of the Canadian Institute of Steel Construction" when connection for shear only (standard connection) is required.

.2 Select or design connections to support reaction from maximum uniformly distributed load that can be safely supported by beam in bending, provided no point loads act on beam, when shears are not indicated.

.3 For composite construction select or design minimum end connection to resist reaction resulting from factored movement resistance as tabulated in the "Handbook of the Canadian Institute of Steel Construction" assuming 100% shear connection with depth of steel deck and/or slab shown on drawings.

.4 Submit sketches and design calculations stamped and signed by qualified professional engineer licensed in Province of Ontario, Canada for non-standard connections.

2.2 MATERIALS

.1 Structural steel: toCSA-G40.20/G40.21, Grade as indicated, 300W and/or CAN/CSA-S136.

.2 Anchor bolts: to CSA-G40.20/G40.21, Grade 300W, ASTM A36/A36M.

.3 High strength anchor bolts: to ASTM A193/A193M, Grade 50.

.4 Bolts, nuts and washers: to ASTM A307, ASTM A325, ASTM A325M, ASTM A490/A490M.

.5 Welding materials: to CSA W48 Series, CSA W59 and certified by Canadian Welding Bureau.

.6 Shop paint primer: to CISC/CPMA2-75 solvent reducible alkyd, red oxide grey.

.7 Hot dip galvanizing: galvanize steel, where indicated, to CAN/CSA-G164, minimum zinc coating of 600 g/m^2.

.8 Shear studs: to CSA W59, Appendix H.

2.3 FABRICATION

.1 Fabricate structural steel in accordance with CAN/CSA-S16, CAN/CSA-S136 and in accordance with reviewed shop drawings.

.2 Install shear studs in accordance with CSA W59.

.3 Continuously seal members by continuous welds.

2.4 SHOP PAINTING

.1 Clean, prepare surfaces and shop prime structural steel in accordance with CAN/CSA-S16, CAN/CSA-S136, except where members to be encased in concrete.

.2 Clean members, remove loose mill scale, rust, oil, dirt and foreign matter. Prepare surface according to NACE No.3/SSPC-SP-6.

.3 Apply one coat of primer in shop to steel surfaces to achieve minimum dry film thickness of 2.95 to 3.20 mils, except:

.1 Surfaces to be encased in concrete.

.2 Surfaces to receive field installed stud shear connections.

.3 Surfaces and edges to be field welded.

.4 Faying surfaces of slip-critical connections.

.5 Below grade surfaces in contact with soil.

.4 Apply paint under cover, on dry surfaces when surface and air temperatures are above 5 degrees C.

.5 Maintain dry condition and 5 degrees C minimum temperature until paint is thoroughly dry.

.6 Strip paint from bolts, nuts, sharp edges and corners before prime coat is dry.

Part 3 Execution

3.1 APPLICATION

.1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 GENERAL

.1 Structural steel work: in accordance with CAN/CSA-S16 CAN/CSA-S136.

.2 Welding: in accordance with CSA W59.

.3 Companies to be certified under Division 1 or 2.1 of CSA W47.1 for fusion welding of steel structures and/or CSA W55.3 for resistance welding of structural components.

3.3 CONNECTION TO EXISTING WORK

.1 Verify dimensions and condition of existing work, report discrepancies and potential problem areas to NRC Departmental Representative for direction before commencing fabrication.

3.4 MARKING

.1 Mark materials in accordance with CSA G40.20/G40.21. Do not use die stamping. When steel is to be left in unpainted condition, place marking at locations not visible from exterior after erection.

.2 Match marking: shop mark bearing assemblies and splices for fit and match.

3.5 ERECTION

.1 Erect structural steel, as indicated and in accordance with CAN/CSA-S16, CAN/CSA-S136 and in accordance with reviewed erection drawings.

.2 Field cutting or altering structural members: to approval of NRC Departmental Representative.

.3 Clean with mechanical brush and touch up shop primer to bolts, rivets, welds and burned or scratched surfaces at completion of erection.

.4 Continuously seal members by continuous welds where indicated. Grind smooth.

3.6 FIELD QUALITY CONTROL

.1 Inspection and testing of materials and workmanship will be carried out by testing laboratory designated by NRC Departmental Representative.

.2 Provide safe access and working areas for testing on site, as required by testing agency and as authorized by NRC Departmental Representative.

.3 Submit test reports to NRC Departmental Representative within 2 weeks of completion of inspection.

.4 NRC Departmental Representative Owner will pay costs of tests as specified in Division 01.

.5 Test shear studs in accordance with CSA W59.

3.7 FIELD PAINTING

.1 Paint in accordance with Section 09 91 23 - Interior Painting.

.1 Touch up damaged surfaces and surfaces without shop coat with primer to NACE No.3/SSPC-SP-6 except as specified otherwise. Apply in accordance: MPI Architectural Painting Specification Manual.

3.8 CLEANING

.1 Clean in accordance with Division 01.

.2 Waste Management: separate waste materials for reuse recycling in accordance with Division 01.

3.9 EXISTING STEEL

.1 Facilitate inspection of roof steel structure for corrosion and loss of section once ceiling is removed and scaffold is in place.

.2 Blast clean steel as directed by Consultant.

.3 Reinforce where required.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 05 12 23, Structural Steel For Buildings.

1.2 REFERENCES

.1 ASTM International

.1 ASTM A653/A653M-09a, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

.2 ASTM A792/A792M-09a, Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.

.2 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-1.181-99, Ready-Mixed Organic Zinc-Rich Coating.

.3 CSA International

.1 CSA C22.2 No.79-1978(R2008), Cellular Metal and Cellular Concrete Floor Raceways and Fittings.

.2 CSA S16-09, Design of Steel Structures.

.3 CSA S136-07, North American Specification for the Design of Cold Formed Steel Structural Members.

.4 CSA W47.1-09, Certification of Companies for Fusion Welding of Steel Structures.

.5 CSA W55.3-08, Certification of Companies for Resistance Welding of Steel and Aluminum.

.6 CSA W59-03(R2008), Welded Steel Construction, (Metal Arc Welding).

.4 Canadian Sheet Steel Building Institute (CSSBI)

.1 CSSBI 10M-08, Standard for Steel Roof Deck.

.2 CSSBI 12M-08, Standard for Composite Steel Deck.

.5 Green Seal Environmental Standards (GS)

.1 GS-11-2008, 2nd Edition, Paints and Coatings.

.6 South Coast Air Quality Management District (SCAQMD), California State, Regulation XI. Source Specific Standards

.1 SCAQMD Rule 1113-A2007, Architectural Coatings.

.2 SCAQMD Rule 1168-A2005, Adhesives and Sealants Applications.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Division 01.

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for steel decking 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 Province of Ontario, Canada.

.2 Submit design calculations if requested by NRC Departmental Representative.

.3 Indicate deck plan, profile, dimensions, base steel thickness, metallic coating designation, connections to supports and spacings, projections, openings, reinforcement details and accessories.

.4 Indicate details of temporary shoring of steel deck, such as location, time and duration of placement and removal of shoring for concrete fill decks.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Division 01 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 decking from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

.4 Develop Construction Waste Management Plan, Waste Reduction Workplan related to Work of this Section and in accordance with Division 01.

Part 2 Products

2.1 DESIGN CRITERIA

.1 Design steel deck to CSA S136, CSSBI 10M, CSSBI 12M.

.2 Steel deck and connections to steel framing to carry dead, live and other loads including lateral loads, diaphragm action, composite deck action, and uplift as indicated.

.3 Deflection under specified live load not to exceed 1/360 of span.

.4 Where vibration effects are to be controlled as indicated, dynamic characteristics of decking system to be designed to be in accordance with CSA S16.

2.2 MATERIALS

.1 Zinc-iron Alloy (ZF) coated steel sheet: to ASTM A653/A653M structural quality Grade 230, with ZF75 coating, for interior surfaces not exposed to weather, unpainted finish, 0.76 mm minimum base steel thickness.

.2 Decks to be painted: zinc-iron alloy coated decks suitable for finish painting.

.3 Zinc (Z) coated steel sheet: to ASTM A653/A653M structural quality Grade 230, with ZF75, coating, regular spangle, extra smooth, surface, chemically treated for unpainted finish, not chemically treated for paint finish, for exterior surfaces exposed to weather, 0.76 mm minimum base steel thickness.

.4 Aluminum-zinc alloy (AZ) coated steel sheet: to ASTM A792/A 792M structural quality grade 230, with AZ 150, coating, surface, not chemically treated for paint finish, for exterior surfaces exposed to weather, 0.76 mm minimum base steel thickness.

.5 Acoustic insulation: fibrous glass 17.5 kg/m^3 density minimum profiled to suit deck flutes.

.6 Closures: as indicated in accordance with manufacturer's recommendations.

.7 Cover plates, cell closures and flashings: steel sheet with minimum base steel thickness of 0.76 mm minimum. Metallic coating same as deck material.

.8 Shear studs: to CSA W59.

2.3 TYPES OF DECKING

.1 Steel roof deck: 0.76 mm minimum base steel thickness, 1.21 mm maximum deep profile, non-cellular, cellular, interlocking side laps.

.2 Acoustic steel roof deck: 0.76 mm minimum base steel thickness, 1.21 mm maximum deep profile, non-cellular, perforated on vertical face of flutes, interlocking side laps.

.3 Composite steel roof deck: 0.76 mm minimum base steel thickness, 1.21 mm deep profile, non-cellular, cellular, upright, inverted, embossed fluted profile, interlocking side laps.

.4 Cellular roof deck for electrical raceway: to CSA C22.2 No. 79.

Part 3 Execution

3.1 EXAMINATION

.1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for steel decking installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate in presence of NRC Departmental Representative.

.2 Inform NRC 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 NRC Departmental Representative.

3.2 INSTALLATION

.1 Structural steel work: in accordance with CSA S136.

.2 Welding: in accordance with CSA W59, except where specified otherwise.

.3 Companies to be certified under Division 1 or 2.1 of CSA W47.1 for fusion welding of steel and/or CSA W55.3 for resistance welding.

3.3 ERECTION

.1 Erect steel deck as indicated and in accordance with CSA S136 and in accordance with reviewed erection drawings.

.2 Butt ends: to 1.5 to 3 mm gap. Install steel cover plates over gaps wider than 3 mm.

.3 Lap ends: to 50 mm minimum.

.4 Weld and test stud shear connectors through steel deck to steel joists/beams below in accordance with CSA W59.

.5 Immediately after deck is permanently secured in place, touch up metallic coated top surface with compatible primer where burned by welding.

.6 Prior to concrete placement, steel deck to be free of soil, debris, standing water, loose mil scale and other foreign matter.

.7 Temporary shoring, if required, to be designed to support construction loads, wet concrete and other construction equipment. Do not remove temporary shoring until concrete attains 75% of its specified 28 day compression strength.

.8 Place and support reinforcing steel as indicated.

3.4 CLOSURES

.1 Install closures in accordance with approved details.

3.5 OPENINGS AND AREAS OF CONCENTRATED LOADS

.1 No reinforcement required for openings cut in deck which are smaller than 150 mm square.

.2 Frame deck openings with any one dimension between 150 to 300 mm as recommended by manufacturer, except as otherwise indicated.

.3 For deck openings with any one dimension greater than 300 mm and for areas of concentrated load, reinforce in accordance with structural framing details, except as otherwise indicated.

3.6 CONNECTIONS

.1 Install connections in accordance with CSSBI recommendations as indicated.

3.7 CLEANING

.1 Progress Cleaning: clean in accordance with Division 01.

.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 Division 01.

.3 Waste Management: separate waste materials for reuse recycling in accordance with Division 01.

.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.8 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by steel decking installation.

END OF SECTION

Part 1 General

1.1 REFERENCES

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

.1 ASTM A653/A653M-10, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

.2 ASTM C1177/C1177M-13, Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing.

.3 ASTM E84-15, Standard Test Method for Surface Burning Characteristics of Building Materials.

.4 ASTM E136-12, Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750°C.

.2 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-1.181-99, Ready-Mixed Organic Zinc-Rich Coating.

.3 Canadian Standards Association (CSA International)

.1 CAN/CSA-G164-M92(R2003), Hot Dip Galvanizing of Irregularly Shaped Articles.

.2 CSA W47.1-09, Certification of Companies for Fusion Welding of Steel.

.3 CSA W55.3-08, Resistance Welding Qualification Code for Fabricators of Structural Members Used in Buildings.

.4 CSA W59-03(R2008), Welded Steel Construction (Metal Arc Welding) (Metric Version).

.5 CAN/CSA S136-07, North American Specification for the Design of Cold-Formed Steel Structural Members.

.4 Canadian Sheet Steel Building Institute (CSSBI)

.1 CSSBI 51-06, Lightweight Steel Framing Design Manual -- 2nd Edition.

.2 CSSBI LSF Technical Bulletins.

.3 CSSBI Sheet Steel Fact Sheet SSF 3, Care and Maintenance of Pre-finished Sheet Steel Building Products - February 2006.

.4 CSSBI LSF Technical Bulletin, Vol. 7, No. 2, Changing Standard Thicknesses for Canadian Lightweight Steel Framing Applications.

.5 CSSBI S5-11, UPDATED Guide Specification for Wind Bearing Steel Studs.

1.2 QUALITY ASSURANCE

.1 Retain a Professional Engineer registered in the province of Ontario, Canada to design the Structural Metal Stud Framing; to prepare, seal and sign all shop drawings; and to perform field review. Shop drawings shall show both design and installation requirements.

.2 Site Meetings: as part of Manufacturer's Services as described in PART 3 - FIELD QUALITY CONTROL, schedule site visits, to review Work, at stages listed:

.1 After delivery and storage of products, and when preparatory Work is complete but before installation begins.

.2 Twice during progress of Work at 25% and 60% complete.

.3 Upon completion of Work, after cleaning is carried out.

1.3 DESIGN CRITERIA

.1 Design shall be based on Limit States Design principles using factored loads and resistances.

.2 Loads and load factors shall be in accordance with the National Building Code. For wind load calculations, the reference velocity pressure, q, shall be based on a 1 in 30 probability of being exceeded in any one year for strength design and 1 in 10 for deflection.

.3 Resistances and resistance factors shall be determined in accordance with the National Building Code and CSA-S136.

.4 Conform to requirements of ULC and authorities having jurisdiction for fire-rated assemblies.

.5 Stud depths are shown on the drawings. Adjust stud and joist material thicknesses and spacings, as required by the design criteria. Use greater or lesser stud and joist depths only if approved by the NRC Departmental Representative.

.6 Space wall studs at 400 mm maximum. Use lesser stud spacing if required by the design criteria.

.7 For studs and track the minimum design thickness exclusive of coating shall be 1.12 mm. Use greater stud and track design thicknesses if required by the design criteria.

.8 The minimum design thickness for bridging channel shall be 1.22 mm for studs. Use greater bridging channel design thickness if required by the design criteria.

.9 The minimum design thickness for clip angles shall be 1.52 mm for studs. Use greater clip angle thickness if required by the design criteria.

.10 Maximum flexural deflections under specified live or wind loads shall conform to the following:

.1 Wall studs supporting masonry veneer shall meet the requirements of CSA S304.1, with stud deflections limited to L/720.

.2 Wall studs supporting other finishes: L/360.

.11 Building sway due to all effects, 1/400 of building height or 1/500 of storey height.

.12 For wind bearing studs, design connections to accommodate vertical deflection movement of the structure, frame shortening and vertical tolerances without imposing axial loads onto the framing. Leave a minimum gap of 12 mm. Larger gaps may be required to accommodate structural movement. Co-ordinate with the Project Structural Engineer.

.13 For wind bearing studs, limit free play and movement in connections perpendicular to the plane of the framing to □□0.5 mm relative to the building structure.

.14 Design Structural Metal Stud Framing components and assemblies to accommodate specified erection tolerances of the structure.

.15 Design bridging to prevent member rotation and member translation perpendicular to the minor axis. Provide for secondary stress effects due to torsion between lines of bridging. Do not rely on collateral sheathing to help restrain member rotation and translation perpendicular to the minor axis. Provide bridging at 1500 mm o.c. maximum for wind bearing studs, 1200 mm o.c. maximum for axial load bearing studs. Space bridging at equal intervals over the span length of the member. Closer spacings may be required to satisfy structural requirements.

.16 Design anchorage and splice details for bridging.

.17 Design for local loading due to anchorage of cladding and interior wall mounted fixtures where shown.

.18 Connections between light steel framing members shall be by bolts, welding or sheet metal screws.

.19 Allow for appropriate end eccentricities in the design of axial load bearing members.

.20 Design interior axial load bearing walls with a nominal lateral wind load of 0.24 kPa in combination with the required axial loads.

.21 Design diagonally braced stud walls to act as shear walls. The location of the shear walls and the applied factored lateral loads are indicated on drawings.

.22 For stud walls, provide head, sill and jamb members and connections to frame openings larger than 100 mm in any dimension.

.23 For stud walls anchor top and bottom track to structure at a maximum spacing of 800 mm o.c. Closer spacing may be required to satisfy structural requirements.

1.4 SUBMITTALS

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

.2 Shop Drawings:

.1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.

.2 Indicate design loads.

.3 Include all necessary shop details and erection diagrams. Indicate member sizes, locations, thicknesses exclusive of coating, coatings, and material types. Include connection details for attaching framing to itself and for attachment to the structure. Show splice details where permitted.

.4 Indicate locations, dimensions, openings, requirements of related work and critical installation procedures. Show temporary bracing required for erection purposes.

.5 Indicate welds by welding symbols as defined in CSA W59.

.3 Submit samples of framing components and fasteners to NRC Departmental Representative.

.4 Submit three certified copies of mill reports covering chemical and mechanical properties, and coating designation of steel used in this work.

.5 Submit product data for mechanical fasteners indicating sizes, load capacities and type of corrosion protection.

.6 Submit on request, three representative pieces of all framing component parts including mechanical fasteners if used.

.7 Submit on request, three copies of engineering calculations or data verifying the capacity of the members, including masonry connectors if specified, and the ability of the assemblies to meet the design requirements.

.8 Do not fabricate or construct until submittals other than field review reports are reviewed and approved.

.9 Prior to beginning Work, submit: two certified copies of mill reports covering material properties.

.10 Submit to NRC Departmental Representative manufacturer's written report, within 3 days of review, verifying compliance of Work, as described in PART 3 - FIELD QUALITY CONTROL

1.5 DELIVERY, STORAGE AND HANDLING

.1 Protect steel studs during transportation, site storage and installation in accordance with CSSBI Sheet Steel Facts #SSF3.

.2 Handle and protect galvanized materials from damage to zinc coating.

.3 Waste Management and Disposal:

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

Part 2 Products

2.1 MATERIALS

.1 Steel: to CSA S136, fabricated from ASTM A653/A653M, Grade 230 minimum steel.

.2 Zinc coated steel sheet: quality to ASTM A653/A653M, with Z180 designation coating.

.3 Welding materials: to CSAW59 and certified by Canadian Welding Bureau.

.4 Screws: self-drilling, self-tapping sheet metal screws, corrosion protected with minimum zinc coating thickness of 0.008 mm, size and head type as required in reviewed shop drawings, but generally pan head, minimum 7 mm length

.5 Anchors: concrete expansion anchors or other suitable drilled type fasteners.

.6 Bolts, nuts, washers: hot dipped galvanized to CAN/CSA-G164, 600 g/m^2 zinc coating.

.7 Touch up primer: zinc rich, to CAN/CGSB 1-GP-181.

.8 Sheathing: Meets or exceeds requirements of ASTM C1177, gypsum sheathing, water-resistant treated core, non-combustible when tested in accordance with ASTM E136, maximum flame spread 5 and smoke developed 0 when tested in accordance with ASTM E84, 12 mm thickness.

.9 Sheathing screws: Type S-12, bugle head, self-tapping, rust-resistant, fine thread for heavy steel gauge.

.10 Thermal Insulator: self-adhering cork tape, minimum 3 mm thick x width of steel member.

2.2 STEEL STUD DESIGNATIONS

.1 Colour code: to CSSBI Technical Bulletin Vol.7, No. 2.

2.3 METAL FRAMING

.1 Steel studs: to CSA S136, fabricated from galvanized steel, depth as indicated.

.1 Minimum steel thickness of 0.84 mm.

.2 Stud tracks: fabricated from same material and finish as steel studs, depth to suit.

.1 Minimum steel thickness of 0.84 mm.

.2 Bottom track: single piece.

.3 Top track: two piece telescoping.

.3 Bridging: fabricated from same material and finish as studs, 38 x 12 x 1.09 mm minimum thickness.

.4 Angle clips: fabricated from same material and finish as studs, 38 x 38 mm x depth of steel stud, 1.37 mm minimum thickness.

.5 Tension straps and accessories: as recommended by manufacturer.

2.4 SOURCE QUALITY CONTROL

.1 Ensure mill reports covering material properties are reviewed by NRC Departmental Representative.

Part 3 Execution

3.1 GENERAL

.1 Do welding in accordance with CSA W59.

.2 Certification of companies: CSA W47.1 for fusion welding and CSA W55.3 for resistance welding.

.3 Do work to CSSBI S5.

3.2 ERECTION

.1 Erect components to requirements of reviewed shop drawings.

.2 Anchor tracks securely to structure at 800 mm on centre maximum, unless lesser spacing prescribed on shop drawings.

.3 Erect studs plumb, aligned and securely attached with two screws minimum, or welded in accordance with manufacturer's recommendations, if so indicated on reviewed shop drawings.

.4 Seat studs into bottom tracks and two piece telescoping top track.

.5 Install 50.0 mm minimum telescoping track at top of walls where required to accommodate vertical deflection.

.1 Nest top track into deflection channel minimum of 30.0 mm and maximum of 40.0 mm.

.2 Do not fasten tracks together.

.3 Stagger joints.

.6 Install studs at not more than 50.0 mm from abutting walls, openings, and each side of corners and terminations with dissimilar materials.

.7 Brace steel studs with horizontal internal bridging at 1500 mm maximum.

.1 Fasten bridging to steel clips fastened to steel studs with screws or by welding.

.8 Frame openings in stud walls to adequately carry loads by use of additional framing members and bracing as detailed on shop drawings.

.9 Touch up welds with coat of zinc rich primer.

3.3 SHEATHING

.1 Install sheathing in accordance with manufacturer's instructions and applicable instructions in ASTM C1280.

.2 Use maximum lengths possible to minimize number of joints.

.3 Attach sheathing to metal framing with screws spaced 200 mm o.c. at perimeter where there are framing supports and 200 mm o.c. along intermediate framing in field.

.4 Drive fasteners to bear tight against and flush with surface of sheathing. Do not countersink.

.5 Locate fasteners minimum 10 mm from edges and ends of sheathing panels.

3.4 ERECTION TOLERANCES

.1 Plumb: not to exceed 1/500th of member length.

.2 Camber: not to exceed 1/1000th of member length.

.3 Spacing: not more than +/- 3.0 mm from design spacing.

.4 Gap between end of stud and track web: not more than 4.0 mm.

3.5 CUTOUTS

.1 Maximum size of cutouts for services as follows:

Member Depth	Across Member Depth	Along Member Length	Centre to Centre Spacing (mm)
92	40 max.	105 max.	600 min.
102	40 max.	105 max.	600 min.
152	64 max.	114 max.	600 min.

.2 Limit distance from centerline of last unreinforced cutout to end of member to less than 300 mm.

3.6 FIELD QUALITY CONTROL

.1 Manufacturer's Field Services:

.1 Obtain written report from manufacturer's 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.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 ASTM International

.1 ASTM A 53/A 53M-07, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.

.2 CSA International

.1 CSA G40.20/G40.21-04(R2009), General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.

.2 CAN/CSA G164-M92(R2003), Hot Dip Galvanizing of Irregularly Shaped Articles.

.3 CSA S16-09, Design of Steel Structures.

.4 CSA W48-06, Filler Metals and Allied Materials for Metal Arc Welding (Developed in co-operation with the Canadian Welding Bureau).

.5 CSA W59-M03(R2008), Welded Steel Construction (Metal Arc Welding) Metric.

.3 Environmental Choice Program

.1 CCD-047-98(R2005), Architectural Surface Coatings.

.4 Green Seal Environmental Standards (GS)

.1 GS-11-2008, 2nd Edition, Paints and Coatings.

.5 Health Canada / Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

.6 The Master Painters Institute (MPI)

.1 Architectural Painting Specification Manual - current edition.

1.2 ACTION AND INFORMATIONAL

.1 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for sections, plates, pipe, tubing, bolts and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Submit two copies of WHMIS MSDS.

.1 For finishes, coatings, primers, and paints applied on site: indicate VOC concentration in g/L.

.2 Shop Drawings:

.1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.

.2 Indicate materials, core thicknesses, finishes, connections, joints, method of anchorage, number of anchors, supports, reinforcement, details, and accessories.

1.3 QUALITY ASSURANCE

.1 Test Reports: submit certified test reports showing compliance with specified performance characteristics and physical properties.

.2 Certifications: submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with 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 Replace defective or damaged materials with new.

.4 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials.

Part 2 PRODUCTS

2.1 MATERIALS

.1 Steel sections and plates: to CSA G40.20/G40.21, Grade 300W.

.2 Steel pipe: to ASTM A 53/A 53M standard weight,galvanized finish.

.3 Welding materials: to CSA W59.

.4 Welding electrodes: to CSA W48 Series.

.5 Bolts and anchor bolts: to ASTM A 307.

.6 Grout: non-shrink, non-metallic, flowable, 15 MPa at 24 hours.

2.2 FABRICATION

.1 Fabricate work square, true, straight and accurate to required size, with joints closely fitted and properly secured.

.2 Use self-tapping shake-proof flat headed screws on items requiring assembly by screws or as indicated.

.3 Where possible, fit and shop assemble work, ready for erection.

.4 Ensure exposed welds are continuous for length of each joint. File or grind exposed welds smooth and flush.

2.3 FINISHES

.1 Galvanizing: hot dipped galvanizing with zinc coating 600 g/mý to CAN/CSA-G164.

.2 Chromium plating: chrome on steel with plating sequence of 0.009 mm thickness of copper 0.010 mm thickness of nickel and 0.0025 mm thickness of chromium.

.3 Shop coat primer: MPI- INT EXT 5.1A MPI- INT EXT 5.1B in accordance with chemical component limits and restrictions requirements and VOC limits of CCD-047a CCD-048 GS-11.

.4 Zinc primer: zinc rich, ready mix to MPI-INT EXT 5.2C in accordance with chemical component limits and restrictions requirements and VOC limits of CCD-047a CCD-048 GS-11.

2.4 ISOLATION COATING

.1 Isolate aluminum from following components, by means of bituminous paint:

.1 Dissimilar metals except stainless steel, zinc, or white bronze of small area.

.2 Concrete, mortar and masonry.

.3 Wood.

2.5 SHOP PAINTING

.1 Primer: VOC limit 250 g/L maximum to GS-11 CCD-047a CCD-048.

.2 Apply one shop coat of primer to metal items, with exception of galvanized or concrete encased items.

.3 Use primer unadulterated, as prepared by manufacturer. Paint on dry surfaces, free from rust, scale, grease. Do not paint when temperature is lower than 7 degrees C.

.4 Clean surfaces to be field welded; do not paint.

2.6 ANGLE LINTELS

.1 Steel angles: prime painted, sizes indicated for openings. Provide 150 mm minimum bearing at ends.

.2 Weld or bolt back-to-back angles to profiles as indicated.

.3 Finish: shop painted.

.1 Primer: VOC limit 250 g/L maximum to GS-11 when applied onsite.

2.7 PIPE RAILINGS

.1 Steel pipe: 30mm nominal outside diameter, formed to shapes and sizes as indicated.

.2 Galvanize exteriorand interior pipe railings after fabrication. Shop coat prime interior railings after fabrication.

2.8 CORNER GUARDS

.1 Steel angle: sized as indicatetd.

.2 Galvanized finish for exterior, prime paint for interior.

.1 Primer: maximum VOC limit 250 g/L to GS-11 when applied onsite.

Part 3 PART 3 - EXECUTION

3.1 EXAMINATION

.1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for metal fabrications installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate.

.2 Inform NRC 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 NRC Departmental Representative.

3.2 ERECTION

.1 Do welding work in accordance with CSA W59 unless specified otherwise.

.2 Erect metalwork square, plumb, straight, and true, accurately fitted, with tight joints and intersections.

.3 Provide suitable means of anchorage acceptable to NRC Departmental Representative such as dowels, anchor clips, bar anchors, expansion bolts and shields, and toggles.

.4 Exposed fastening devices to match finish and be compatible with material through which they pass.

.5 Supply components for work by other trades in accordance with shop drawings and schedule.

.6 Make field connections with bolts to CSA S16 or Weld field connection.

.7 Deliver items over for casting into concrete and building into masonry together with setting templates to appropriate location and construction personnel.

.8 Touch-up rivets, field welds, bolts and burnt or scratched surfaces with primer after completion of:

.1 Primer: maximum VOC limit 250 g/L to GS-11.

.9 Touch-up galvanized surfaces with zinc rich primer where burned by field welding.

.1 Primer: maximum VOC limit 250 g/L to GS-11.

3.3 PIPE RAILINGS

.1 Install pipe railings to stairs as indicated.

.2 Set railing standards in concrete. Grout to fill hole. Trowel surface smooth and flush with adjacent surfaces.

3.4 CORNER GUARDS

.1 Install corner guards in locations as indicated.

3.5 CHANNEL FRAMES

.1 Install steel channel frames to openings as indicated.

3.6 CLEANING

.1 Progress Cleaning:

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.

.3 Waste Management: separate waste materials for reuse and recycling.

.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.7 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by metal fabrications installation.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

1.2 REFERENCES

.1 American National Standards Institute/National Association of Architectural Metal Manufacturers (ANSI/NAAMM)

.1 ANSI/NAAMM MBG 531-00, Metal Bar Grating Manual.

.2 ASTM International

.1 ASTM A 53/A 53M-07, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.

.2 ASTM A 307-07b, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.

.3 ASTM A 325M-09, Standard Specification for Structural Bolts, Steel, Heat Treated, 830 MPa Minimum Tensile Strength Metric.

.3 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-1.40-97, Anti-corrosive Structural Steel Alkyd Primer.

.2 CAN/CGSB-1.181-99, Ready-Mixed Organic Zinc-Rich Coating.

.4 CSA International

.1 CSA G40.20/G40.21-04(R2009), General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.

.2 .2 CAN/CSA G164-M92(R2003), Hot Dip Galvanizing of Irregularly Shaped Articles.

.3 CSA W59-03(R2008), Welded Steel Construction (Metal Arc Welding).

.5 Health Canada / Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

.6 National Association of Architectural Metal Manufactures (NAAMM)

.1 AMP 510-92, Metal Stair Manual.

.7 The Society for Protective Coatings (SSPC)

.1 Systems and Specifications Manual, Volume 2, 2008 Edition.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for stairs, ladders and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Shop Drawings:

.1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.

.2 Indicate construction details, sizes of steel sections and thickness of steel sheet.

1.4 QUALITY ASSURANCE

.1 Test Reports: submit certified test reports showing compliance with specified performance characteristics and physical properties.

.2 Certifications: submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance 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 stairs, ladders from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

.4 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials.

Part 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

.1 Design Requirements:

.2 Design metal stair, balustrade and landing construction and connections to NBC vertical and horizontal live load requirements.

.3 Detail and fabricate stairs to NAAMM Metal Stairs Manual.

2.2 MATERIALS

.1 Steel sections: to CSA G40.20/G40.21 Grade 300 W.

.2 Steel pipe: to ASTM A 53/A 53M, standard weight, schedule 40 seamless black.

.3 Steel tubing: to CSA G40.20/G40.21, sizes and dimensions as indicated.

.4 Welding materials: to CSA W59.

.5 Bolts: to ASTM A 307.

.6 High strength bolts: to ASTM A 325M.

2.3 FABRICATION

.1 Fabricate in accordance with NAAMM, Metal Stair Manual.

.2 Weld connections where possible, otherwise bolt connections. Countersink exposed fastenings, cut off bolts flush with nuts. Make exposed connections of same material, colour and finish as base material on which they occur.

.3 Accurately form connections with exposed faces flush:

.1 Make mitres and joints tight.
.2 Make risers of equal height.

.4 Grind or file exposed welds and steel sections smooth.

.5 Shop fabricate stairs in sections as large and complete as practicable.

2.4 STEEL PAN STAIRS

.1 Fabricate stairs withopen riser steel pan construction.

.2 Form treads and risers from 3 mm thick steel plate. Secure treads and risers to L 35 x 35 x 5 horizontal and vertical welded to stringers.

.3 Form wall stringers from MC 310 x 15.8.

.4 Form outer stringers from MC 310 x 15.8 with 5 mm thick plate fascia welded on.

.5 Form landings from 3 mm thick steel plate, reinforced by L 55 x 55 x 6 mm spaced at 400 mm on centre.

.6 Provide clip angles for fastening of furring channels, where applied finish is indicated for underside of stairs and landings.

.7 Extend stringers around mid landings to form steel base.

.8 Close ends of stringers where exposed.

2.5 PIPE/TUBING BALUSTRADES

.1 Construct balusters and handrails from steel pipe and steel bar as indicated.

.2 Cap and weld exposed ends of balusters and handrails.

.3 Terminate at abutting wall with end flange.

2.6 BAR BALUSTRADES

.1 Construct bar balustrades as follows:

.1 Balusters: Steel pipe.
.2 Top rail: Steel pipe.
.3 Bottom rail: Steel pipe.
.4 Pickets: 10 x 10 mm bar at 100 mm on centre.

.2 Weld balustrades to stringers as indicated.

2.7 FINISHES

.1 Galvanizing: hot dipped galvanizing with zinc coating 600 g/mý to CAN/CSA-G164.

.2 Shop coat primer: to CAN/CGSB-1.40.

.3 Zinc primer: zinc rich, ready mix to CAN/CGSB-1.181.

2.8 SHOP PAINTING

.1 Clean surfaces in accordance with Steel Structures Painting Council Manual Volume 2.

.2 Apply one coat of shop primer except interior surfaces of pans.

.3 Apply two coats of primer of different colours to parts inaccessible after final assembly.

.4 Use primer as prepared by manufacturer without thinning or adding admixtures. Paint on dry surfaces, free from rust, scale, grease, do not paint when temperature is below 7 degrees C.

.5 Do not paint surfaces to be field welded.

Part 3 EXECUTION

3.1 EXAMINATION

.1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for metal stairs and ladders installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate.
.2 Inform NRC 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 NRC Departmental Representative.

3.2 INSTALLATION OF STAIRS, GUARDS AND RAILINGS

.1 Install in accordance with NAAMM, Metal Stair Manual.

.2 Install plumb and true in exact locations, using welded connections wherever possible to provide rigid structure. Provide anchor bolts, bolts and plates for connecting stairs to structure.

.3 Hand items over for casting into concrete or building into masonry to appropriate trades together with setting templates.

.4 Do welding work in accordance with CSA W59 unless specified otherwise.

.5 Touch up shop primer to bolts, welds, and burned or scratched surfaces at completion of erection.

3.3 CLEANING

.1 Progress Cleaning:

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.

.3 Waste Management: separate waste materials for reuse and recycling.

.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.4 CLEANING

.1 Perform cleaning as soon as possible after installation to remove construction and accumulated environmental dirt.

.2 Upon completion of installation, remove surplus materials, rubbish, tools and equipment barriers.

3.5 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by metal stairs and ladders installation.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 06 40 00 - Architectural Woodwork.

.2 Section 10 21 13.13 - Metal Toilet Compartments

.3 Section 10 28 10 - Toilet and Bath Accessories.

1.2 REFERENCES

.1 American National Standards Institute/National Particleboard Association (ANSI/NPA)

.1 ANSI/NPA A208.1-2009, Particleboard.

.2 ASTM International

.1 ASTM A 123/A 123M-09, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

.2 ASTM A 653/A 653M-11, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvanealled) by the Hot-Dip Process.

.3 ASTM C 1396/C 1396M-11, Standard Specification for Gypsum Board.

.4 ASTM D 1761-06, Standard Test Methods for Mechanical Fasteners in Wood.

.3 CSA International

.1 CSA B111-1974(R2003), Wire Nails, Spikes and Staples.

.2 CSA O121-08, Douglas Fir Plywood.

.3 CSA O141-05(R2009), Softwood Lumber.

.4 CSA O151-09, Canadian Softwood Plywood.

.5 CSA O153-M1980(R2008), Poplar Plywood.

.4 National Lumber Grades Authority (NLGA)

.1 Standard Grading Rules for Canadian Lumber 2010.

.5 South Coast Air Quality Management District (SCAQMD), California State, Regulation XI. Source Specific Standards

.1 SCAQMD Rule 1113-A2011, Architectural Coatings.

.2 SCAQMD Rule 1168-A2005, Adhesives and Sealants Applications.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for wood products and accessories and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Shop Drawings:

.1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.

1.4 QUALITY ASSURANCE

.1 Lumber by grade stamp of an agency certified by Canadian Lumber Standards Accreditation Board.

.2 Plywood, particleboard, OSB and wood based composite panels in accordance with CSA and ANSI standards.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance 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 wood from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

.4 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials.

Part 2 Products

2.1 FRAMING STRUCTURAL AND PANEL MATERIALS

.1 Description:

.1 Plywood, Particleboard: urea-formaldehyde free, CAN/CSA-Z809 or FSC or SFI certified.

.2 Lumber: softwood, S4S, moisture content 19% (S-dry) or less in accordance with following standards:

.1 CSA O141.

.2 NLGA Standard Grading Rules for Canadian Lumber.

.3 Furring, blocking, nailing strips, grounds, rough bucks, cants, curbs, fascia backing and sleepers:

.1 S2S is acceptable.

.2 Board sizes: "Standard" or better grade.

.3 Dimension sizes: "Standard" light framing or better grade.

.4 Plywood, OSB and wood based composite panels: to CSA O325.

.5 Douglas fir plywood (DFP): to CSA O121, standard construction.

.6 Canadian softwood plywood (CSP): to CSA O151, standard construction.

.7 Poplar plywood (PP): to CSA O153, standard construction.

.8 Interior mat-formed wood particleboard: to ANSI/NPA 208.1.

.9 Gypsum sheathing: to ASTM C 1396/C 1396M.

2.2 ACCESSORIES

.1 Sealants: in accordance with Section 07 92 00 - Joint Sealants.

.1 Sealants: VOC limit 250 g/L maximum to SCAQMD Rule 1168.

.2 General purpose adhesive: to CSA O112.9.

.1 VOC limit 70 200 g/L maximum to SCAQMD Rule 1168 GS-36.

.3 Nails, spikes and staples: to CSA B111.

.4 Bolts: 12.5 mm diameter unless indicated otherwise, complete with nuts and washers.

.5 Proprietary fasteners: toggle bolts, expansion shields and lag bolts, screws and lead or inorganic fibre plugs, recommended for purpose by manufacturer.

.6 Fastener Finishes:

.1 Galvanizing: to ASTM A 123/A 123M, use galvanized fasteners for fire-retardant treated lumber.

Part 3 Execution

3.1 EXAMINATION

.1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for product installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate.

.2 Inform NRC 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 NRC Departmental Representative.

3.2 MATERIAL USAGE

.1 Electrical equipment mounting boards:

.1 Plywood, DFP or CSP grade, square edge 19mm thick.

3.3 INSTALLATION

.1 Install members true to line, levels and elevations, square and plumb.

.2 Construct continuous members from pieces of longest practical length.

.3 Install furring and blocking as required to space-out and support casework, cabinets, wall and ceiling finishes, facings, fascia, soffit, siding electrical equipment mounting boards, and other work as required.

.4 Install rough bucks, nailers and linings to rough openings as required to provide backing for frames and other work.

.5 Install wood cants, fascia backing, nailers, curbs and other wood supports as required and secure using galvanized steel fasteners.

.6 Install sleepers as indicated.

.7 Use dust collectors and high quality respirator masks when cutting or sanding wood panels.

.8 Frame, anchor, fasten, tie and brace members to provide necessary strength and rigidity.

.9 Countersink bolts where necessary to provide clearance for other work.

.10 Use nailing disks for soft sheathing as recommended by sheathing manufacturer.

3.4 CLEANING

.1 Progress Cleaning:

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.

.3 Waste Management: separate waste materials for reuse and recycling.

.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.5 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by rough carpentry installation.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 06 10 00 - Rough Carpentry.

.2 07 92 00 - Joint Sealants.

1.2 REFERENCES

.1 American National Standards Institute (ANSI)

.1 ANSI A208.1-09, Particleboard.

.2 ANSI A208.2-09, Medium Density Fiberboard (MDF) for Interior Applications.

.2 Architectural Woodwork Manufacturers Association of Canada (AWMAC) and Architectural Woodwork Institute (AWI)

.1 Architectural Woodwork Standards Illustrated, 2nd edition, (2014).

.3 CSA International

.1 CSA B111-74(R2003), Wire Nails, Spikes and Staples.

.2 CSA O121-08, Douglas Fir Plywood.

.3 CSA O141-05(R2009), Softwood Lumber.

.4 CSA O151-09, Canadian Softwood Plywood.

.5 CSA O153-M1980(R2008), Poplar Plywood.

.4 Green Seal Environmental Standards (GS)

.1 GS-11-11, Paints and Coatings.

.2 GS-36-11, Commercial Adhesives.

.5 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

.6 National Electrical Manufacturers Association (NEMA)

.1 ANSI/NEMA LD-3-05, High-Pressure Decorative Laminates (HPDL).

.7 National Lumber Grades Authority (NLGA)

.1 Standard Grading Rules for Canadian Lumber 2010.

.8 South Coast Air Quality Management District (SCAQMD), California State, Regulation XI. Source Specific Standards

.1 SCAQMD Rule 1113-A2011, Architectural Coatings.

.2 SCAQMD Rule 1168-A2005, Adhesives and Sealants Applications.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for architectural woodwork and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Submit two copies of WHMIS MSDS.

.2 Shop Drawings:

.1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.

.2 Indicate details of construction, profiles, jointing, fastening and other related details.

.1 Scales: profiles full size, details half full size.

.3 Indicate materials, thicknesses, finishes and hardware.

.4 Indicate locations of service outlets in casework, typical and special installation conditions, and connections, attachments, anchorage and location of exposed fastenings.

.3 Samples:

.1 Submit for review and acceptance of each unit.

.2 Samples will be returned for inclusion into work.

.3 Submit duplicate samples of laminated plastic for colour selection.

.4 Submit duplicate samples of laminated plastic joints, edging, cutouts and postformed profiles.

.4 Certifications: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

1.4 QUALITY ASSURANCE

.1 Lumber by grade stamp of an agency certified by Canadian Lumber Standards Accreditation Board.

.2 Plywood, particleboard, OSB and wood based composite panels to CSA and ANSI standards.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance 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.

.1 Protect millwork against dampness and damage during and after delivery.

.2 Store millwork in ventilated areas, protected from extreme changes of temperature or humidity.

.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 architectural woodwork from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

.4 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials.

Part 2 Products

2.1 MATERIALS

.1 Softwood lumber: unless specified otherwise, S4S, moisture content 19 % or less in accordance with following standards:

.1 CSA O141.

.2 CAN/CSA-Z809 or FSC or SFI certified.

.3 NLGA Standard Grading Rules for Canadian Lumber.

.4 AWMAC premium grade, moisture content as specified.

.2 Machine stress-rated lumber is acceptable for all purposes.

.3 Hardwood lumber: moisture content 15 % or less in accordance with following standards:

.1 National Hardwood Lumber Association (NHLA).

.2 CAN/CSA-Z809 or FSC or SFI certified.

.3 AWMAC premium grade, moisture content as specified.

.4 Canadian softwood plywood (CSP): to CSA O151, standard construction, CAN/CSA-Z809 or FSC or SFI certified.

.1 Plywood resin to contain no added urea-formaldehyde.

.5 Hardwood plywood: to ANSI/HPVA HP-1, CAN/CSA-Z809 or FSC or SFI certified.

.1 Plywood resin to contain no added urea-formaldehyde.

.6 Poplar plywood (PP): to CSA O153, standard construction, CAN/CSA-Z809 or FSC or SFI certified.

.1 Plywood resin to contain no added urea-formaldehyde.

.7 Interior mat-formed wood particleboard: to ANSI/NPA A208.1, CAN/CSA-Z809 or FSC or SFI certified.

.1 Particleboard resin to contain no added urea-formaldehyde.

.8 Birch plywood: to AWMAC Paint Grade, CAN/CSA-Z809 or FSC or SFI certified.

.1 Plywood resin to contain no added urea-formaldehyde.

.9 Fibreboard must contain less than 10% roundwood by weight, using weighted average over three month period at manufacturing locations.

.1 Fibreboard resin to contain no added urea-formaldehyde.

.2 CAN/CSA-Z809 or FSC or SFI certified.

.10 Hardboard:

.1 To CAN/CGSB-11.3, CAN/CSA-Z809 or FSC or SFI certified.

.2 Hardboard resin to contain no added urea-formaldehyde.

.11 MDF (medium density fibreboard) core: to ANSI A208.2, density 769 kg/m^2, CAN/CSA-Z809 or FSC or SFI certified.

.1 Medium density fibreboard performance requirements to: ANSI A208.2.

.2 MDF resin to contain no added urea-formaldehyde.

.12 Plastic laminate: ANSI/NEMA LD-3, high pressure paper base decorative laminates. Unless otherwise specified, use the following:

.1 Horizontal postform work: Grade HGP, minimum 1 mm thick.

.2 Horizontal flat work: Grade HGS, minimum 1.2 mm thick.

.3 Vertical postform work: Grade VGP, minimum 0.7 mm thick.

.4 Vertical flat work: Grade VGS minimum 0.7 mm thick.

.5 Backing sheet: BK, same thickness as facing sheets, sanded one face and manufactured by the same manufacturer as the facing sheet.

.6 Colour: Refer to Section 00 01 30, List of Materials.

.13 Nails and staples: to CSA B111.

.14 Wood screws: type and size to suit application.

.15 Splines: wood.

.16 Sealant: in accordance with Section 07 92 00 - Joint Sealants,

.1 Sealants: VOC limit 250 g/L maximum to SCAQMD Rule 1168.

.17 Laminated plastic adhesive:

.1 Adhesive: as recommended by manufacturer.

.2 Adhesives: VOC limit 30 120 g/L maximum to SCAQMD Rule 1168 GS-36.

2.2 MANUFACTURED UNITS

.1 Casework:

.1 Fabricate caseworks to AWMAC premium quality grade.

.2 Furring, blocking, nailing strips, grounds and rough bucks and sleepers.
.1 S2S is acceptable.
.2 Board sizes: "standard" or better grade.
.3 Dimension sizes: "standard" light framing or better grade.
.4 Urea-formaldehyde free.
.3 Framing, NLGA grade.
.4 Case bodies (ends, divisions and bottoms).
.1 Softwood and poplar plywood DFP or CSP or PP, square edge, 19 mm thick.
.2 Hardwood plywood:
.1 Thickness: 19mm.
.3 Particleboard, grade 19mm thick.
.5 Backs:
.1 Softwood and poplar plywood DFP or CSP or PP, square edge, 19 mm thick.
.2 Hardwood plywood:
.1 Thickness: 19mm.
.3 Particleboard, 19mm thick.
.6 Shelving:
.1 Softwood and poplar plywood DFP or CSP or PP grade, square edge, 19mm thick.
.2 Edge banding: provide 10 mm thick solid matching wood strip on plywood, particleboard edges 12 mm or thicker, exposed in final assembly. Strips same width as plywood, particleboard. Matching colour in HPL.

.2 Drawers:

.1 Fabricate drawers to AWMAC premium grade supplemented as follows:
.2 Sides and Backs.
.1 Thermofused melamine: 12mm thick.
.3 Bottoms:
.1 Softwood and poplar plywood DFP or CSP or PP grade, square edge, 12mm thick.
.4 Fronts:
.1 Medium density fibreboard: 19mm thick, HPL.

.3 Casework Doors:

.1 Fabricate doors to AWMAC premium grade supplemented as follows:
.2 Medium Density Fibreboard, laminated with HPL.

2.3 FABRICATION

.1 Set nails and countersink screws apply stained plain wood filler to indentations, sand smooth and leave ready to receive finish.

.2 Shop install cabinet hardware for doors, shelves and drawers. Recess shelf standards unless noted otherwise.

.3 Shelving to cabinetwork to be adjustable unless otherwise noted.

.4 Provide cutouts for plumbing fixtures, inserts, appliances, outlet boxes and other fixtures.

.5 Shop assemble work for delivery to site in size easily handled and to ensure passage through building openings.

.6 Obtain governing dimensions before fabricating items which are to accommodate or abut appliances, equipment and other materials.

.7 Ensure adjacent parts of continuous laminate work match in colour and pattern.

.8 Veneer laminated plastic to core material in accordance with adhesive manufacturer's instructions. Ensure core and laminate profiles coincide to provide continuous support and bond over entire surface. Use continuous lengths up to 3000 mm. Keep joints 600 mm from sink cutouts.

.9 Form shaped profiles and bends as indicated, using postforming grade laminate to laminate manufacturer's instructions.

.10 Use straight self-edging laminate strip for flatwork to cover exposed edge of core material. Chamfer exposed edges uniformly at approximately 20 degrees. Do not mitre laminate edges.

.11 Apply laminate backing sheet to reverse side of core of plastic laminate work.

.12 Apply laminated plastic liner sheet to interior of cabinetry.

Part 3 Execution

3.1 EXAMINATION

.1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for architectural woodwork installation in accordance with manufacturer's instructions.

.1 Visually inspect substrate.

.2 Inform NRC 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 NRC Departmental Representative.

3.2 INSTALLATION

.1 Do architectural woodwork to Quality Standards of AWMAC.

.2 Install prefinished millwork at locations shown on drawings.

.1 Position accurately, level, plumb straight.

.3 Fasten and anchor millwork securely.

.1 Supply and install heavy duty fixture attachments for wall mounted cabinets.

.4 Use draw bolts in countertop joints.

.5 Scribe and cut as required to fit abutting walls and to fit properly into recesses and to accommodate piping, columns, fixtures, outlets or other projecting, intersecting or penetrating objects.

.6 At junction of plastic laminate counter back splash and adjacent wall finish, apply small bead of sealant in accordance with Section 07 92 00 - Joint Sealants.

.7 Apply water resistant building paper over wood framing members in contact with masonry or cementitious construction.

.8 Fit hardware accurately and securely in accordance with manufacturer's written instructions.

3.3 CLEANING

.1 Progress Cleaning:

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.

.1 Clean millwork and cabinet work inside cupboards and drawers and outside surfaces.

.2 Remove excess glue from surfaces.

.3 Waste Management: separate waste materials for reuse and recycling.

.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.4 PROTECTION

.1 Protect millwork and cabinet work from damage until final inspection.

.2 Protect installed products and components from damage during construction.

.3 Repair damage to adjacent materials caused by architectural woodwork installation.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 06 40 00 - Architectural Woodwork.

1.2 REFERENCES

.1 American National Standards Institute (ANSI)

.1 ANSI 208.1-09, Particleboard.

.2 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-71.20-M88, Adhesive, Contact, Brushable.

.3 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

.4 National Electrical Manufacturers Association (NEMA)

.1 ANSI/NEMA LD-3-05, High Pressure Decorative Laminates (HPDL).

.5 South Coast Air Quality Management District (SCAQMD), California State, Regulation XI. Source Specific Standards

.1 SCAQMD Rule 1113-A2011, Architectural Coatings.

.2 SCAQMD Rule 1168-A2005, Adhesives and Sealants Applications.

1.3 ACTION AND INFORMATION SUBMITTALS

.1 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for laminate, adhesive, and core materials and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Submit two copies of WHMIS MSDS. Indicate VOC's for adhesives in g/L.

.2 Samples:

.1 Submit for review and acceptance of each unit.

.2 Samples will be returned for inclusion into work.

.3 Submit duplicate samples of joints, edging, cutouts and postformed profiles.

.3 Certifications: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

1.4 CLOSEOUT SUBMITTALS

.1 Provide maintenance data for laminate work for incorporation into manual.

1.5 QUALITY ASSURANCE

.1 Test Reports: certified test reports showing compliance with specified performance characteristics and physical properties.

.2 Certificates: product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance 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 laminate, adhesive, and core materials from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

.4 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials.

Part 2 Products

2.1 MATERIALS

.1 Laminated plastic for flatwork PLAM1: to NEMA LD3.

.1 Type: general purpose.

.2 Grade: HGS.

.3 Size: 1.27 mm thick.

.4 Colour: multilayered.

.5 Pattern: solid.

.6 Finish: matt.

.2 Laminated plastic for flatwork PLAM2: to NEMA LD3.

.1 Type: general purpose.

.2 Grade: HGS.

.3 Size: 1.27 mm thick.

.4 Colour: multilayered.

.5 Pattern: solid.

.6 Finish: matt.

.3 Laminated plastic for flatwork PLAM3: to NEMA LD3.

.1 Type: general purpose.
.2 Grade: HGS.
.3 Size: 1.27 mm thick.
.4 Colour: multilayered.
.5 Pattern: solid.
.6 Finish: matt.

.4 Laminated plastic for flatwork PLAM4: to NEMA LD3.

.1 Type: general purpose.
.2 Grade: HGS.
.3 Size: 1.27 mm thick.
.4 Colour: multilayered.
.5 Pattern: solid.
.6 Finish: matt.

.5 Laminated plastic adhesive: urea resin adhesive to CSA O112.10 as recommended by manufacturer.

.1 Test for acceptable VOC emissions in accordance with ASTM D 2369 and ASTM D 2832.

2.2 FABRICATION

.1 Comply with NEMA LD3, Annex A.

.2 Obtain governing dimensions before fabricating items which are to accommodate or abut appliances, equipment and other materials.

.3 Ensure adjacent parts of continuous laminate work match in colour and pattern.

.4 Veneer laminated plastic to core material in accordance with adhesive manufacturer's instructions. Ensure core and laminate profiles coincide to provide continuous support and bond over entire surface. Use continuous lengths up to3000 mm. Keep joints 600 mm from sink cutouts.

.5 Form shaped profiles and bends as indicated, using postforming grade laminate to laminate manufacturer's instructions.

.6 Use straight self-edging laminate strip for flatwork to cover exposed edge of core material. Chamfer exposed edges uniformly at approximately 20 degrees. Do not mitre laminate edges.

.7 Apply laminate backing sheet to reverse side of core of plastic laminate work.

Part 3 Execution

3.1 EXAMINATION

.1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for laminate, adhesive, and core materials installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate.

.2 Inform NRC 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 NRC Departmental Representative.

3.2 MANUFACTURER'S INSTRUCTIONS

.1 Compliance: comply with manufacturer's written recommendations, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, and data sheets.

3.3 INSTALLATION

.1 Install work plumb, true and square, neatly scribed to adjoining surfaces.

.2 Make allowances around perimeter where fixed objects pass through or project into laminated plastic work to permit normal movement without restriction.

.3 Use draw bolts and splines in countertop joints. Maximum spacing 450 mm on centre, 75 mm from edge. Make flush hairline joints.

.4 Provide cutouts for inserts, grilles, appliances, outlet boxes and other penetrations. Round internal corners, chamfer edges and seal exposed core.

.5 At junction of laminated plastic counter back splash and adjacent wall finish, apply small bead of sealant.

3.4 CLEANING

.1 Progress Cleaning:

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.

.1 Clean to NEMA LD3, Annex B.

.2 Remove traces of primer, caulking, epoxy and filler materials and clean doors and frames.

.3 Waste Management: separate waste materials for reuse and recycling.

.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.5 PROTECTION

.1 Cover finished laminated plastic veneered surfaces with heavy kraft paper or put in cartons during shipment.

.2 Protect installed laminated surfaces in accordance with manufacturer's written recommendations.

.1 Remove protection only immediately before final inspection.

.3 Protect installed products and components from damage during construction.

.4 Repair damage to adjacent materials caused by laminate, adhesive, and core materials installation.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 American Railway Engineering & Maintenance of Way Association (AREMA) Specification Chapter 29 - Waterproofing.

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

.1 ASTM D146 – 04, Standard Test Methods for Sampling and Testing Bitumen-Saturated Felts and Woven Fabrics Used in Roofing and Waterproofing.

.2 ASTM D412 – 06ae2, Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers-Tension.

.3 ASTM D570 – 98(2010)e1, Standard Test Method for Water Absorption of Plastics.

.4 ASTM E96/E96M – 10, Standard Test Methods for Water Vapor Transmission of Materials.

.5 ASTM E154 – 08a, Standard Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover.

.3 Health Canada

.1 Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

1.2 PRODUCT DATA

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

.2 Submit product data sheets for self-adhering waterproofing products. Including:

.1 Product characteristics.

.2 Performance criteria.

.3 Application methods.

.4 Limitations.

.3 Manufacturer's Instructions: Provide to indicate special handling criteria, installation sequence, and cleaning procedures.

1.3 DELIVERY, STORAGE AND HANDLING

.1 Provide and maintain dry, off-ground weatherproof storage.

.2 Store materials on supports to prevent deformation.

.3 Remove only in quantities required for same day use.

.4 Store materials in accordance with manufacturer's written instructions.

1.4 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.

.2 Remove from site and dispose of packaging materials at appropriate recycling facilities.

.3 Collect and separate for disposal packaging material for recycling in accordance with Waste Management Plan.

.4 Ensure emptied containers are sealed and stored safely.

.5 Fold up metal banding, flatten and place in designated area for recycling.

.6 Divert unused asphalt primer materials from landfill to recycling facility approved by NRC Departmental Representative.

1.5 WARRANTY

.1 For sealant and sheet materials the 12 months warranty period prescribed in subsection GC 32.1 of General Conditions "C" is extended to 24 months.

Part 2 Products

2.1 MATERIALS

.1 Rolled, Self-Adhering Waterproofing Membrane: Polymeric waterproofing membrane, with backing of cross-laminated polyethylene carrier film with release paper, and with exposed polymeric membrane strips on both sides protected by pull-off release strips.

- .1 Compliance: AREMA Specification Chapter 29 - Waterproofing.
- .2 Thickness:
  - .1 Carrier Film: 4 mils.
  - .2 Polymeric Membrane: 56 mils.
- .3 Tensile Strength, ASTM D 412, Die C:
  - .1 Carrier Film: 40.71 MPa (5,900 psi) minimum.
  - .2 Polymeric Membrane: 4.07 MPa (590 psi) minimum.
- .4 Elongation, ASTM D 412, Die C: Polymeric Membrane: 455 % minimum.
- .5 Peel Adhesion:
  - .1 Dry: 125 g/mm (7 pounds/inch).
  - .2 Wet: 125 g/mm (7 pounds/inch).
- .6 Pliability, ASTM D 146: 180° Bend 25.4 mm (1”) Mandrel at -32° C (-25° F): Unaffected.

.7 Water Vapour Permeability, ASTM E 96, Method B: 0.019 perms.

.8 Water Absorption, ASTM D 570: 0.1%, 72 hours maximum.

.9 Resistance to Hydrostatic Head: Equivalent to 73.1 m (240') of water.

.10 Puncture Resistance, ASTM E 154: 67 pounds.

.11 Exposure to Fungi, Soil Test: Pass, 16 weeks.

.12 Colour:

.1 Carrier Film: White.

.2 Polymeric Membrane: Black.

.2 Primer: Rubber based solvent primer achieving a minimum coverage rate of 6.2 m^2/L, as recommended by membrane manufacturer.

.3 Mastic: Rubber based trowellable/gunnable grade mastic for membrane terminations as recommended by manufacturer.

.4 Protection board: Asphalt hardboard 3 mm thick for foundation walls and horizontal decks.

Part 3 Execution

3.1 WORKING CONDITIONS

.1 Surfaces and surrounding air temperature shall be at least 4°C.

.2 Concrete shall have 7 day curing period prior to the application of waterproofing membrane.

.3 Clean surfaces free of dirt, oil, grease and other foreign matter. Surfaces shall be dry and frost-free.

.4 Install waterproofing membrane as specified below, otherwise in accordance with the manufacturer's directions and using equipment, tool and materials approved by the membrane manufacturer.

.5 After installation, protect the membrane from damage with protective board applied to the entire surface of the waterproofing membrane.

3.2 EXAMINATION

.1 Ensure surfaces to be waterproofed are free of fins, loose material, grease, oil and foreign matter.

.2 Walls, structural slabs, services, equipment and fastenings preventing the application of a continuous waterproofing film shall not be placed prior to the completion and approval of the waterproofing.

3.3 APPLICATION

.1 Install membrane in accordance with manufacturer's recommendations.

.2 Prime concrete at the rate of 1 litre/5-7 sq. mm depending on porosity. Primer shall dry minimum 1 hour, maximum 24 hours. Re-prime after 24 hours.

.3 Provide minimum 63.5 mm overlap at seams and 150 mm at all end laps.

.4 Reinforce inside and outside corners with an initial strip of membrane minimum 300 mm wide.

.5 Install membrane at expansion and control joints in strict accordance with the manufacturers written instructions.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 ACI 302.1R.17 – Guide for Concrete Floor and Slab Construction.

.2 ASTM C836 - Standard Specification for High Solids Content, Cold Liquid-Applied Elastomeric Waterproofing Membrane for Use with Separate Wearing Course.

.3 ASTM D412-06: Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers - Tension.

.4 ASTM D882: Standard Test Method for Tensile Properties of Thin Plastic Sheeting.

.5 ASTM D903: Standard Test Method for Peel or Stripping Strength of Adhesive Bonds.

.6 ASTM D1970-01 - Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection.

.7 ASTM D5385-93: Standard Test Method for Hydrostatic Pressure Resistance of Waterproofing Membranes.

.8 ASTM E96 (Method B): Standard Test Methods for Water Vapor Transmission of Materials.

.9 ASTM E154: Standard Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover.

.10 ASTM F2130: Standard Test Method for Measuring Repellency, Retention, and Penetration of Liquid Pesticide Formulation Through Protective Clothing Materials.

.11 GSA-PBS 07115: General Services Administration, Public Building Service - Guide Specification for Elastomeric Waterproofing.

.12 Texas A&M Method Resistance to Penetration by Termites.

1.2 QUALITY ASSURANCE

.1 Contractor will provide the proper equipment, manpower, and supervision at the jobsite to install the membrane in compliance with the project plans and specifications.

.2 Installation shall be carried out by an experienced applicator with an adequate number of skilled personnel, experienced in the application of the specified membrane applications.

.3 Maintain a record of the batch numbers of all materials supplied for this project.

1.3 PRE-CONSTRUCTION MEETING

.1 Convene one week prior to commencing work of this section, meeting with manufacturer's technical representative, to review the installation procedures.

1.4 PRODUCT DATA

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

.2 Submit product data sheets for waterproofing products. Including:

.1 Product characteristics.

.2 Performance criteria.

.3 Application methods.

.4 Limitations.

.3 Manufacturer's Instructions: Provide to indicate special handling criteria, installation sequence, and cleaning procedures.

1.5 DELIVERY, STORAGE, AND HANDLING

.1 Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying product name and manufacturer.

.2 Store materials in a clean, dry area in accordance with manufacturer's instructions.

.3 Store adhesive at temperatures of 4.4°C (40°F) and above to facilitate handling.

.4 Do not store at temperatures above 32°C (90°F) for extended periods.

.5 Protect materials during handling and application to prevent damage or contamination.

1.6 ENVIRONMENTAL REQUIREMENTS

.1 Product not intended for uses subject to abuse or permanent exposure to the elements.

.2 Apply membrane when conditions are dry and rain is not imminent.

.3 Ensure concrete is poured within 60 days of membrane application.

Part 2 Products

2.1 MATERIALS

.1 Waterproofing Membrane: 73 mil (1.85mm) thick, composite sheet membrane comprised of an elastomeric membrane bonded to a three-ply plasmatic matrix and a non-woven geotextile fabric.

.1 Performance Based Spec: waterproofing membrane shall have the following properties as determined by laboratory testing:

.1 Membrane Thickness: 1.85 mm (73 mil)

.2 Low Temperature Flexibility, ASTM D1970: Pass

.3 Resistance to Hydrostatic Head, ASTM D5385-93: 70 m (230')

.4 Elongation, ASTM D412-06: >400%

.5 Tensile Strength (film), ASTM D882: 63.4 MPa (9,200 psi)

.6 Crack Cycling, ASTM C836: Pass

.7 Puncture Resistance, ASTM E154: >934 N (>210 lb)

.8 Peel Adhesion to Concrete, ASTM D903: 1,754 N/m (10 lb/in)

.9 Moisture Vapor Transmission, ASTM E96 (Method B): 0.0011 perms

.10 Resistance to Penetration by Termites, Texas A&M Method, Percentage of Penetration: 0.0%

.11 Resistance to Penetration by Pesticides, ASTM F2130, Percentage of Penetration: 0.0%

.12 Resistance to Fungi in Soil, GSA-PBS 07115 – 16 weeks: No Effect

.2 Accessories: Membrane manufacturer's recommended liquid membrane for fastener and overlap details, terminations fabric, tape adhesives, and drainage system.

Part 3 Execution

3.1 EXAMINATION

.1 Examine surfaces to receive membrane. Notify architect if surfaces are not acceptable. Do not begin surface preparation or installation until unacceptable conditions have been corrected.

3.2 SURFACE PREPARATION

.1 Inspect all surfaces for any conditions detrimental to the proper completion of the work.

.2 Ensures surfaces are structurally sound.

.3 Remove debris or any other foreign material that could damage the membrane.

3.3 INSTALLATION

.1 Horizontal Application

.1 Prepare subgrade prior to membrane application according to ACI 302.1R.17.

.2 Ensure the fabric side of the membrane is facing up.

.3 Remove release paper on 150 mm (6") selvedge edge and overlap edges of additional sheet. Roll press into place.

.4 For end-to-end overlap, overlap membrane 152.4 mm (6").

.5 Apply liquid detail membrane in this area to be lapped and roll press membrane into this liquid detail membrane.

.6 Apply liquid detail membrane at terminations of membrane, 310 mm (12”) wide centered over the termination.

.7 Embed detail fabric into this wet liquid detail membrane centered over the termination, 152.4 mm (6”) on each side of lap edge, and roll press into place.

.8 Apply additional liquid detail membrane on all terminations of detail fabric.

.9 Inspect membrane prior to pouring of concrete for any punctures or damage.

.10 Repair damaged areas as directed by the manufacturer.

3.4 PROTECTION

.1 Ensure membrane is not damaged prior to concrete pour.

.2 Ensure concrete is poured within 60 days of membrane application.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 CAN/ULC-S701-11, Standard for Thermal Insulation, Polystyrene, Boards and Pipe Coverings.

1.2 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 board insulation and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Certificates:

.1 Submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

.4 Test Reports:

.1 Submit certified test reports showing compliance with specified performance characteristics and physical properties.

1.3 DELIVERY, STORAGE AND HANDLING

.1 Deliver materials to Site in their original wrappings with labels intact and store in areas directed by Consultant.

.2 Store insulation on raised platforms and protect with waterproof covers. Prevent exposure of insulation to UV exposure.

.3 Store materials inside buildings for 24 hours prior to installation.

Part 2 Products

2.1 MATERIALS

.1 Wall or Perimeter Insulation: Extruded, expanded polystyrene, CAN/ULC S701 Type 4, minimum RSI (R) value of 0.87 per 25 mm (5.0 per 1"), compressive strength 210 kPa, thickness as indicated on Drawings. Boards shall have ship-lap edges.

.2 Adhesive: As recommended by manufacturer of insulating materials.

.3 Cement Mortar Mix: 1 part Portland cement, 6 part masonry sand, 1 part hydrated lime, potable water to produce a workable mix.

Part 3 Execution

3.1 PREPARATION

.1 Ensure that surfaces to receive adhesive or insulation are dry, firm, straight, and free from loose material, projections, ice, frost, slick, grease, oil or other matter detrimental to bond of the adhesive or uniform bedding of the insulation.

.2 Maintain surface and ambient temperatures during application and curing of adhesive at a temperature recommended by the manufacturer of the type of adhesive used.

3.2 INSTALLATION

.1 Do not install insulation until substrate surfaces have been reviewed by the Consultant.

.2 Do not apply any insulation when surface and air temperature is below 4°C.

.3 Surfaces to receive insulation shall be dry and free of dew, frost, voids, loose material, oil, grease and other material detrimental to bond.

.4 Cut out back of insulation as required to fit over projecting anchors or fastenings. Cut and fit insulation neatly with tight joints around pipes, ducts, obstructions, openings and corners.

.5 Apply daubs of adhesive to back of insulation boards and press firmly into place with joints butted and staggered.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 09 21 16 - Gypsum Board Assemblies.

1.2 REFERENCES

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

.1 ASTM C 553-02, Specification for Mineral Fibre Blanket Thermal Insulation for Commercial and Industrial Applications.

.2 Canadian Standards Association (CSA International)

.1 CSA B111-1974(R2003), Wire Nails, Spikes and Staples.

.3 Underwriters Laboratories of Canada (ULC)

.1 CAN/ULC-S702-1997, Standard for Mineral Fibre Insulation.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Product Data:

.1 Submit manufacturer's printed product literature, specifications and data sheets.

.2 Manufacturer's Instructions:

.1 Submit manufacturer's installation instructions.

1.4 QUALITY ASSURANCE

.1 Test Reports: certified test reports showing compliance with specified performance characteristics and physical properties.

.2 Certificates: product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

1.5 WASTE MANAGEMENT AND DISPOSAL

.1 Separate waste materials for reuse and recycling.

.2 Remove from site and dispose of packaging materials at appropriate recycling facilities.

.3 Collect and separate for disposal paper, plastic, polystyrene ,corrugated cardboard packaging material for recycling in accordance with Waste Management Plan.

Part 2 Products

2.1 INSULATION

.1 Batt and blanket mineral fibre: to CAN/ULC S702.

.1 Type: 1.

.2 Thickness: as indicated.

2.2 ACCESSORIES

.1 Insulation clips:

.1 Impale type, perforated 50 x 50 mm cold rolled carbon steel 0.8 mm thick, adhesive back, spindle of 2.5 mm diameter annealed steel, length to suit insulation, 25 mm diameter washers of self locking type.

.2 Nails: galvanized steel, length to suit insulation plus 25 mm, to CSA B111.

.3 Staples: 12 mm minimum leg.

.4 Tape: as recommended by manufacturer.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

.1 Compliance: comply with manufacturer's written data, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, and data sheets.

3.2 INSULATION INSTALLATION

.1 Install insulation to maintain continuity of thermal protection to building elements and spaces and to ASTM C 1320 .

.2 Fit insulation closely around electrical boxes, pipes, ducts, frames and other objects in or passing through insulation.

.3 Do not compress insulation to fit into spaces.

.4 Keep insulation minimum 75 mm from heat emitting devices such as recessed light fixtures.

.5 Do not enclose insulation until it has been inspected and approved by NRC Departmental Representative.

3.3 CLEANING

.1 Upon completion of installation, remove surplus materials, rubbish, tools and equipment barriers.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 09 21 16 - Gypsum Board Assemblies.

1.2 REFERENCES

.1 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-51.33-M89, Vapour Barrier Sheet, Excluding Polyethylene, for Use in Building Construction.

.2 CAN/CGSB-51.34-M86, Vapour Barrier, Polyethylene Sheet, for Use in Building Construction.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Section 00 10 00 General Instructions.

.2 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet and include:

.1 Product characteristics.

.2 Performance criteria.

.3 Limitations.

.3 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS).

.4 Quality assurance submittals:

.1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.2 Instructions: submit manufacturer's installation instructions and comply with written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

1.4 DELIVERY, STORAGE AND HANDLING

.1 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 SHEET VAPOUR BARRIER

.1 Polyethylene film: to CAN/CGSB-51.34, 0.10mm thick.

2.2 ACCESSORIES

.1 Joint sealing tape: type recommended by vapour barrier manufacturer, 50 mm wide for lap joints and perimeter seals, 25 mm wide elsewhere.

.2 Sealant: compatible with vapour retarder materials, recommended by vapour retarder manufacturer. To Section 07 92 00 - Joint Sealants.

.3 Staples: minimum 6 mm leg.

.4 Moulded box vapour barrier: factory-moulded polyethylene box for use with recessed electric switch and outlet device boxes.

Part 3 Execution

3.1 INSTALLATION

.1 Ensure services are installed and inspected prior to installation of retarder.

.2 Install sheet vapour retarder on warm side of exterior wall assemblies prior to installation of gypsum board to form continuous retarder.

.3 Use sheets of largest practical size to minimize joints.

.4 Inspect for continuity. Repair punctures and tears with sealing tape before work is concealed.

3.2 EXTERIOR SURFACE OPENINGS

.1 Cut sheet vapour retarder to form openings and ensure material is lapped and sealed to frame.

3.3 PERIMETER SEALS

.1 Seal perimeter of sheet vapour barrier as follows:

.1 Apply continuous bead of sealant to substrate at perimeter of sheets.

.2 Lap sheet over sealant and press into sealant bead.

.3 Install staples through lapped sheets at sealant bead into wood substrate.

.4 Ensure that no gaps exist in sealant bead. Smooth out folds and ripples occurring in sheet over sealant.

3.4 LAP JOINT SEALS

.1 Seal lap joints of sheet vapour barrier as follows:

.1 Attach first sheet to substrate.

.2 Apply continuous bead of sealant over solid backing at joint.

.3 Lap adjoining sheet minimum 150 mm and press into sealant bead.

.4 Install staples through lapped sheets at sealant bead into wood substrate.

.5 Ensure that no gaps exist in sealant bead. Smooth out folds and ripples occurring in sheet over sealant.

3.5 ELECTRICAL BOXES

.1 Seal electrical switch and outlet device boxes that penetrate vapour barrier as follows:

.1 Install moulded box vapour barrier .

.2 Apply sealant to seal edges of flange to main vapour barrier and seal wiring penetrations through box cover.

3.6 CLEANING

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

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 04 04 99 –Masonry for Minor Works

1.2 REFERENCES

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

.1 ASTM C920-11, Standard Specification for Elastomeric Joint Sealants

.2 ASTM D412 – 06ae2, Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers-Tension.

.3 ASTM E96/E96M – 10, Standard Test Methods for Water Vapor Transmission of Materials.

.4 ASTM E283 – 04: Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.

.5 ASTM E2357 – 11, Standard Test Method for Determining Air Leakage of Air Barrier Assemblies

.2 Canadian General Standards Board (CGSB)

.1 CGSB 37-GP-56M85: Membrane, Modified, Bituminous, Prefabricated, and Reinforced.

.2 CGSB 71-GP-24M85: Adhesive, Flexible, for Bonding Cellular Polystyrene Insulation

1.3 SUBMITTALS

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

.2 Shop drawings: Provide drawings of special joint conditions and locations.

.3 Product data: Submit manufacturer's product data sheets on products, characteristics, performance criteria, and limitations, installation instructions indicating preparation, installation requirements, product storage and handling criteria.

.4 Samples: Two 150 mm x 150 mm samples of sheet air barriers.

1.4 QUALITY ASSURANCE

.1 Perform Work in accordance with requirements for materials and installation.

.2 Perform Work in accordance with National Air Barrier Association - Professional Contractor Quality Assurance Program and requirements for materials and installation.

.3 Perform Work in accordance with Canadian Urethane Foam Contractors Association - Professional Contractor Quality Assurance Program and requirements for materials and installation.

.4 Maintain one copy of documents on site.

1.5 QUALIFICATIONS

.1 Applicator: Company specializing in performing work of this section with minimum 5 years experience with installation of air/vapour barrier systems. Completed installation must be approved by the material manufacturer.

.2 Applicator: Company who is currently licensed by National Air Barrier Association, Canadian Urethane Foam Contractors Association or other certifying organization must maintain their license throughout the duration of the project.

1.6 PRE- INSTALLATION MEETINGS

.1 Convene one week prior to commencing Work of this section.

1.7 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with manufacturer=s written instructions.

.2 Avoid spillage. Immediately notify NRC Departmental Representative if spillage occurs and start clean up procedures.

.3 Clean spills and leave area as it was prior to spill.

1.8 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal, and with the Waste Reduction Workplan.

.2 Place materials defined as hazardous or toxic waste in designated containers.

.3 Ensure emptied containers are sealed and stored safely for disposal away from children.

1.9 PROJECT ENVIRONMENTAL REQUIREMENTS

.1 Do not install solvent curing sealants or vapour release adhesive materials in enclosed spaces without ventilation. Ventilate enclosed spaces.

.2 Maintain temperature and humidity recommended by materials manufactures before, during and after installation.

1.10 SEQUENCING

.1 Sequence work to permit installation of materials in conjunction with related materials and seals.

1.11 WARRANTY

.1 For sealant and sheet materials the 12 months warranty period prescribed in subsection GC 32.1 of General Conditions "C" is extended to 24 months.

.2 Warranty: Include coverage of installed sealant and sheet materials which fail to achieve air tight and watertight seal, exhibit loss of adhesion or cohesion, or do not cure.

Part 2 Products

2.1 SHEET MATERIALS

.1 Sheet air/vapour barrier membrane: SBS modified bitumen, self-adhering sheet membrane complete with a cross-laminated polyethylene film, having the following physical properties:

.1 Thickness: 1.0 mm (40 mils)
.2 Air leakage: <0.005 L/s.m² @ 75 Pa to ASTM E283-91
.3 Tested to ASTM E 2357 for the air barrier assembly
.4 Water vapour permeance: 1.6 ng/Pa.m².s (0.03 perms) to ASTM E96
.5 Low temperature flexibility: -30 °C to CGSB 37-GP-56M
.6 Elongation: 200% to ASTM D412-modifed.

2.2 ACCESSORIES

.1 Primer for self-adhering membranes at temperatures above -4 degrees C: polymer emulsion based adhesive, quick setting, having the following physical properties:

.1 Weight: 1.0 kg/l
.2 Solids by weight: 53%
.3 Water based, no solvent odours
.4 Drying time (initial set): 30 minutes at 50%RH and 20 degrees C.

.2 Liquid air seal mastic and insulation adhesive: synthetic, trowel applied, rubber based adhesive, compatible with air/vapour barrier membrane, substrate and insulation, having the following characteristics:

.1 Air leakage: 0.013 L/s.m² @ 100 Pa.
.2 Water vapour permeance: 1.7 ng/Pa.m².s. (0.03 perms).
.3 Long term flexibility: to CGSB 71-GP-24M.
.4 Chemical resistance: Alkalis and salt.

.3 Termination Sealant: moisture cure, medium modulus polymer modified sealing compound, compatible with sheet air barrier and substrate, having the following physical properties:

.1 Complies with ASTM C 920, Type S, Grade NS, Class 25.

.2 Elongation: 450 – 550%.

.4 Termination Sealant: polymer modified sealing compound, compatible with sheet waterproofing membrane and substrate, having the following characteristics:

.1 Solids by volume: 70%.

.2 Vapour permeance: 2.9 ng/Pa.m^2.s, ASTM E96.

.3 Chemical resistance: Alkalis, calcium chloride, mild acid and salt solutions.

.5 Thinner and cleaner for Sheet: As recommended by sheet material manufacturer.

.6 Attachments: Galvanized steel bars and anchors.

Part 3 Execution

3.1 EXAMINATION

.1 Verify that surfaces and conditions are ready to accept the Work of this section.

.2 Ensure all surfaces are clean, dry, sound, smooth, continuous and comply with air barrier manufacturer’s requirements.

.3 Report any unsatisfactory conditions to the NRC Departmental Representative in writing.

.4 Do not start work until deficiencies have been corrected. Commencement of Work implies acceptance of conditions.

3.2 PREPARATION

.1 Remove loose or foreign matter which might impair adhesion of materials.

.2 Ensure all substrates are clean of oil or excess dust; all masonry joints struck flush, and open joints filled; and all concrete surfaces free of large voids, spalled areas or sharp protrusions.

.3 Ensure all substrates are free of surface moisture prior to application of self-adhesive membrane and primer.

.4 Ensure metal closures are free of sharp edges and burrs.

.5 Prime all surfaces prior to application of membranes in accordance with manufacturer's instructions.

3.3 INSTALLATION

.1 Install the membrane in strict accordance with the manufacturer's written instructions and the representative's on site instructions.

.2 Ensure complete coverage of and adhesion to all substrate to receive the air/vapour barrier membrane, including all wall protrusions. Co-operate with other Sections to ensure continuity of the barrier.

.3 Apply membranes to primed substrate in accordance with manufacturer's recommendations and written instructions.

.4 Apply membrane so that horizontal joints overlap with the upper sheet over the lower sheet, shingle style. Lap all horizontal joints minimum 50 mm all side joints minimum 64 mm and all end joints minimum 150 mm. Stagger vertical joints to avoid four way joints.

.5 Apply a trowelled head of mastic to all terminations of the membrane at the end of a day's work and at membrane terminations.

.6 Reinforce all inside and outside corners with a continuous 300 mm wide sheet membrane prior to installing the air/vapour barrier.

.7 Fill gaps and joints with mastic and reinforce with a continuous 300 mm wide sheet membrane prior to installing the air/vapour barrier.

.8 Use mastic at all protrusions and difficult detail areas and provide a minimum 64 mm overlap with the sheet membrane.

.9 Apply air/vapour barrier so that the exterior wall is air tight, with air tight junctures at openings, penetrations and edges.

.10 Inspect air/vapour barrier for continuity immediately prior to installation of insulation. Do not cover the air/vapour barrier until it has been inspected.

.11 Repair punctures, rips and tears with pieces of membrane completely adhered to the damaged membrane.

.12 Where punctures and tears are extensive, replace entire damaged section.

.13 Install membrane over doors, and other openings to exterior walls.

.14 At openings, extend membrane 200 mm beyond jambs, heads and sills.

.15 Use mastic or fixing bars to adhere membrane to doors to maintain continuity of the barrier.

3.4 PROTECTION OF WORK

.1 Do not permit adjacent work to damage work of this section.

.2 Ensure finished Work is protected from climatic conditions.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 07 92 00 - Joint Sealing.

1.2 REFERENCES

.1 American Society for Testing and Materials International, (ASTM).

.1 ASTM A653/A653M-09, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

.2 ASTM D523-08, Standard Test Method for Specular Gloss.

.3 ASTM D822-01 (2006), Standard Practice for Filtered Open-Flame Carbon-Arc Exposures of Paint and Related Coatings.

.2 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-19.24-M90, Multicomponent, Chemical-Curing Sealing Compound

.3 Canadian Standards Association (CSA International)

.1 CSA G40.20-04/G40.21-04 (R2009), General Requirements for Rolled or Welded Structural Quality Steel/ Structural Quality Steel

.2 CSA G164-M92, Hot Dip Galvanizing of Irregularly Shaped Articles Metals and Metal Products

.4 Underwriters' Laboratories of Canada (ULC).

.1 CAN/ULC-S702-09-EN, Standard for Mineral Fibre Thermal Insulation for Buildings

1.3 PERFORMANCE REQUIREMENTS

.1 Design temperatures: In accordance with requirements of OBC.

.2 Expansion and contraction: Design work to accommodate expansion and contraction within design temperature range.

.3 Design wind load: In accordance with requirements of OBC.

.4 Design snow load: In accordance with requirements of OBC.

.5 Deflection: Maximum L/240 of clear span at design loads.

.6 Design work to maintain profile specified.

1.4 SUBMITTALS

.1 Product data: submit manufacturer's printed product literature, specifications and data sheet in accordance with Section 01 33 00 - Submittal Procedures.

.1 Submit two copies of WHMIS MSDS - Material Safety Data Sheets in accordance with Section 01 33 00 - Submittal Procedures.

.2 Shop Drawings:

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

.2 Indicate dimensions, profiles, attachment methods, schedule of wall elevations, trim and closure pieces, metal furring, and related work.

.3 Samples:

.1 Submit samples in accordance with Section 01 33 00 - Submittal Procedures.

.2 Submit duplicate 50 x 75 mm samples of cladding material, of colour and profile specified.

.4 Manufacturer's Instructions:

.1 Submit manufacturer's installation instructions.

1.5 QUALITY ASSURANCE

.1 Test Reports: certified test reports showing compliance with specified performance characteristics and physical properties.

.2 Certificates: product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

.3 Pre-Installation Meetings: conduct pre-installation meeting to verify project requirements, manufacturer's installation instructions and manufacturer's warranty requirements

1.6 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.

.2 Divert used metal cut-offs from landfill by disposal removed for disposal at the nearest metal recycling facility.

.3 Divert reusable materials for reuse at nearest used building materials facility.

.4 Divert unused caulking, sealants, and adhesive materials from landfill through disposal at hazardous material depot.

Part 2 Products

2.1 SHEET METAL MATERIALS

.1 Zinc coated steel sheet: to ASTM A653/A653M, commercial quality, with Z275 coating, regular spangle surface, 0.8 mm minimum base metal thickness.

2.2 STEEL CLADDING AND COMPONENTS

.1 Exterior wall panels:

.1 Type PNL-1: Pre-finished steel, 950 mm width, 35 mm deep, flat profile, vertical application.

.2 Type PNL-2: Pre-finished steel, 300 mm width, 39 mm deep, flat profile, vertical application.

.2 Metal Liner: of suitable core thickness hot dipped galvanized steel.

.3 Flashings, trims, and closures: Steel core thickness and finish to match siding. Inside corners, outside corners, cap strip, drip cap, undersill trim, starter strip and door trim of same material and colour as siding, with fastener holes pre-punched.

.4 Sub-Girts, Z members, clips, and brackets: to CAN/CSA G40.21, Grade 300W of required core steel thickness to meet design requirements, hot dipped galvanized after fabrication to CSA G164.

.5 Fiberglass Thermal Spacers: 100 % Pultruded glass fibre and thermoset polyester resin insulation clip, 4.8 mm nominal thickness for top, base and web.

.1 Fasteners: As recommended by panel manufacturer, concealed and non-corrosive.

.6 Fasteners: Non-corrosive concealed fasteners of stainless steel, aluminum or cadmium plated steel, as recommended by the manufacturer. Where exposed fasteners are required, provide fasteners in colours matching siding work.

.7 Rigid/Semi Rigid Insulation Boards (for walls): Preformed glass or mineral fibre batt insulation, CAN/ULC-S702, Type 1, in thickness as indicated on Drawings.

.8 Sealant: to CAN/CGSB-19.24.

.9 Backer rod: Non-absorbent, non-gassing, closed cell polyolefin foam, over sized 25%.

2.3 FABRICATION

.1 Co-ordinate and verify at job site dimensions affecting work of this Section. Ensure suitability of adjacent building components in relation to work of this Section.

.2 Accurately fit joints and intersecting members to true planes, adequately and securely fastened and made completely water and weathertight. Component fastening devices shall be of adequate strength and concealed, except as specified otherwise.

.3 Fabricate work to profiles and sizes indicated complete with rabbets, interlocks, flashings, cappings, trim, filler sections as required to interface with work of other Sections. Make provisions for thermal and structural movements.

.4 Fabricate all devices required for erection and adequate anchorage and attachment required to be built into or attached to substrate and framing members for proper support.

.5 Accurately cut and form flashing true and straight without waves or buckles. Make adequate provision for thermal movement and make joints watertight.

.6 Reinforce work to meet specified requirements and prevent undue deflection. Provide concealed corrosion resistant fastening and continuous formed pre-finished cleats.

2.4 COATING SYSTEM

.1 Factory applied polyvinylidene fluoride.

.1 Class F1S.
.2 Colour to match the patina of the adjacent copper roofing.
.3 Specular gloss: 30 units +/-5 to ASTM D523.
.4 Coating thickness: not less than 22micrometres.
.5 Resistance to accelerated weathering for chalk rating of 8, colour fade 5 units or less and erosion rate less than 20% to ASTM D822 as follows:
.1 Outdoor exposure period 2500 hours.
.2 Humidity resistance exposure period 5000 hours.

Part 3 Execution

3.1 INSTALLATION - GENERAL

.1 Install cold rolled structural girts and other members required to support work of this Section except as otherwise shown on Drawings.

.2 Install work in accordance with manufacturer's written instructions, plumb with intersecting parts joined together to provide tight, accurately fitted joints with adjoining surfaces in true planes. Attach components in manner not restricting thermal movement.

3.2 INSTALLATION - METAL WALL SYSTEM

.1 Lay a ribbon of sealant on the face of the support at top and bottom of wall panels and around perimeter of openings. Line up and adjust interior liner sheets, press tightly against sealant and seal all vertical joints to form an air/vapour seal between liner and structural supports.

.2 Fasten Z members and girts through liner sheets to structural supports with self-tapping screws at 300 mm centres and to suit loading requirements.

.3 Clip fiberglass thermal spacers to Z-girts, spaced to meet design load requirements. Fasten the top spacer with single screw so the Z-girt can pivot, allowing installation of insulation. After insulation is in place, drill the balance of screws in the spacers, and continue to the next bay.

.4 Install insulation using stick clips and washers, in sufficient numbers to ensure firm and continuous contact with air barrier and adjacent insulation boards. Butt each board against adjacent boards, with joints staggered. Fit neatly with tight joints around obstructions, openings and corners. Fill voids behind flashings and trim with neatly cut insulation.

.5 Fasten siding to Z members and girts with concealed fasteners where possible and at spacings to suit loading requirements. Ensure complete nesting of exterior siding sheets on Z members and girts and sealed side lap joints.

.6 Align units end-to-end to provide accurate fit with corresponding sections parallel and straight. Keep exposed fasteners to a minimum. Maintain minimum end overlap of 50 mm and locate directly over supports.

3.3 INSTALLATION - FLASHING, CLOSURE, TRIM AND ACCESSORIES

.1 Cut and flash openings for doors, windows and the like. Provide all necessary closures, flashings, gutter, downspouts, drips and trims, sealed to stop direct weather penetration.

3.4 SEALING

.1 Seal junctions with adjoining work with sealant. Apply and cure sealant in accordance with manufacturer's instructions.

.2 Use backer rod to maintain correct sealant width/depth ratio as recommended by the sealant manufacturer.

.3 Apply sealant in continuous beads, using gun with proper size nozzle and sufficient pressure to fill voids and joints solid.

.4 Form surface of sealant with full bead, smooth, free from ridges, wrinkles, sags, air pockets, embedded impurities.

.5 Tool exposed surfaces to give slightly concave shape.

3.5 CLEANING

.1 Upon completion of installation, remove surplus materials, rubbish, tools and equipment barriers.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 ASTM International Inc.

.1 ASTM C1177/C1177M-08, Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing.

.2 Canadian General Standards Board (CGSB)

.1 CGSB 37-GP-9Ma-83, Primer, Asphalt, Unfilled, for Asphalt Roofing, Dampproofing and Waterproofing.

.2 CGSB 37-GP-56M-85, Membrane, Modified, Bituminous, Prefabricated, and Reinforced for Roofing.

.3 CAN/CGSB-51.33-M89, Vapour Barrier Sheet, Excluding Polyethylene, for Use in Building Construction.

.3 Canadian Roofing Contractors Association (CRCA)

.1 CRCA Roofing Specifications Manual-1997.

.4 Canadian Standards Association (CSA International)

.1 CSA A123.21-04, Standard Test Method for the Dynamic Wind Uplift Resistance of Mechanically Attached Membrane-Roofing Systems

.2 CSA-A123.3-05, Asphalt Saturated Organic Roofing Felt.

.3 CSA-A123.4-04 (R2008), Asphalt for Constructing Built-Up Roof Coverings and Waterproofing Systems.

.4 CSA O121-08, Douglas Fir Plywood.

.5 Factory Mutual (FM Global)

.1 FM Approvals - Roofing Products.

.6 Health Canada / Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

.7 Underwriters Laboratories' of Canada (ULC)

.1 CAN/ULC-S702.2-09, Standard for Mineral Fibre Thermal Insulation for Buildings.

.2 CAN/ULC-S704-03, Standard for Thermal Insulation, Polyurethane and Polyisocyanurate Boards, Faced.

1.2 ADMINISTRATIVE REQUIREMENTS

.1 Convene pre-installation meeting one week prior to beginning waterproofing Work, with roofing contractor's representative and NRC Departmental Representative to:

.1 Verify project requirements.

.2 Review installation and substrate conditions.

.3 Co-ordination with other building subtrades.

.4 Review manufacturer's installation instructions and warranty requirements.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Provide two copies of most recent technical roofing components data sheets describing materials' physical properties and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Provide two copies of WHMIS MSDS, and indicate VOC content for:

.1 Primers.

.2 Asphalt.

.3 Sealers.

.4 Filter fabric.

.3 Provide shop drawings:

.1 Indicate flashing, control joints, tapered insulation details.

.2 Provide layout for tapered insulation.

.4 Samples: submit two (2) samples of membrane cap sheet.

.5 Manufacturer's Certificate: certify that products meet or exceed specified requirements.

.6 Test and Evaluation Reports: submit laboratory test reports certifying compliance of bitumens and roofing felts and membrane with specification requirements.

.7 Manufacturer's Installation Instructions: indicate special precautions required for seaming the membrane.

.8 Manufacturer's field report: in accordance with Section 01 45 00 - Quality Control.

.9 Reports: indicate procedures followed, ambient temperatures and wind velocity during application.

1.4 QUALITY ASSURANCE

.1 Installer qualifications: company or person specializing in application of modified bituminous roofing systems with 5 years documented experience approved by manufacturer.

.2 Sustainability Standards Certification:

.1 Recycled Content: provide listing of recycled content products used, including details of required percentages or recycled content materials and products, showing their costs and percentages of post-consumer and post-industrial content, and total cost of materials for project.

.2 Regional Materials: provide evidence that project incorporates required percentage of regional materials/products, showing their cost, distance from project to furthest site of extraction or manufacture, and total cost of materials for project.

1.5 FIRE PROTECTION

.1 Fire Extinguishers:

.1 Maintain one cartridge operated type or stored pressure rechargeable type with hose and shut-off nozzle,

.2 ULC labelled for A, B and C class protection.

.3 Provide one fire extinguisher on roof per torch applicator, within 6 m of torch applicator.

.2 Maintain fire watch for 1 hour after each day's roofing operations cease.

1.6 DELIVERY, STORAGE, AND HANDLING

.1 Deliver, store and handle materials in accordance with manufacturer's written instructions and Section 01 61 00 - Common Product Requirements.

.2 Storage and Handling Requirements:

.1 Safety: comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage, and disposal of asphalt, sealing compounds, primers and caulking materials.

.2 Provide and maintain dry, off-ground weatherproof storage.

.3 Store rolls of felt and membrane in upright position. Store membrane rolls with salvage edge up.

.4 Remove only in quantities required for same day use.

.5 Place plywood runways over completed Work to enable movement of material and other traffic.

.6 Store sealants at +5 degrees C minimum.

.7 Store insulation protected from daylight and weather and deleterious materials.

.3 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, paddling and packaging materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

.1 Collect and separate plastic, paper packaging and corrugated cardboard in accordance with Waste Management Plan.

.2 Fold up metal banding, flatten and place in designated area for recycling.

1.7 FIELD CONDITIONS

.1 Ambient Conditions

.1 Do not install roofing when temperature remains below -18 degrees C for torch application, or to manufacturers' recommendations for mop application.

.2 Minimum temperature for solvent-based adhesive is -5 degrees C.

.2 Install roofing on dry deck, free of snow and ice, use only dry materials and apply only during weather that will not introduce moisture into roofing system.

1.8 WARRANTY

.1 For Work of this Section 07 52 00 - Modified Bituminous Membrane Roofing, 12 months warranty period is extended to 60 months.

Part 2 Products

2.1 PERFORMANCE CRITERIA

.1 Compatibility between components of roofing system is essential. Provide written declaration to NRC Departmental Representative stating that materials and components, as assembled in system, meet this requirement.

.2 Roofing System: to CSA A123.21 for wind uplift resistance.

2.2 ACCEPTABLE MANUFACTURERS

.1 Manufacturers: Subject to compliance with requirements, provide products by one of the following, or equivalent approved by the NRC Departmental Representative::

.1 Soprema.

.2 Henry Company.

.3 IKO.

2.3 DECK PRIMER

.1 Asphalt primer: to CGSB 37-GP-9Ma.

2.4 VAPOUR RETARDER

.1 Self adhesive air/vapour barrier modified bitumen membrane.

2.5 MEMBRANE

.1 Base sheet: to CGSB 37-GP-56M, Type 2, Class C, Grade 1, minimum 2.0 mm thick, non-woven fibrous glass reinforcement and thermofusible elastomeric

asphalt, thermofusible plastic film top face and lightly sanded bottom face, applied by mopping only.

.2 Cap sheet membrane: to CGSB 37-GP-56M, Type 1, Class A, Grade 2, minimum 3.5 mm thick, non-woven 250 g/sq.m. polyester reinforcement and thermofusible elastomeric asphalt, coloured ceramic or mineral granules top face and thermofusible plastic film bottom face, applied by torching only

2.6 ADHESIVE

.1 Adhesive for securing overlay board and insulation: asphalt extended vulcanized adhesive, two component unit, consisting of two liquids mixed on site to produce pourable adhesive.

2.7 OVERLAY BOARD

.1 Overlay Board: 6 mm thick asphalt based recovery board with non-woven glass facers, as recommended by the membrane manufacturer.

.1 Install over insulation to provide torch safe surface.

2.8 BITUMEN

.1 Asphalt: to CAN/CSA A123.4, Type 2.

2.9 INSULATION

.1 Polyisocyanurate Insulation

.1 To CAN/ULC-S704, flame spread classification: less than 500, thickness as indicated.

.2 Tapered Insulation

.1 To CAN/ULC-S702.2, taper cut to provide slopes indicated, on computer controlled machine and sequence packed with detailed installation instruction. Thickness shall not be less than 13 mm.

2.10 SEALERS

.1 Plastic cement: asphalt.

.2 Sealing compound: rubber asphalt type.

2.11 WALKWAYS

.1 Walkways to consist of one additional ply of cap sheet membrane. Colour to be different from field membrane as selected by NRC Departmental Representative.

2.12 CANT STRIPS

.1 Cut from prefabricated fibreboard material, to measure 140 mm on slope.

2.13 FASTENERS

.1 Covering to steel deck: No. 10 flat head, self tapping, Type A or AB, cadmium plated screws. Recommend FM Approved screw and plate assemblies.

.2 Insulation to deck: coated insulation fasteners and galvanized plates must meet FM Approval for wind uplift and corrosion resistance, as recommended by insulation manufacturer.

Part 3 Execution

3.1 QUALITY OF WORK

.1 Do examination, preparation and roofing Work in accordance with Roofing Manufacturer's Specification Manual and CRCA Roofing Specification Manual.

.2 Do priming in accordance with manufacturers written recommendations.

.3 The interface of the walls and roof assemblies will be fitted with durable rigid material plywood providing connection point for continuity of air barrier.

.4 Assembly, component and material connections will be made in consideration of appropriate design loads, with reversible mechanical attachments.

3.2 EXAMINATION OF ROOF DECKS

.1 Verification of Conditions:

.1 Inspect with NRC Departmental Representative deck conditions including parapets, construction joints, roof drains, plumbing vents and ventilation outlets to determine readiness to proceed.

.2 Evaluation and Assessment:

.1 Prior to beginning of work ensure:

.1 Decks are firm, straight, smooth, dry, free of snow, ice or frost, and swept clean of dust and debris. Do not use calcium or salt for ice or snow removal.

.2 Curbs have been built.

.3 Roof drains have been installed at proper elevations relative to finished roof surface.

.4 Plywood and lumber nailer plates have been installed to deck, walls and parapets as indicated.

.3 Do not install roofing materials during rain or snowfall.

3.3 PROTECTION OF IN-PLACE CONDITIONS

.1 Cover walls, walks, slopped roofs and adjacent work where materials hoisted or used.

.2 Use warning signs and barriers. Maintain in good order until completion of Work.

.3 Clean off drips and smears of bituminous material immediately.

.4 Dispose of rain water off roof and away from face of building until roof drains or hoppers installed and connected.

.5 Protect roof from traffic and damage. Comply with precautions deemed necessary by NRC Departmental Representative.

.6 At end of each day's work or when stoppage occurs due to inclement weather, provide protection for completed Work and materials out of storage.

.7 Metal connectors and decking will be treated with rust proofing or galvanization.

3.4 PRIMING DECK

.1 Apply deck primer to roofing substrate at the rate recommended by manufacturer.

3.5 VAPOUR RETARDER (CONCRETE/GYPSUM BOARD/PLYWOOD DECK)

.1 Modified bituminous vapour retarder sheet.

3.6 (EXPOSED) CONVENTIONAL MEMBRANE ROOFING (CMR) APPLICATION

.1 Insulation: fully adhered, adhesive application:

.1 Adhere insulation to laminated vapour barrier using solvent-based adhesive.

.2 Place boards in parallel rows with ends staggered, and in firm contact with one another.

.3 Cut end pieces to suit.

.4 Apply adhesive in continuous ribbons at 300 mm on centre.

.5 Separate the membrane and insulation with a drainage layer or slipsheet.

.2 Insulation: fully adhered, bitumen application:

.1 Embed insulation in 1 to 1.5 kg/m^2 mopping of bitumen.

.2 Place boards in parallel rows with ends staggered, and in firm contact with one another.

.3 Cut end pieces to suit.

.3 Insulation: mechanically fastened application:

.1 Mechanically fasten insulation using screws and pressure distribution plates.

.2 Fasten insulation as per manufacturer's written recommendations.

.3 Number and pattern of screws per board to meet Factory Mutual requirements.

.4 Place boards in parallel rows with ends staggered, and in firm contact with one another.

.5 Cut end boards to suit.

.4 Tapered insulation application:

.1 Mop insulation to vapour retarder with hot asphalt at rate of 1 kg/m^2.

.2 Install tapered insulation as firstinsulation layer, in accordance with shop drawings. Stagger joints between layers 150 mm minimum.

.5 Overlay Board: adhesive application:

.1 Adhere overlay board to insulation with vulcanized adhesive at the rate of one litre per m^2.

.2 Place boards in parallel rows with end joints staggered. Cap joints approximately 25 mm.

.3 Cut ends to suit and apply adhesive in continuous ribbons at 300 mm on centre.

.6 Base sheet application:

.1 Starting at low point of roof, perpendicular to slope, unroll base sheet, align and reroll from both ends.

.2 Unroll and embed base sheet in uniform coating of asphalt applied at rate of 1.2 kg/m^2, at 230 degrees C.

.3 Lap sheets 75 mm minimum for side and 150 mm minimum for end laps.

.4 Application to be free of blisters, wrinkles and fishmouths.

.7 Cap sheet application:

.1 Starting at low point on roof, perpendicular to slope, unroll cap sheet, align and reroll from both ends.

.2 Unroll and torch cap sheet onto base sheet taking care not to burn membrane or its reinforcement.

.3 Lap sheets 75 mm minimum for side laps and 150 mm minimum for end laps. Offset joints in cap sheet 300 mm minimum from those in base sheet.

.4 Application to be free of blisters, fishmouths and wrinkles.

.5 Do membrane application in accordance with manufacturer's recommendations.

.8 Flashings:

.1 Complete installation of flashing base sheet stripping prior to installing membrane cap sheet.

.2 Torch base and cap sheet onto substrate in 1 metre wide strips.

.3 Lap flashing base sheet to membrane base sheet minimum 150 mm and seal by mopping or torch welding.

.4 Lap flashing cap sheet to membrane cap sheet 250 mm minimum and torch weld.

.5 Provide 75 mm minimum side lap and seal.

.6 Properly secure flashings to their support, without sags, blisters, fishmouths or wrinkles.

.7 Do work in accordance with manufacturer's recommendations.

.9 Roof penetrations:

.1 Install roof drain pans, vent stack covers and other roof penetration flashings and seal to membrane in accordance with manufacturer's recommendations and details.

3.7 CANTS

.1 Install prefabricated fibre cants over rigid insulation.

.2 Apply hot bitumen to receiving surface and embed cant firmly by hand.

.3 Angle cut cants to fit tightly on back and bottom where roof to wall angle varies from 90 degrees.

3.8 WALKWAYS

.1 Install walkway membrane in accordance with manufacturer's instructions and as indicated.

.1 Apply primer to cap sheet membrane and torch apply, ensuring selvage edge is removed.

.2 Install pavers, level on insulation pads, as indicated.

3.9 FIELD QUALITY CONTROL

.1 Inspections:

.1 Inspection and testing of roofing application will be carried out by testing laboratory designated by NRC Departmental Representative.

.2 NRC Departmental Representative will pay for tests as specified in Section 01 45 00 - Quality Control.

3.10 CLEANING

.1 Remove bituminous markings from finished surfaces.

.2 In areas where finished surfaces are soiled caused by work of this section, consult manufacturer of surfaces for cleaning advice and complying with their documented instructions.

.3 Repair or replace defaced or disfigured finishes caused by work of this section.

.4 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Construction/Demolition Waste Management.

.1 Place materials defined as hazardous or toxic in designated containers.

.2 Clearly label location of salvaged material's storage areas and provide barriers and security devices.

.3 Ensure emptied containers are sealed and stored safely.

.4 Unused adhesive, sealant and asphalt materials must not be disposed of into sewer system, into streams, lakes, onto ground or in other location where it will pose health or environmental hazard.

.5 Dispose of unused adhesive material at official hazardous material collections site approved by NRC Departmental Representative.

.6 Dispose of unused sealant material at official hazardous material collections site approved by NRC Departmental Representative.

.7 Dispose of unused asphalt material at official hazardous material collections site approved by NRC Departmental Representative.

.8 Divert unused gypsum materials from landfill to recycling facility as reviewed by NRC Departmental Representative.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

.2 Underwriter's Laboratories of Canada (ULC)

.1 ULC-S115-1995, Fire Tests of Fire stop Systems.

1.2 DEFINITIONS

.1 Fire Stop Material: device intended to close off opening or penetration during fire or materials that fill openings in wall or floor assembly where penetration is by cables, cable trays, conduits, ducts and pipes and poke-through termination devices, including electrical outlet boxes along with their means of support through wall or floor openings.

.2 Single Component Fire Stop System: fire stop material that has Listed Systems Design and is used individually without use of high temperature insulation or other materials to create fire stop system.

.3 Multiple Component Fire Stop System: exact group of fire stop materials that are identified within Listed Systems Design to create on site fire stop system.

.4 Tightly Fitted; (ref: NBC Part 3.1.9.1.1 and 9.10.9.6.1): penetrating items that are cast in place in buildings of noncombustible construction or have "0" annular space in buildings of combustible construction.

.1 Words "tightly fitted" should ensure that integrity of fire separation is such that it prevents passage of smoke and hot gases to unexposed side of fire separation.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Submit two copies of WHMIS MSDS - Material Safety Data Sheets.

.2 Shop Drawings:

.1 Submit shop drawings to show location, proposed material, reinforcement, anchorage, fastenings and method of installation.

.2 Construction details should accurately reflect actual job conditions.

.3 Quality assurance submittals:

.1 Test reports: in accordance with CAN-ULC-S101 for fire endurance and CAN-ULC-S102 for surface burning characteristics.

.1 Submit certified test reports from approved independent testing laboratories, indicating compliance of applied fire stopping with specifications for specified performance characteristics and physical properties.

.2 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.3 Manufacturer's Instructions: submit manufacturer's installation instructions and special handling criteria, installation sequence, cleaning procedures.

1.4 QUALITY ASSURANCE

.1 Qualifications:

.1 Installer: person specializing in fire stopping installations with 5 years documented experience or approved by manufacturer.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Packing, shipping, handling and unloading:

.1 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.2 Deliver materials to the site in undamaged condition and in original unopened containers, marked to indicate brand name, manufacturer, ULC markings.

.2 Storage and Protection:

.1 Store materials indoors, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Replace defective or damaged materials with new.

.3 Waste Management and Disposal:

.1 Separate waste materials for reuse and recycling.

Part 2 Products

2.1 MATERIALS

.1 Fire stopping and smoke seal systems: in accordance with CAN-ULC-S115.

.1 Asbestos-free materials and systems capable of maintaining effective barrier against flame, smoke and gases in compliance with requirements of CAN- ULC-S115 and not to exceed opening sizes for which they are intended and conforming to specified special requirements described in PART 3.

.2 Fire stop system rating: 2hrs.

.2 Service penetration assemblies: systems tested to CAN-ULC-S115.

.3 Service penetration fire stop components: certified by test laboratory to CAN-ULC-S115.

.4 Fire-resistance rating of installed fire stopping assembly in accordance with NBC.

.5 Fire stopping and smoke seals at openings intended for ease of re-entry such as cables: elastomeric seal.

.6 Fire stopping and smoke seals at openings around penetrations for pipes, ductwork and other mechanical items requiring sound and vibration control: elastomeric seal.

.7 Primers: to manufacturer's recommendation for specific material, substrate, and end use.

.8 Water (if applicable): potable, clean and free from injurious amounts of deleterious substances.

.9 Damming and backup materials, supports and anchoring devices: to manufacturer's recommendations, and in accordance with tested assembly being installed as acceptable to authorities having jurisdiction.

.10 Sealants for vertical joints: non-sagging.

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 PREPARATION

.1 Examine sizes and conditions of voids to be filled to establish correct thicknesses and installation of materials.

.1 Ensure that substrates and surfaces are clean, dry and frost free.

.2 Prepare surfaces in contact with fire stopping materials and smoke seals to manufacturer's instructions.

.3 Maintain insulation around pipes and ducts penetrating fire separation.

.4 Mask where necessary to avoid spillage and over coating onto adjoining surfaces; remove stains on adjacent surfaces.

3.3 INSTALLATION

.1 Install fire stopping and smoke seal material and components in accordance with manufacturer's certified tested system listing.

.2 Seal holes or voids made by through penetrations, poke-through termination devices, and unpenetrated openings or joints to ensure continuity and integrity of fire separation are maintained.

.3 Provide temporary forming as required and remove forming only after materials have gained sufficient strength and after initial curing.

.4 Tool or trowel exposed surfaces to neat finish.

.5 Remove excess compound promptly as work progresses and upon completion.

3.4 SEQUENCES OF OPERATION

.1 Proceed with installation only when submittals have been reviewed by NRC Departmental Representative.

.2 Install floor fire stopping before interior partition erections.

.3 Metal deck bonding: fire stopping to precede spray applied fireproofing to ensure required bonding.

.4 Mechanical pipe insulation: certified fire stop system component.

.1 Ensure pipe insulation installation precedes fire stopping.

3.5 FIELD QUALITY CONTROL

.1 Inspections: notify NRC Departmental Representative when ready for inspection and prior to concealing or enclosing fire stopping materials and service penetration assemblies.

3.6 CLEANING

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

.2 Remove temporary dams after initial set of fire stopping and smoke seal materials.

3.7 SCHEDULE

.1 Fire stop and smoke seal at:

.1 Penetrations through fire-resistance rated masonry, concrete, and gypsum board partitions and walls.

.2 Edge of floor slabs at curtain wall and precast concrete panels.

.3 Top of fire-resistance rated masonry and gypsum board partitions.

.4 Intersection of fire-resistance rated masonry and gypsum board partitions.

.5 Control and sway joints in fire-resistance rated masonry and gypsum board partitions and walls.

.6 Penetrations through fire-resistance rated floor slabs, ceilings and roofs.

.7 Openings and sleeves installed for future use through fire separations.

.8 Around mechanical and electrical assemblies penetrating fire separations.

.9 Rigid ducts: greater than 129 cm^2: fire stopping to consist of bead of fire stopping material between retaining angle and fire separation and between retaining angle and duct, on each side of fire separation.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 ASTM International

.1 ASTM C 919-08, Standard Practice for Use of Sealants in Acoustical Applications.

.2 Canadian General Standards Board (CGSB)

.1 CGSB 19-GP-5M-1984, Sealing Compound, One Component, Acrylic Base, Solvent Curing (Issue of 1976 reaffirmed, incorporating Amendment No. 1).

.2 CAN/CGSB-19.13-M87, Sealing Compound, One-component, Elastomeric, Chemical Curing.

.3 CGSB 19-GP-14M-1984, Sealing Compound, One Component, Butyl-Polyisobutylene Polymer Base, Solvent Curing (Reaffirmation of April 1976).

.4 CAN/CGSB-19.17-M90, One-Component Acrylic Emulsion Base Sealing Compound.

.5 CAN/CGSB-19.24-M90, Multi-component, Chemical Curing Sealing Compound.

.3 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

.4 South Coast Air Quality Management District (SCAQMD), California State, Regulation XI. Source Specific Standards

.1 SCAQMD Rule 1168-A2005, Adhesives and Sealants Applications.

1.2 ACTION AND INFORMATI SUBMITTALS

.1 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for joint sealants and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Manufacturer's product to describe:

.1 Caulking compound.

.2 Primers.

.3 Sealing compound, each type, including compatibility when different sealants are in contact with each other.

.3 Submit 2 copies of WHMIS MSDS.

.2 Samples:

.1 Submit 2 samples of each type of material and colour.

.2 Cured samples of exposed sealants for each colour where required to match adjacent material.

.3 Manufacturer's Instructions:

.1 Submit instructions to include installation instructions for each product used.

1.3 CLOSEOUT

.1 Operation and Maintenance Data: submit operation and maintenance data for incorporation into manual.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance 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 Replace defective or damaged materials with new.

.4 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials.

1.5 SITE CONDITIONS

.1 Ambient Conditions:

.1 Proceed with installation of joint sealants only when:

.1 Ambient and substrate temperature conditions are within limits permitted by joint sealant manufacturer or are above 4.4 degrees C.

.2 Joint substrates are dry.

.3 Conform to manufacturer's recommended temperatures, relative humidity, and substrate moisture content for application and curing of sealants including special conditions governing use.

.2 Joint-Width Conditions:

.1 Proceed with installation of joint sealants only where joint widths are more than those allowed by joint sealant manufacturer for applications indicated.

.3 Joint-Substrate Conditions:

.1 Proceed with installation of joint sealants only after contaminants capable of interfering with adhesion are removed from joint substrates.

1.6 ENVIRONMENTAL REQUIREMENTS

.1 Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage, and disposal of hazardous materials; and regarding labelling and provision of Material Safety Data Sheets (MSDS) acceptable to Health Canada.

.2 Ventilate area of work as directed by NRC Departmental Representative.

Part 2 Products

2.1 SEALANT MATERIALS

.1 Do not use caulking that emits strong odours, contains toxic chemicals or is not certified as mould resistant in air handling units.

.2 When low toxicity caulks are not possible, confine usage to areas which off gas to exterior, are contained behind air barriers, or are applied several months before occupancy to maximize off gas time.

.3 Where sealants are qualified with primers use only these primers.

2.2 SEALANT MATERIAL DESIGNATIONS

.1 Polysulfide two part:

.1 Self-levelling to CAN/CGSB-19.24, Type 1, Class B, clear colour.

.2 Polysulfide two part:

.1 Non-sag: to CAN/CGSB-19.24, Type 2, Class B, clear colour.

.3 Urethanes two part:

.1 Self-levelling: to CAN/CGSB-19.24, Type 1, Class B, clear colour.

.4 Urethanes two part:

.1 Non-sag: to CAN/CGSB-19.24, Type 2, Class B, clear colour.

.5 Silicones one part: to CAN/CGSB-19.13.

.6 Acrylics one part: to CGSB 19-GP-5M.

.7 Acrylic latex one part: to CAN/CGSB-19.17.

.8 Acoustical sealant: to ASTM C 919.

.9 Butyl: to CGSB 19-GP-14M.

.10 Preformed compressible and non-compressible back-up materials:

.1 Polyethylene, urethane, neoprene or vinyl foam:

.1 Extruded closed cell foam backer rod.

.2 Size: oversize 30 to 50 %.

.2 Neoprene or butyl rubber:

.1 Round solid rod, Shore A hardness 70.

.3 High density foam:

.1 Extruded closed cell polyvinyl chloride (PVC), extruded polyethylene, closed cell, Shore A hardness 20, tensile strength 140 to 200 kPa, extruded polyolefin foam, 32 kg/mü density, or neoprene foam backer, size as recommended by manufacturer.

.4 Bond breaker tape:

.1 Polyethylene bond breaker tape which will not bond to sealant.

2.3 SEALANT SELECTION

.1 Refer to drawings for sealing work not specifically listed in this Section.

.2 Perimeters of exterior openings where frames meet exterior facade of building (i.e. brick, block, precast masonry): sealant type: Urethane two part.

.3 Expansion and control joints in exterior surfaces of poured-in-place concrete walls: sealant type: Compessable.

.4 Expansion and control joints in exterior surfaces of precast, architectural wall panels: sealant type: Compressable.

.5 Control and expansion joints in exterior surfaces of unit masonry walls: sealant type: Compressable.

.6 Seal interior perimeters of exterior openings as detailed on drawings: sealant type: Urethane two part.

.7 Control and expansion joints on the interior of exterior surfaces of unit masonry walls: sealant type: Compressable.

.8 Perimeters of interior frames, as detailed and itemized: sealant type: Acrylic.

.9 Interior masonry vertical control joints (block-to-block, block-to-concrete, and intersecting masonry walls): sealant type: Compressable.

.10 Joints at tops of non-load bearing masonry walls at the underside of poured concrete: sealant type: Compressable.

.11 Perimeter of bath fixtures (e.g. sinks, tubs, urinals, stools, water closets, basins, vanities): sealant type: Silicone.

2.4 JOINT CLEANER

.1 Non-corrosive and non-staining type, compatible with joint forming materials and sealant in accordance with sealant manufacturer's written recommendations.

.2 Primer: in accordance with sealant manufacturer's written recommendations.

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 joint sealants installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate.

.2 Inform NRC 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 NRC Departmental Representative.

3.2 SURFACE PREPARATION

.1 Examine joint sizes and conditions to establish correct depth to width relationship for installation of backup materials and sealants.

.2 Clean bonding joint surfaces of harmful matter substances including dust, rust, oil grease, and other matter which may impair Work.

.3 Do not apply sealants to joint surfaces treated with sealer, curing compound, water repellent, or other coatings unless tests have been performed to ensure compatibility of materials. Remove coatings as required.

.4 Ensure joint surfaces are dry and frost free.

.5 Prepare surfaces in accordance with manufacturer's directions.

3.3 PRIMING

.1 Where necessary to prevent staining, mask adjacent surfaces prior to priming and caulking.

.2 Prime sides of joints in accordance with sealant manufacturer's instructions immediately prior to caulking.

3.4 BACKUP MATERIAL

.1 Apply bond breaker tape where required to manufacturer's instructions.

.2 Install joint filler to achieve correct joint depth and shape, with approximately 30% compression.

3.5 MIXING

.1 Mix materials in strict accordance with sealant manufacturer's instructions.

3.6 APPLICATION

.1 Sealant:

- .1 Apply sealant in accordance with manufacturer's written instructions.
- .2 Mask edges of joint where irregular surface or sensitive joint border exists to provide neat joint.
- .3 Apply sealant in continuous beads.
- .4 Apply sealant using gun with proper size nozzle.
- .5 Use sufficient pressure to fill voids and joints solid.
- .6 Form surface of sealant with full bead, smooth, free from ridges, wrinkles, sags, air pockets, embedded impurities.
- .7 Tool exposed surfaces before skinning begins to give slightly concave shape.
- .8 Remove excess compound promptly as work progresses and upon completion.

.2 Curing:

- .1 Cure sealants in accordance with sealant manufacturer's instructions.
- .2 Do not cover up sealants until proper curing has taken place.

3.7 CLEANING

.1 Progress Cleaning:

- .1 Leave Work area clean at end of each day.
- .2 Clean adjacent surfaces immediately.
- .3 Remove excess and droppings, using recommended cleaners as work progresses.
- .4 Remove masking tape after initial set of sealant.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.

.3 Waste Management: separate waste materials for reuse and recycling.

- .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.8 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by joint sealants installation.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 08 71 00 - Door Hardware.

.2 Section 08 80 50 - Glazing.

.3 Section 09 91 23 - Interior Painting.

1.2 REFERENCES

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

.1 ASTM A 653/A 653M-06a, Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

.2 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-1.181-99, Ready-Mixed Organic Zinc-Rich Coating.

.2 CGSB 41-GP-19Ma-84, Rigid Vinyl Extrusions for Windows and Doors.

.3 Canadian Standards Association (CSA International)

.1 CSA-G40.20-04/G40.21-04, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.

.2 CSA W59-03, Welded Steel Construction (Metal Arc Welding).

.4 Canadian Steel Door Manufacturers' Association (CSDMA)

.1 CSDMA, Recommended Specifications for Commercial Steel Doors and Frames, 2000.

.2 CSDMA, Selection and Usage Guide for Commercial Steel Doors, 1990.

.5 National Fire Protection Association (NFPA)

.1 NFPA 80-99, Standard for Fire Doors and Fire Windows.

.2 NFPA 252-03, Standard Methods of Fire Tests of Door Assemblies.

.6 South Coast Air Quality Management District (SCAQMD), California State

.1 SCAQMD Rule 1113-04, Architectural Coatings.

.2 SCAQMD Rule 1168-05, Adhesives and Sealants Applications.

.7 Underwriters' Laboratories of Canada (ULC)

.1 CAN/ULC-S702-09, Standard for Thermal Insulation, Mineral Fibre, for Buildings.

.2 CAN/ULC-S704-03, Standard for Thermal Insulation, Polyurethane and Polyisocyanurate Boards, Faced.

.3 CAN4-S104-M80, Standard Method for Fire Tests of Door Assemblies.

.4 CAN4-S105-M85, Standard Specification for Fire Door Frames Meeting the Performance Required by CAN4-S104.

1.3 SYSTEM DESCRIPTION

.1 Design Requirements:

.1 Design exterior frame assembly to accommodate to expansion and contraction when subjected to minimum and maximum surface temperature of -35 degrees C to 35 degrees C.

.2 Maximum deflection for exterior steel entrance screens under wind load of 1.2 kPa not to exceed 1/175th of span.

.3 Steel fire rated doors and frames: labelled and listed by an organization accredited by Standards Council of Canada in conformance with CAN4-S104 NFPA 252 for ratings specified or indicated.

.4 Provide fire labelled frames for openings requiring fire protection ratings. Test products in conformance with CAN4-S104, ASTM E 152 or NFPA 252 and listed by nationally recognized agency having factory inspection services.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Section 01 33 00.

.2 Provide product data: in accordance with Section 01 33 00 - Submittal Procedures.

.3 Provide shop drawings: in accordance with Section 01 33 00 - Submittal Procedures.

.1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.

.2 Indicate each type of door, material, steel core thicknesses, mortises, reinforcements, location of exposed fasteners, openings, glazed louvred, arrangement of hardware and fire rating and finishes.

.3 Indicate each type frame material, core thickness, reinforcements, glazing stops, location of anchors and exposed fastenings and reinforcing fire rating finishes.

.4 Include schedule identifying each unit, with door marks and numbers relating to numbering on drawings and door schedule.

.5 Submit test and engineering data, and installation instructions.

.4 Provide samples in accordance with Section 01 33 00 - Submittal Procedures.

.5 Submit one 300 x 300 mm corner sample of each type of frame.

.1 Show butt cutout, glazing stops, 300 mm long removable mullion connection snap-on trim with clips.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with manufacture's written instructions.

.2 Waste Management and Disposal:

.1 Separate waste materials for reuse and recycling.

Part 2 Products

2.1 MATERIALS

.1 Hot dipped galvanized steel sheet: to ASTM A 653M, ZF75, minimum base steel thickness in accordance with CSDMA Table 1 - Thickness for Component Parts.

.2 Reinforcement channel: to CSA G40.20/G40.21, Type 44W, coating designation to ASTM A 653M, ZF75.

.3 Mineral fibre insulation: to CAN/ULC-S702 minimum density 24 kg/m^3.

2.2 DOOR CORE MATERIALS

.1 Honeycomb construction:

.1 Structural small cell, 24.5 mm maximum kraft paper 'honeycomb', weight: 36.3 kg per ream minimum, density: 16.5 kg/mü minimum sanded to required thickness.

.2 Stiffened: face sheets welded, insulated core.

.1 Vertically stiffen with steel ribs all insulated doors.

.2 Fill voids with mineral fibre insulation.

2.3 ADHESIVES

.1 Honeycomb cores and steel components: heat resistant, spray grade, resin reinforced neoprene/rubber (polychloroprene) based, low viscosity, contact cement.

.1 Adhesive: maximum VOC content 50 g/L to SCAQMD Rule 1168.

.2 Insulation: heat resistant, epoxy resin based, low viscosity, contact cement.

.3 Lock-seam doors: fire resistant, resin reinforced polychloroprene, high viscosity, sealant/adhesive.

2.4 PRIMER

.1 Touch-up prime CAN/CGSB-1.181.

.1 Maximum VOC limit 50 g/L to GC-03.

2.5 PAINT

.1 Field paint steel doors and frames in accordance with Sections 09 91 23 - Interior Painting, 09 91 13 - Exterior Painting. Protect weatherstrips from paint. Provide final finish free of scratches or other blemishes.

.1 Maximum VOC emission level 50 g/L to GS-11 to SCAQMD Rule 1113.

2.6 ACCESSORIES

.1 Door silencers: single stud rubber/neoprene type. Two at head of each door, three at strike of each door.

.2 Exterior and interior top and bottom caps: steel.

.3 Fabricate glazing stops as formed channel, minimum 16 mm height, accurately fitted, butted at corners and fastened to frame sections with counter-sunk oval head sheet metal screws.

.4 Metallic paste filler: to manufacturer's standard.

.5 Fire labels: metal rivited.

.6 Make provisions for glazing as indicated and provide necessary glazing stops.

.1 Provide removable stainless steel glazing beads for use with glazing tapes and compounds and secured with countersunk stainless steel screws.

.2 Design exterior glazing stops to be tamperproof.

2.7 FRAMES FABRICATION GENERAL

.1 Fabricate frames in accordance with CSDMA specifications.

.2 Fabricate frames to profiles and maximum face sizes as indicated.

.3 Exterior frames: 1.3 mm welded, thermally broken type construction.

.4 Interior frames: 1.3 mm weldedtype construction.

.5 Blank, reinforce, drill and tap frames for mortised, templated hardware, and electronic hardware using templates provided by finish hardware supplier. Reinforce frames for surface mounted hardware.

.6 Protect mortised cutouts with steel guard boxes.

.7 Manufacturer's nameplates on frames and screens are not permitted.

.8 Conceal fastenings except where exposed fastenings are indicated.

.9 Provide factory-applied touch up primer at areas where zinc coating has been removed during fabrication.

.10 Insulate exterior frame components with polyurethane insulation.

2.8 FRAME ANCHORAGE

.1 Provide appropriate anchorage to floor and wall construction.

.2 Locate each wall anchor immediately above or below each hinge reinforcement on hinge jamb and directly opposite on strike jamb.

.3 Provide 2 anchors for rebate opening heights up to 1520 mm and 1 additional anchor for each additional 760 mm of height or fraction thereof.

.4 Locate anchors for frames in existing openings not more than 150 mm from top and bottom of each jambs and intermediate at 660 mm on centre maximum.

2.9 FRAMES: WELDED TYPE

.1 Welding in accordance with CSA W59.

.2 Accurately mitre or mechanically joint frame product and securely weld on inside of profile.

.3 Cope accurately and securely weld butt joints of mullions, transom bars, centre rails and sills.

.4 Grind welded joints and corners to a flat plane, fill with metallic paste and sand to uniform smooth finish.

.5 Securely attach floor anchors to inside of each jamb profile.

.6 Weld in 2 temporary jamb spreaders per frame to maintain proper alignment during shipment.

2.10 DOOR FABRICATION GENERAL

.1 Doors: swing type, flush, with provision for glass and/or louvre openings as indicated.

.2 Exterior doors: insulated hollow steel construction. Interior doors: honeycomb construction.

.3 Fabricate doors with longitudinal edges welded. Seams: grind welded joints to a flat plane, fill with metallic paste filler and sand to a uniform smooth finish.

.4 Blank, reinforce, drill doors and tap for mortised, templated hardware and electronic hardware.

.5 Factory prepare holes 12.7 mm diameter and larger except mounting and through-bolt holes, on site, at time of hardware installation.

.6 Reinforce doors where required, for surface mounted hardware. Provide flush steel top caps to exterior doors. Provide inverted, recessed, spot welded channels to top and bottom of interior doors.

.7 Provide factory-applied touch-up primer at areas where zinc coating has been removed during fabrication.

.8 Provide fire labelled doors for those openings requiring fire protection ratings, as scheduled. Test such products in conformance with CAN4-S104 ASTM E 152 NFPA 252 and list by nationally recognized agency having factory inspection service and construct as detailed in Follow-Up Service Procedures/Factory Inspection Manuals issued by listing agency to individual manufacturers.

.9 Manufacturer's nameplates on doors are not permitted.

2.11 DOORS: HONEYCOMB CORE CONSTRUCTION

.1 Form face sheets for exterior doors from1.0 mm sheet steel with polystyrene core laminated under pressure to face sheets.

.2 Form face sheets for interior doors from 1.0 mm sheet steel with honeycomb core laminated under pressure to face sheets.

2.12 HOLLOW STEEL CONSTRUCTION

.1 Form face sheets for exterior doors from 1.0 mm sheet steel.

.2 Form face sheets for interior doors from 1.0 mm sheet steel.

.3 Fill voids between stiffeners of exterior doors with mineral fibre insulation.

2.13 THERMALLY BROKEN DOORS AND FRAMES

.1 Fabricate thermally broken doors by using insulated core and separating exterior parts from interior parts with continuous interlocking thermal break.

.2 Thermal break: rigid polyvinylchloride extrusion conforming to CGSB 41-GP-19Ma.

.3 Fabricate thermally broken frames separating exterior parts form interior parts with continuous interlocking thermal break.

.4 Apply insulation.

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 GENERAL

.1 Install labelled steel fire rated doors and frames to NFPA 80 except where specified otherwise.

.2 Install doors and frames to CSDMA Installation Guide.

3.3 FRAME INSTALLATION

.1 Set frames plumb, square, level and at correct elevation.

.2 Secure anchorages and connections to adjacent construction.

.3 Brace frames rigidly in position while building-in. Install temporary horizontal wood spreader at third points of door opening to maintain frame width. Provide vertical support at centre of head for openings over 1200 mm wide. Remove temporary spreaders after frames are built-in.

.4 Make allowances for deflection of structure to ensure structural loads are not transmitted to frames.

.5 Caulk perimeter of frames between frame and adjacent material.

.6 Maintain continuity of air barrier and vapour retarder.

3.4 DOOR INSTALLATION

.1 Install doors and hardware in accordance with hardware templates and manufacturer's instructions and Section 08 71 00 - Door Hardware.

.2 Provide even margins between doors and jambs and doors and finished floor and thresholds as follows.

.1 Hinge side: 1.0 mm.

.2 Latchside and head: 1.5 mm.

.3 Finished floor, top of carpet, noncombustible sill and thresholds: 13 mm.

.3 Adjust operable parts for correct function.

.4 Install glazing.

3.5 FINISH REPAIRS

.1 Touch up with primer finishes damaged during installation.

.2 Fill exposed frame anchors and surfaces with imperfections with metallic paste filler and sand to a uniform smooth finish.

3.6 GLAZING

.1 Install glazing for doors and frames in accordance with Section 08 80 50 - Glazing.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 08 71 00 - Door Hardware.

1.2 REFERENCES

.1 Architectural Woodwork Manufacturers Association of Canada (AWMAC).

.1 Quality Standards for Architectural Woodwork 1998.

.2 Canadian General Standards Board (CGSB).

.1 CAN/CGSB-71.19-M88, Adhesive, Contact, Sprayable.

.2 CAN/CGSB-71.20-M88, Adhesive, Contact, Brushable.

.3 Canadian Standards Association (CSA International).

.1 CAN/CSA-O132.5-M1992(R1998), Stile and Rail Wood Doors.

.4 Environmental Choice Program (ECP).

.1 CCD-045-92, Sealants and Caulking Compounds.

.2 CCD-046-92, Adhesives.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Product Data:

.1 Submit manufacturer's printed product literature, specifications and data sheet in accordance with Section 00 10 00 General Instructions.

.2 Submit two copies of WHMIS MSDS - Material Safety Data Sheets. Indicate VOC's:

.1 For door materials and adhesives.

.2 Shop Drawings:

.1 Submit shop drawings in accordance with Section 00 10 00 General Instructions .

.2 Indicate door types , sizes, core construction.

1.4 SAMPLES

.1 Submit samples in accordance with Section 00 10 00 General Instructions.

.2 Submit one 300 x 300 mm corner sample of each type wood door.

.3 Show door construction, core, glazing detail and faces.

.4 Manufacturer's Instructions:

.1 Submit manufacturer's installation instructions.

1.5 QUALITY ASSURANCE

.1 Certificates: product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

.1 Storage and Protection:

.1 Protect doors from dampness. Arrange for delivery after work causing abnormal humidity has been completed.

.2 Store doors in well ventilated room, off floor, in accordance with manufacturer's recommendations.

.3 Protect doors from scratches, handling marks and other damage. Wrap, Crate doors.

.4 Store doors away from direct sunlight.

1.7 WASTE MANAGEMENT AND DISPOSAL

.1 Remove from site and dispose of packaging materials at appropriate recycling facilities.

.2 Dispose of corrugated cardboard, polystyrene, plastic packaging material in appropriate on-site bin for recycling.

.3 Unused or damaged glazing materials are not recyclable and must not be diverted to municipal recycling programs.

Part 2 Products

2.1 WOOD FLUSH DOORS

.1 Solid core: to CAN/CSA-O132.2.1.

.1 Construction:

.1 Solid particleboard core: stile and rail frame bonded to particleboard core with wood lock blocks, 3-ply construction.

.2 Solid wood core:

.1 Glued block core with wood edge band.

.2 Framed block glued core.

.3 Framed block nonglued core.

.4 Stile and rail core.

.5 5-ply 7-ply construction.

.2 Face Panels:

.1 Laminated plastic: with hardwood plywood subface.

2.2 LAMINATED PLASTIC

.1 Plastic laminate: PLAM3.

.2 Backing: hardwood plywood subface to CSA O115.

.3 Laminated plastic adhesive:

.1 According to manufacturer's written instructions.

2.3 FABRICATION

.1 Vertical edge strips to match face plastic laminate.

.2 Finish laminated plastic smooth and flush with stile edges of door and bevel at approximately 20 degrees.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

.1 Compliance: comply with manufacturer's written data, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, and data sheets.

3.2 INSTALLATION

.1 Unwrap and protect doors in accordance with CAN/CSA-O132.2 Series, Appendix A.

.2 Install doors and hardware in accordance with manufacturer's printed instructions and CAN/CSA-O132.2 Series, Appendix A.

.3 Adjust hardware for correct function.

.4 Secure transom and side panels by means of concealed fasteners or countersunk screws.

3.3 ADJUSTMENT

.1 Re-adjust doors and hardware just prior to completion of building to function freely and properly.

3.4 CLEANING

.1 Perform cleaning as soon as possible after installation to remove construction and accumulated environmental dirt.

.2 On completion of installation, remove surplus materials, rubbish, tools and equipment barriers.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 04 04 99 – Masonry for Minor Works.

.2 Section 09 21 16 - Gypsum Board Assemblies.

.3 Mechanical Divisions.

1.2 REFERENCES

.1 Green Seal Environmental Standards (GS)

.1 GS-11-2008, 2nd Edition, Paints and Coatings.

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 access door components and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:

.1 Submit catalogue details for each type of door illustrating profiles, dimensions and methods of assembly.

.4 Samples:

.1 Submit for review and acceptance of each unit.

.2 Samples will be returned for inclusion into work.

.3 Submit 1 of each type of hand entry access door.

.4 Submit one 300 x 300 mm corner sample of each type of body entry door.

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 cleaning and maintenance of stainless steel finishes 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 access doors from nicks, scratches, and blemishes.

.3 Apply temporary protective coating to finished surfaces. Remove coating after installation.

.1 Use coatings in accordance with manufacturer's written instructions that are easily removable.

.2 Leave protective coating in place until final cleaning of building.

.4 Replace defective or damaged materials with new.

Part 2 Products

2.1 ACCESS DOORS

.1 Sizes: 500 x 1000 mm unless indicated:

.2 Construction: rounded safety corners, concealed hinges, screwdriver latch, anchor straps, able to open 180 degrees.

.1 Flush Access Doors with Exposed Flanges: Fabricate door to fit flush to frame. Provide manufacturer's standard-width exposed flange, proportional to door size.

.3 Materials:

.1 Prime coated steel.

.1 Primer: VOC limit 250 g/L maximum to GS-11.

2.2 EXCLUSIONS

.1 Lay-in tile ceilings: use unobtrusive identification locators.

Part 3 Execution

3.1 EXAMINATION

.1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for access door installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate in presence of NRC Departmental Representative.

.2 Inform NRC 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 NRC Departmental Representative.

3.2 INSTALLATION

.1 Installation: locate access doors within view of equipment and ensure equipment is accessible for operating, inspecting, adjusting, servicing without using special tools.

.1 Install masonry surfaces: in accordance with Section 04 04 99 – Masonry for Minor Works.

.2 Install gypsum board surfaces: in accordance with Section 09 21 16 - Gypsum Board Assemblies.

3.3 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.

.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 Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.4 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by access door installation.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Division 26, Electrical

1.2 REFERENCES

.1 ASTM International

.1 ASTM A 653/A 653M-11, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

.2 Electrical and Electronic Manufacturers' Association of Canada (EEMAC)

.3 Green Seal Environmental Standards (GS)

.1 GS-36-00, Commercial Adhesives.

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 door components and grilles 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 Province of Ontario, Canada.

.2 Indicate each type of door, arrangement of hardware, required clearances, electrical characteristics including voltage, size of motors, auxiliary controls and wiring diagrams.

.3 Indicate assembly details and dimensions of fabrication, required clearances and electrical connections.

.4 Samples:

.1 Submit for review and acceptance of each unit.

.2 Samples will be returned for inclusion into work.

.5 Test Reports: certified test reports showing compliance with specified performance characteristics and physical properties.

1.4 CLOSEOUT SUBMITTALS

.1 Operation and Maintenance Data: submit operation and maintenance data for overhead coiling doors, and hardware for incorporation into manual.

1.5 QUALITY ASSURANCE

.1 Certifications: product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance 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 overhead coiling doors from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

.4 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials.

Part 2 Products

2.1 DESIGN CRITERIA

.1 Design rolling door curtain and assembly to withstand wind load of 960 Pa within door opening area.

2.2 MATERIALS

.1 Galvanized steel sheet: to ASTM A653/A653M, commercial quality with Coating Designation Z275.

.2 Doors:

.1 Door face sheets to interior doors 0.9 mm minimum base thickness.

.2 Door face sheets to exterior doors 1.2 mm minimum base thickness.

.3 Adhesives and Sealants: VOC limit to GS-36.

2.3 DOOR FABRICATION

.1 Coiling door curtain interlocking flat slat sections:

.1 Roll formed steel: 75 mm wide, galvanized.

.2 Ensure bottom bar is equipped with tubular neoprene weatherstrip.

.3 Where wind locks are required:

.1 Rivet alternate end locks to slat ends.

.2 Rivet alternate wind locks to slat ends.

.4 Where wind locks are not required:

.1 Rivet continuous end locks to slat ends.

.5 Non-fire rated doors, up to 4800 mm wide:

.1 Provide bottom bar of extruded aluminum section, equipped with tubular neoprene weatherstrip.

.6 Non-fire rated doors, more than 4800 mm wide:

.1 Provide bottom bar of double equal weight steel angles, equipped with tubular neoprene weatherstrip.

.7 Form guides of metal angles of sections of 4.8 mm minimum thickness for between jambs or face of wall installation. Equip guides of non-fire rated doors with tubular neoprene weatherstrip.

.8 Construct counterbalance assembly of heat treated torsion spring with 25% overload factor.

.1 Enclose spring in steel pipe to support door curtain and counterbalance mechanism with maximum deflection of 1/360th of opening width.

.2 Include ball bearings at rotating points and spring tension adjusting wheel, accessible for setting.

.9 Support counterbalance assembly on 5 mm minimum thickness steel plate brackets, forming end enclosures.

.10 Enclose counterbalance assembly with galvanized steel sheet formed hood, equipped with weatherstripping.

.11 Equip door for locking from inside with slide bolt and lockset.

2.4 OPERATION

.1 Equip door for operation by:

.1 Electric motor operator.

2.5 ELECTRICAL OPERATOR

.1 Electrical motors, controller units, remote pushbutton stations, relays and other electrical components: to CSA and ULC approval with EEMAC enclosures.

.2 Motor: high starting torque, instant reversing, capacity to operate grille at 200 mm per second, removable without affecting emergency chain device or setting of limit switches. Equip motor with overload protection, centrifugal clutch and electric brake.

.3 Motor size matching gear reducer with gears running in oil bath.

.4 Controller units with integral motor reversing starter, 3 heater elements for overload protection, including pushbuttons and control relays as applicable.

.5 Operation:

.1 Remote push button stations: surface mounted, in locations indicated, with OPEN-STOP-CLOSE push buttons.

.6 Design brake to stop and hold doors in any position.

.7 Include hand chain interlocked auxiliary operator to disconnect motor mechanically and electrically when engaged and allow manual operation of door.

.8 Safety switch: electro mechanical or electro pneumatic device full length of bottom rail of bottom section of door, to reverse door to open position when coming in contact with object on closing cycle.

.9 Mounting brackets: galvanized steel, size and thickness to suit conditions.

.10 Control circuit: 24 VAC.

Part 3 Execution

3.1 EXAMINATION

.1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for overhead coiling doors and grilles installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate.

.2 Inform NRC 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 NRC Departmental Representative.

3.2 INSTALLATION

.1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, and data sheets.

.2 Install doors in accordance with manufacturer's printed instructions.

.3 Install electrical motors, controller units, pushbutton stations, relays and other electrical equipment required for door operation.

.4 Install electric wiring from power supply located near door.

.5 Adjust door operating components to ensure smooth opening and closing of doors.

3.3 FIELD QUALITY CONTROL

.1 Test coiling door in presence of NRC Departmental Representative.

.2 Have manufacturer of products supplied under this Section review Work involved in handling, installation, protection and cleaning of its products, and submit written reports in acceptable format to verify compliance of Work with Contract.

.3 Manufacturer's Field Services:

.1 Obtain written reports from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product within 3 days.

.4 Submit manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

.5 Ensure manufacturer's representative is present before and during critical periods of installation construction of field joints and testing.

.6 Schedule site visits to review Work at stages listed:

.1 After delivery and storage of products, and when preparatory Work on which Work of this Section depends is complete, but before installation begins.

.2 Twice during progress of Work at 25% and 60% complete.

.3 Upon completion of Work, after cleaning is carried out.

3.4 CLEANING

.1 Progress Cleaning:

.1 Leave Work area clean at end of each day.

.2 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.

.1 Leave Work area clean at end of each day.

.3 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

.1 Remove traces of primer, caulking; clean doors and frames.

.4 Waste Management: separate waste materials for reuse and recycling.

.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.5 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by overhead coiling door and grille installation.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 08 71 00 - Door Hardware.

1.2 REFERENCES

.1 Aluminum Association (AA)

.1 AA DAF 45-03(R2009), Designation System for Aluminum Finishes.

.2 ASTM International

.1 ASTM A 167-99(R2009), Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet and Strip.

.2 ASTM A 480/4 80M-09b, Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet and Strip.

.3 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-12.1-M90, Tempered or Laminated Safety Glass.

.4 Green Seal Environmental Standards (GS)

.1 GS-11-2008, 2nd Edition, Paints and Coatings.

.2 GS-36-00, Commercial Adhesives.

.5 Health Canada / Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

.6 South Coast Air Quality Management District (SCAQMD), California State, Regulation XI. Source Specific Standards

.1 SCAQMD Rule 1113-A2007, Architectural Coatings.

.2 SCAQMD Rule 1168-A2005, Adhesives and Sealants Applications.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for door materials and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Shop Drawings:

.1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.

.2 Indicate each type of door, sizes, hardware locations, rail shapes and materials.

.3 Submit complete list of hardware for safety glass doors, indicating catalogue and reference identification to specified standards. Include certification of conformance to referenced CGSB standards.

.3 Samples:

.1 Submit for review and acceptance of each unit.

.2 Samples will be returned for inclusion into work.

.3 Submit duplicate 100 x 100 mm samples of safety glass.

.4 Test Reports: certified test reports showing compliance with specified performance characteristics and physical properties.

1.4 CLOSEOUT SUBMITTALS

.1 Operation and Maintenance Data: submit operation and maintenance data for door closers, locksets and door holders for incorporation into manual.

.2 Tools: supply 2 sets of wrenches for door closers and locksets.

1.5 QUALITY ASSURANCE

.1 Certifications: product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance 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 hinged safety glass doors from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

.4 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials.

Part 2 Products

2.1 GLASS

.1 Clear safety glass: to CAN/CGSB-12.1, type 2, Class B glazing quality, of thickness indicated.

.2 Glazing gasket: purpose made gasket for dry glazing.

2.2 METAL RAILS AND FITTINGS

.1 Aluminum: Aluminum Association alloy AA 6063-T5.

.2 Stainless steel: to ASTM A 167, Type 304 with satin finish.

2.3 ALUMINUM FINISHES

.1 Finish exposed surfaces of aluminum components in accordance with Aluminum Association Designation System for Aluminum Finishes.

.1 As fabricated.

.2 Clear anodic finish.

.3 Adhesives and Sealants: VOC limit 30 g/L maximum to SCAQMD Rule 1168 GS-36.

.4 Primer: VOC limit 250 g/L maximum to GS-11 SCAQMD Rule 1113.

.5 Finish: VOC limit 50 250 g/L maximum to GS-11 SCAQMD Rule 1113.

2.4 FABRICATION

.1 Cut glass to required size, finish edges as detailed, include cutouts for hardware and other attachments before heat treatment.

.2 Attach top and bottom rails and hardware before shipping doors to site.

Part 3 Execution

3.1 EXAMINATION

.1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for hinged safety glass doors installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate.

.2 Inform NRC 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 NRC Departmental Representative.

3.2 INSTALLATION

.1 Manufacturer's Instructions: comply with manufacturer's written data, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, and data sheets.

.2 Install hinged safety glass doors where indicated.

.3 Adjust operable parts for correct function and smooth operation.

.4 Adjust weatherstripping to ensure weathertight seal.

3.3 CLEANING

.1 Progress Cleaning:

.1 Leave Work area clean at end of each day.

.2 Clean aluminum with damp rag and approved non-abrasive cleaner in accordance with manufacturer's instructions.

.3 Remove traces of primer, caulking; clean doors and frames.

.4 Clean glass and glazing materials with approved non-abrasive cleaner.

.5 Polish hardware with non-abrasive cleaner, polish as recommended by and in accordance with manufacturer's written instructions.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.

.3 Waste Management: separate waste materials for reuse and recycling.

.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.4 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by hinged safety glass door installation.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 Aluminum Association (AA)

.1 AA DAF 45-03(R2009), Designation System for Aluminum Finishes.

.2 American Architectural Manufacturers Association (AAMA)

.1 AAMA 501-05, Methods of Test for Exterior Walls.

.3 ASTM International

.1 ASTM A653/A653M-09a, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

.2 ASTM C794-10, Standard Test Method for Adhesion-in-Peel of Elastomeric Joint Sealants

.3 ASTM C920-14a, Standard Specification for Elastomeric Joint Sealants

.4 ASTM C1087-00(2011), Standard Test Method for Determining Compatibility of Liquid-Applied Sealants with Accessories Used in Structural Glazing Systems

.5 ASTM C1184-14, Standard Specification for Structural Silicone Sealants

.6 ASTM C1193-13, Standard Guide for Use of Joint Sealants

.7 ASTM E283-04, Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.

.8 ASTM E330-02, Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights, and Curtain Walls, by Uniform Static Air Pressure Difference.

.9 ASTM E413-04, Classification for Rating Sound Insulation.

.4 Canadian General Standards Board (CGSB)

.1 CAN/CGSB 1.108-M89, Bituminous Solvent Type Paint.

.2 CAN/CGSB-12.20-M89, Structural Design of Glass for Buildings.

.3 CAN/CGSB-12.1-M90, Tempered or Laminated Safety Glass.

.4 CAN/CGSB-12.3-M91, Flat, Clear Float Glass.

.5 CAN/CGSB-12.8-97, Insulating Glass Units.

.6 CAN/CGSB-12.8-97 (Amendment), Insulating Glass Units.

.5 CSA International

.1 CSA G40.20/G40.21-04(R2009), General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.

.2 CAN/CSA-G164-M92(R2003), Hot Dip Galvanizing of Irregularly Shaped Articles.

.3 CSA S136-07, North American Specification for the Design of Cold Formed Steel Structural Members.

.4 CAN/CSA-S157/S157.1-05, Strength Design in Aluminum/Commentary on CAN/CSA-S157, Strength Design in Aluminum.

.5 CSA W47.1-03, Certification of Companies for Fusion Welding of Steel.

.6 CSA W55.3-1965(R2003), Resistance Welding Qualification Code for Fabricators of Structural Members Used in Buildings.

.7 CSA W59-M03(R2008), Welded Steel Construction (Metal Arc Welding) [Metric].

1.2 QUALITY ASSURANCE

.1 Do steel welding to CSA W59 by fabricators certified by the Canadian Welding Bureau to CSA W47.1.

.2 Do steel resistance welding to CSA W55.2 by fabricators certified by the Canadian Welding Bureau to CSA W55.3.

.3 Do aluminum welding by fabricators certified by the Canadian Welding Bureau to CSA W47.2.

.4 Pre-installation meeting: Prior to commencing work of this Section, arrange for manufacturer's technical representative to visit the site and review preparatory and installation procedures to be followed, conditions under which the work will be done, and inspect the surfaces to receive the work of this Section. Advise the NRC Departmental Representative of the date and time of the meeting.

.5 Manufacturer’s site inspection: Have the manufacturer’s technical representative inspect the Work at suitable intervals during application and at conclusion of the work of this Section, to ensure the Work is correctly installed. When requested, submit manufacturer’s inspection reports and verification that the work of this Section is correctly installed.

.6 Structural silicone sealant: Perform and record findings of snap time, peel adhesion and butterfly test at start of each production run. Submit records if requested by NRC Departmental Representative.

.7 The anodizing coatings and metal pre-treatments shall be performed by applicators approved in writing by the manufacturer of the coatings and under the supervision of the manufacturer's qualified representative.

1.3 ENGINEERING DESIGN - GENERAL

.1 Have work of this Section reviewed and stamped by a professional structural engineer registered in the Province of Ontario on final submission drawings and calculations.

.2 Design members and their connections to withstand, within acceptable deflection limitations as specified, their own weight, the weight of the glass, weight of panels, loads imposed by the motion of operable elements, and the minimum design loads and combination of loads due to the pressure and suction of wind and internal pressure.

.3 Comply with the building code, and other regulations and requirements of authorities having jurisdiction. Design, engineer, fabricate and install the work to meet these requirements.

.4 Design structural systems to accommodate the tolerance limitations of the structure, and movements.

.5 Design systems to allow for expansion and contraction of components as may be caused by the ambient temperature range and surface temperature, variation of components, without causing distortion, failure of joint and air/vapour barrier seals, stress or other defects detrimental to appearance or performance.

.6 Design systems to accommodate, by means of expansion and contraction provisions, any movements in the curtain wall itself, and between the system and the building structure, without distortion of, or damage to the system, misalignment of joints, breakage of air/vapour barrier seals, water and air seals, or glass breakage.

.7 The system shall incorporate a method of attachment to the structure which shall take into account design stresses and site peculiarities and avoid site and air vibrations or normal temperature movements of the building to loosen, weaken or fracture the connection between each unit and the structure or between units of the system.

.8 Reinforce members as required and in accordance with prevailing building codes, to safely sustain design loads.

.9 Design, assemble and secure systems in a manner which will keep any stresses on sealants within the sealant manufacturer's recommended maximum.

.10 Design the work to facilitate replacement of the components.

.11 Provide a continuous fire stop seal at the junctions between the perimeter edges of concrete slabs and the curtain wall system to prevent the passage of fire and smoke from floor to floor and from floor to roof.

.12 Provide sheet metal smoke stop trim seal at terminations of floor constructions and roof constructions to interior surface of metal air/vapour barrier.

.13 Provide accessories required and necessary to complete the work.

.14 Design for a minimum STC of 35 where not indicated otherwise in accordance with ASTM E413.

1.4 ENGINEERING DESIGN – PRESSURE EQUALIZATION PRINCIPLE

.1 Base the design of the systems on pressure equalization principle.

.2 Provide gaskets, baffles, overlaps, compartmentalization and seals as required to provide a barrier to effectively prevent rain water entry into any of the cavities but allow pressure equalization.

.3 Provide non-permeable air/vapour barriers and seals as required to prevent the entry of interior building air into the curtain wall system cavities, and exterior air into the building. Air/vapour barriers and seals shall be able to withstand design conditions.

.4 Provide such provisions in the form of openings between cavities and the building exterior of sufficient cross sections to provide adequate pressure equalization.

.5 Provide effective baffles at all openings against water entry. Provide baffles and compartmentalization at all air spaces to prevent chimney effect at each storey vertically and horizontally.

.6 Place air/vapour barriers, continuous thermal barrier, and seals to eliminate any contact between interior humid air and a cold surface or structural component to prevent condensation and ice build-up on such surfaces during cold weather.

1.5 ENGINEERING DESIGN - STRUCTURAL

.1 Design the work of this Section to withstand within acceptance deflection limitations, its own weight, forces applied by the movements of the building structure and attached adjacent components, and the maximum design loads due to the pressure and suction of wind, blast, snow, ice and rain.

.2 Design work of this Section to accommodate expansion and contraction within its components due to cyclic temperature changes, to prevent buckling, twisting, distortions, joint seal failure, noise and detrimental stress on securement devices and components.

.3 Design work of this Section to accommodate expansion and contraction between work of this Section and the building structure due to cyclic temperature changes, to prevent damages, twisting, distortion, misalignment, buckling, noise, detrimental stress on components and securement devices to the work of this Section and work of other Sections and the building structure.

.4 Design the work of this Section to accommodate, by means of expansion and contraction provisions, any movements within the work of this Section and between the work of this Section, the building structure and adjacent constructions caused by short and long term structure movements, creep, column shortening, deflection, torsion, sway and racking.

.5 Design expansion and contraction provisions to ensure no damages, distortions, misalignment of work of this Section, the building structure, adjacent constructions and connections occur and shall ensure the thermal, vapour barrier, air infiltration/exfiltration and water and weather tightness requirements are maintained.

.6 Design connections to the building structure and to adjacent constructions, and other peculiarities as may be found on the Project.

.7 Design work of this Section and its connections to the building structure and adjacent constructions to ensure no possibility of weakening, loosening, fracturing occurs due to vibrations from any source.

.8 Design light gauge steel structural members in accordance with CSA S136-M.

.9 Design light gauge aluminum products in accordance with CAN3-S157-M.

.10 Elastic deflection limits of vertical mullions: Tested in accordance with ASTM E330. Deflection limits shall be such that the integrity of the glass and air seals are maintained at design loading. Permanent deformation of members due to applied loads are not permitted. The reduction of glass bite shall not exceed 3 mm at mid-height of any glass light due to member deflection. Deflection limitation shall be lesser of the following:

.1 1/175 of clear span for spans up to 4.1 m; 1/240 of clear spans plus 6 mm for spans greater than 4.1 m.

.2 An amount that restricts edge deflection of individual glazing lites to 19 mm.

.11 Elastic deflection limits of horizontal mullions: Limited to amount not exceeding that which reduces glazing bite to less than 75 percent of design dimension and which reduces edge clearance between framing members and glazing or other fixed components to less than 3mm, as tested to ASTM E330.

.12 Sheet metal air/vapour barriers shall not deflect under design loads sufficient to cause noise, breaking joint seals or to cause them to touch other components of work of this Section and building structure and shall be maintained within the elastic limits specified for the mullions.

.13 Design, fabricate and erect supplementary framing as required to support the air/vapour barriers such that the completed installation meets the specified design requirements.

.14 Reinforce sheet metal air/vapour barriers using galvanized steel top hat sections spot welded in place to resist wind loading forces in a manner that deflection limits do not exceed 6 mm and so that the compression of the fire stopping is not less than 25% at any time.

.15 Anchors, fasteners and braces shall be structurally stressed not more than 50% of the allowable stress when maximum load conditions are applied.

.16 Use a safety factor for glass to the statistical probability of failure, minimum 2.5:1.

.17 Use a safety factor for structural silicone sealant design of 5:1 or a maximum design strength of 138 kPa.

.18 In addition to all requirements of these Specifications, the design of glazing shall take into consideration the characteristics of the mullions and the effects of the connections and sealants at the frame junctions.

1.6 ENGINEERING DESIGN - BUILDING MOVEMENTS

.1 Design the work to accommodate the tolerance requirements permitted of the building structure and the anticipated movements of the building structure.

1.7 ENGINEERING DESIGN - ENVIRONMENTAL CONDITIONS

.1 Winter inside: 22°C; 30% relative humidity.

.2 Winter outside: -26°C.

.3 Summer inside: 23°C wet bulb.

.4 Summer outside: 32°C dry bulb.

1.8 ENGINEERING DESIGN - PRESSURES

.1 Wind load: Provide uniform system design based on the wind loading pressures for suction, impact and gusting of The Building Code, with a return period probability of one year of any 30 years.

.2 Air Supply: Outside air supplied to each floor will be 10,000 cfm. 10% of the supplied air will be used to pressurize the building.

1.9 ENGINEERING DESIGN - AIR INFILTRATION/EXFILTRATION

.1 Air infiltration and exfiltration through the completed systems, when tested to ASTM E283 and AAMA 501, shall not exceed 0.0003 cu.m./sec per square metre of area with an air pressure of 0.075 kPa static pressure.

1.10 ENGINEERING DESIGN - WATER, VAPOUR AND MOISTURE

.1 Make provisions to drain to the exterior face of the assembly, any water entering at joints and any condensation occurring within the curtain wall system.

.2 Design, fabricate and install the assembly to be watertight to the interior under the interior and exterior design conditions in combination with movements occurring due to loads imposed.

.3 The maximum water vapour transmission of all components forming the vapour barrier shall be 0.03 Imperial Perms unless specified otherwise.

.4 At design conditions no condensation shall occur on room side surface.

.5 Frames shall provide pressure equalization to glazing pockets at vision and spandrel panels. Column covers shall have pressure equalization provided to spaces behind and shall not depend upon wet sealants and gaskets to achieve watertight and air and vapour barrier seals.

.6 The curtain wall system shall be self-draining with framing components to the curtain wall assembly profiled to drain off any moisture to the exterior.

.7 An air/vapour barrier consistent with the rain screen principle shall be continuously installed at the inner frame perimeter as an integral part of the curtain wall system design to provide a complete and impervious air and vapour barrier.

1.11 ENGINEERING DESIGN - SOUND

.1 Provide completed installations free from vibrations, wind whistles and noise due to thermal and structural movement and wind pressures.

1.12 TOLERANCES

.1 Erection tolerances for frame assemblies and apply to each individual assembly.

.1 Vertical position: plus/minus 3 mm.

.2 Horizontal position: plus/minus 3 mm.

.3 Deviation from plumb: 3 mm maximum each plane, 12 mm full height of building face.

.4 Racking of face: 6 mm maximum

.5 Racking in elevation: nil

.6 Offset from true alignment between two identical abutting end to end or in line: 0.8mm.

.2 Tolerances shall not be accumulative.

1.13 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Shop Drawings:

.1 Submit shop drawings bearing the stamp and signature of the engineer responsible for the design of this Section, registered or licensed in Province of Ontario, Canada.

.2 Draw details at full size.

.3 Shop drawings shall show details of curtain wall systems, aluminum spandrel and cladding, metal air/vapour barrier, baffles, methods of joining, joint locations, including isometric detail at 4-way intersection at stack joint, thicknesses and finish of materials, methods of anchoring, sizes of anchorages, types of sealants and gaskets, expansion and contraction locations and details, thermal break locations and details, glazing details and glazing methods, drainage details and flow diagrams, provision for expansion and contraction, details of other pertinent components of the work, types of fasteners, structural reinforcing members, all component material information, and adjacent constructions to which work of this Section shall be attached.

.3 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for curtain wall components, anchorage and fasteners, glass and infill, and internal drainage details and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Structural Sealant Data

.1 Submit product information on the sealants to be used, complete with all recommendations and installation instructions, including cleaning and priming procedures.

.2 Submit sealant manufacturer's test reports on adhesion to metal and glass production samples tested in accordance with ASTM C-794, 7 day cure and 14 day water submersion, tensile strength at 100% elongation and bite size of sealants. Provide samples of production-run material for sealant manufacturer’s testing.

.3 Submit sealant manufacturer's compatibility statement that all materials in contact with the sealants are compatible with the sealants after 21 days of high ultraviolet radiation of 2000 - 4000 micro watts minimum exposure, when tested in accordance with ASTM C1087.

.4 Submit sealant manufacturer's statement and test data indicating that the stress on the sealants when exposed to the maximum load does not exceed 138 kPa or a safety factor of 5:1, and a written statement that shop drawings have been reviewed and that stress on each detailed sealant joint will not exceed design stress of sealant when exposed to specified wind loads.

.5 Submit sealant manufacturer's verification that sealants are suitable for purposes intended, and are suitable for temperature, humidity and weather conditions at time of application.

.4 Samples:

.1 Submit for review three samples of all materials, 300 mm x 450 mm for sheets and plates, 300 mm long for extrusion, tapes and gaskets, 150 mm for sealants, with respective finish of each, and before commencing fabrication.

.2 Submit two 600 mm x 600 mm samples of each type of glazed curtain wall assembly having specified finish, showing vertical and horizontal mullions, provision for air/vapour seals and drainage.

.3 Samples shall fully represent physical and chemical properties, finish, and colours of materials to be supplied. Submit three samples of finish colour representing the lightest, darkest and middle range of colour variation proposed in order to establish the acceptable colour range.

.5 Maintenance Instructions

.1 On completion of installation, supply to the NRC Departmental Representative three copies of instructions covering re-glazing, adjustments and other relevant maintenance data.

.6 Sealant Certification

.1 Submit a signed certificate from the sealant manufacturer prior to the commencement of this work which states:

.1 Sealant materials selected for use from those specified;

.2 Surface preparation requirements;

.3 Priming and application procedures;

.4 Verification that sealants are suitable for purposes intended and joint designs;

.5 Sealants are compatible with other materials and products with which they come in contact;

.6 Verification that sealant is suitable for temperature, humidity and weather conditions at the time of application.

.2 Submit sample production run material to sealant manufacturer for adhesion/compatibility testing as required in ASTM C1193 “Standard Guide for Use of Joint Sealants”.

.7 Test Reports:

.1 Submit substantiating engineering data, test results of previous tests by independent laboratory which purport to meet performance criteria, and supportive data.

1.14 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

.2 Operation and Maintenance Data: submit operation and maintenance data for glazed aluminum curtain wall for incorporation into manual.

1.15 DELIVERY, STORAGE AND HANDLING

.1 Handle and store material in such a manner that no damage will be done to the materials or to the work of other Sections.

.2 Provide protection of materials and installed work from damages caused by execution of work of this Section and by other trades.

.3 Protect glass units with interleaving protection between lites. Keep glass and interleaving dry and store cases in clean, cool, dry areas with temperatures above dewpoint. Circulation of cool, dry air in storage areas is essential. Open cases and inspect units periodically for moisture accumulation. Do not store glass in direct sunlight without an opaque protective covering over same.

.4 Do not apply mullion snap-on caps until the building is closed in, until the roofing is installed and until no possibility of alkaline substances can be washed from the building structure onto the completed assemblies.

.5 Do not use adhesive papers or sprayed coatings which will become bonded when exposed to the weather. Remove temporary protection at most suitable time during construction as instructed by Construction Manager. Do not leave coating residue on any surface.

.6 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, packaging materials.

1.16 WARRANTY

.1 Contractor hereby warrants that glazed aluminum curtain wall, will function as specified in accordance with CCDC 24, but for 60 months, and 120 months for insulating glass units.

Part 2 Products

2.1 SYSTEMS

.1 Description:

.1 Vertical glazed aluminum curtain wall system includes thermally broken tubular aluminum sections with support framing, shop fabricated, factory prefinished, vision glass, insulated metal panel spandrel infill, related flashings, anchorage, and attachment devices.

.2 Assembled system to permit re-glazing of individual glass (and infill panel) units from exterior without requiring removal of structural mullion sections.

2.2 ACCEPTABLE MANUFACTURERS

.1 Manufacturers: Subject to compliance with requirements, provide products by one of the following, or equivalent approved by the NRC Departmental Representative:

.1 Kawneer Company Canada Ltd.

.2 A.& D. Prevost Inc.

.3 Commdoor Aluminum.

.4 Alumicor.

.5 Alumico Architectural Inc.

.6 Lessard Group Inc.

2.3 MATERIALS

.1 Aluminum:

.1 Extruded shapes: Alcan 6063-T5 or T6 alloy anodizing quality.

.2 Sheet aluminum: Controlled stretcher levelled, optimum flat to 1/2 commercial tolerances. Aluminum sheets and plates 3 mm thick minimum, anodizing quality in exposed locations, utility grade in unexposed locations.

.3 Structural bar, rod or shapes: CSA HA.5-M, 6061-T6.

.2 Steel: CAN3-G40.21-M Grade 300W or 350W as required by engineering design.

.3 Flashing: Aluminum, finished to match curtain wall, minimum 24 gauge.

.4 Bolts, screws and fasteners: stainless steel or aluminum for aluminum connections; cadmium plated steel may be used at interior side of air/vapour barriers; galvanized steel elsewhere.

.5 Slip washers: Teflon coated steel or aluminum washers.

.6 Thermal separators (thermal break): Of size to conform to the extruded aluminum members, and other locations where required, neoprene or EPDM and having a minimum tensile strength of 2000 psi and Durometer A Hardness of 50 plus/minus 5.

.7 Flexible air/vapour barrier seals: Neoprene or EPDM, designed to remain flexible at low temperatures.

.8 Primer for ferrous metals: CISC/CPMA Standard 2-75a.

.9 Zinc chromate primer: CGSB 1-GP-132M.

.10 Touch-up primer for galvanized steel: Organic zinc rich epoxy primer.

.11 Bituminous paint: CGSB 1-GP-108M Type II.

.12 Insulation for packing into cavities: CSA A101 Type 1 lightweight resilient, inorganic glass fiber insulation having a nominal density of 0.69 lb./cu. ft.

2.4 GLASS AND GLAZING

.1 General: Glass lites shall be float, tempered or heat strengthened in accordance with requirements of glass manufacturer as substantiated by the glass manufacturer's stress analysis for each location required, unless otherwise indicated.

.2 Float glass: CAN/CGSB-12.3, annealed, clear, glazing quality, minimum 6 mm thick.

.3 Tempered safety glass: CAN/CGSB-12.1 Type 2, Class B, tong and roller marks free, minimum 6 mm thick.

.4 Heat strengthened glass: USA Federal Specification DD-G-1403B Type HS. Heat strengthening shall be performed using the horizontal tong-free method.

.5 Insulating glass units: to CAN/CGSB-12.8, composed of two lites of minimum 6 mm thick glass separated by a 13 mm wide warm edge spacer and with argon-filled space, double sealed and atmospheric pressure equalized. Edges of glass shall be straight cut, free of nicks and other imperfections conducive to breakage.

.1 Glass Types:

.1 Typical vision units: Double glazed, double sealed insulating units, 6 mm clear glass outer lite, 6 mm clear glass inner lite with low emissivity coating on No. 2 surface.

.2 Entrance vision units: Double glazed, double sealed insulating units, clear tempered glass outer lite, clear tempered glass inner lite with low emissivity coating on No. 2 surface.

.6 Low emissivity coating: to match Solarban 60 by PPG, and meeting the following insulating glass unit performance.

.1 Insulating Glass Unit Performances:

.2 Visible light:

.1 Transmittance: 70%

.2 Reflectance: 11%

.3 Total Solar Energy:

.1 Transmittance: 33%

.2 Reflectance: 30%

.4 U-Value (winter): .29

.5 Solar Heat Gain coef.: .38

.6 Shading coef.: .44

.7 LSG ratio: 1.84

.7 Use two component silicone for secondary seal of the insulating glass units in structural glazing systems. Remove excess silicone seal from glass edges of outer lite.

.8 Set spacer core straight and even into glass units with a maximum variation in line of spacer core of plus or minus 2 mm and the primary seal not extend past the inside edge of spacer core by more than 1.6 mm. Weld or vulcanize spacer core corners and joints.

.9 Shims: pressure sensitive resilient extruded synthetic rubber and as recommended by the insulating glass unit manufacturer.

.10 Spacers and setting blocks: 50 and 85 Durometer A hardness plus/minus 5 respectively, neoprene rubber, resistant to sunlight, weathering, oxidation and permanent deformation under load.

.11 Setting blocks, structural glazing: Silicone rubber, compatible with silicone sealant, 85 plus or minus 5 Durometer A hardness.

.12 Spacers, structural glazing: Continuous, bond breaker type and compatible with silicone sealant.

.13 Glazing tape: Extruded, ribbon shaped, non-drying, non-skinning, non-oxidizing polyisobutylene tape with continuous synthetic rubber spacer rod, sufficiently wide and thick as to completely cover the bite area of the glazing unit when the unit is pushed into place.

.14 Glazing gaskets: Neoprene or EPDM of sufficient thickness to be 25% compressed when installed. Gaskets shall have a 2000 psi tensile strength, Durometer A hardness of 50, plus/minus 5, resistance to permanent set 30% maximum, minimum elongation at break of 300% and resistance to ozone showing no cracks.

2.5 SEALANT MATERIALS

.1 Sealants: Non-bleeding, resistant to rodents, vermin, mildew, fungus and algae and capable of supporting their own weight.

.2 Tensile bead, structural glazing: two-part, neutral-cure, RTV silicone sealant meeting ASTM C1184.

.3 Weatherseal, structural glazing: one-part, cold-applied, non-sagging silicone, meeting ASTM C1184 and ASTM C 920 Type S, Grade NS, Class 50, Use NT, G, A and O.

.4 Sealants, cleaning solvents, fillers and primers shall be compatible with each other.

.5 Colours: As selected by NRC Departmental Representative, and not necessarily from the sealant manufacturer's standard colour range.

.6 Primers: As recommended by the sealant manufacturer to suit the various job conditions.

.7 Cleaning material: methyl-ethyl-ketone, or as recommended by the sealant manufacturer.

.8 Filler strips for back-up of sealants: non-absorbent, closed cell, chemically compatible rod stock of butyl or neoprene, or white foam polyethylene, of a diameter sized 25% greater than the joint width before application.

.9 Sealant, shall be of the same type and manufacturer throughout the work of this Section.

.10 Sealant: CAN2-19.13, one component silicone sealant.

.11 Select sealant from those specified and co-ordinate with the sealants being used in adjacent systems.

.12 If different sealants are selected, it is the responsibility of this Section to ensure compatibility between sealants of other Sections which come in contact with the selected sealant of this Section.

.13 Sealant tape: Extruded, ribbon-shaped, non-drying, non-skinning, non-oxidizing, reinforced, polyisobutylene tape of sufficient width and thickness, 6 mm minimum, to permit a continuous seal.

2.6 FIRE STOPPING

.1 Mineral fibre insulation complete with galvanized steel installation clips and bearing the label of Underwriters' Laboratories Guide No. 40-U19.13.

.2 Firestopping shall be 25% wider than the space to be filled and be complete with impaling clips.

.3 Sealant to provide openings, penetrations and spaces at joints in fire rated separations: Underwriters' listed and approved sealant for fire and smoke seal.

2.7 METAL AIR/VAPOUR BARRIER AND SPANDREL BACK PAN

.1 Sheet metal for metal air/vapour barriers and air seals: minimum 0.8 mm (20 gauge) sheet steel, galvanized, complying with ASTM A653/A653M, Z275 zinc coating weight.

.2 Back pans which are visually exposed to the interior are to have an aluminum sheet laminated to the interior side of the back pan at exposed portions, finished to match the interior of the curtain wall.

.3 Insulation for application to sheet metal air/vapour barriers: Mineral fiber board insulation.

.4 Stick clips: 25 mm diameter perforated disc base with integral 3 mm square sharpened pin of moulded polyvinylchloride. Pin lengths shall suit insulation thickness. Clips shall have 25 mm x 25 mm galvanized sheet steel retainers punched to catch on plus.

.5 Gun welded pins: Alternative at the Contractor's option to stick clips, 3 mm diameter galvanized steel pins with cup heads, of length to suit insulation thickness and suitable for gun shot welding to the metal air/vapour barriers.

.6 Insulation adhesive: Fire retardant, compatible with insulation.

.7 Adhesive for stick clips: High-strength, resilient adhesive having a drying time of 0 to 30 minutes (rapid initial set), and 24 hours final set. Adhesive shall be compatible with the specified insulation adhesive, insulation and galvanized steel.

.8 Primer for adhesives: As recommended by the adhesive manufacturer for the particular materials to be adhered.

.9 Stiffeners: Hot or cold rolled steel or galvanized sheet steel sections, to the requirements of this Section.

2.8 FABRICATION - GENERAL

.1 Do not start fabrication until shop and erection drawings have been reviewed, and samples have been approved.

.2 Insofar as practical, execute fitting and assembly in the shop with the various parts or assemblies ready for erection at the building site.

.3 Where possible, take field measurements and levels required to verify or supplement those shown on the Drawings for the proper layout and installation of the work.

.4 Co-ordinate dimensional tolerances in adjacent building elements and confirm prior to the commencement of the work.

.5 Fabricate members to the profiles shown on the Drawings. Wall thickness of extrusions shall be as required to meet the design requirements. Provide continuous thermal break in framing members.

.6 Grain of sheet and directions of finish for flashings and panels shall be the same direction.

.7 Accurately machine file and fit, and rigidly frame together all joints, corners and mitres. Match components carefully to produce perfect continuity of line and design.

.8 Make joints toward the exterior weathertight and joints toward the interior airtight in accordance with specified allowances.

.9 Metal in contact shall have hairline joints. Location of exposed joints shall be subject to the approval of the NRC Departmental Representative.

.10 Weld aluminum, where required, with inert metal arc equipment.

.11 Make exposed welds continuous and flush with adjacent surface. Do not mar surface finishes with welds in back of exposed aluminum or glazing infills. Do not deform the exposed metal and finish in any way by welding.

.12 Welded joints shall be of adequate strength and durability with jointing tight and flush.

.13 Where it is necessary to weld components already galvanized, remove galvanizing for 50 mm around welds and paint over welds where galvanizing is removed as specified hereinafter.

.14 Reinforce frames and assemblies by concealed means as necessary to meet the specified design requirements, local prevailing codes and as shown. All reinforcing shall be hot-rolled mild steel and shall be securely anchored to horizontal and vertical members by approved positive mechanical means.

.15 Provide steel or aluminium brackets and support framing to fasten frames in place, with sufficient adjustment to permit correct and accurate alignment. Provide slotted framing and connections as required to accommodate deflection.

.16 Where frame members are lapped, the faces exposed to the weather shall be in full, tight contact. Allow minimal clearance for snap-on components.

.17 Fabricate frame systems designed for outside glazing complete with mullions, head and sill frames, spigots, and plugs for horizontals, thermal breaks, pressure plates, filler pieces, snap-on caps.

.18 Provide split frame expansion/contraction mullions as shown on the Drawings and as required.

.19 Provide stack/expansion horizontals as shown on the Drawings and as required. Provide framing and connections to accommodate design requirements.

.20 Fabricate sills, corner pieces, filler pieces, panels and closures to the profiles shown, by welding prior to application of finish. Make all planes true, and corners square and sharp. Provide concealed clips for fastening plate assemblies in place.

.21 Provide pressure equalizing and weep holes for enclosed air spaces at glazed assemblies including spaces behind spandrel as recommended by the manufacturer of the curtain wall system.

.22 Location of all joints and pressure equalizing drain vents shall be subject to NRC Departmental Representative's acceptance.

.23 Fabricate supplementary framing from rolled steel sections by welding. After fabrication, remove all grease, scale and other substances deleterious to bond and apply one coat of priming paint.

2.9 FABRICATION - METAL AIR/VAPOUR BARRIERS AND SPANDREL BACK PAN

.1 Brake-form sheet metal air/vapour barriers to permit assembly using self-tapping screws, and attachment using power activated or pneumatic fixings or other means of secure fastening.

.2 Make provision in barrier design to accommodate movement resulting from thermal changes and from structural deflections.

.3 Cut, fit and form metal air/vapour barriers as required to accommodate framing, anchors, connections, mechanical and electrical appurtenances and other obstructions.

2.10 FABRICATION - SWING DOORS

.1 Extrude door stiles and rails to approved profiles and to widths as shown. Overall stile and rail thicknesses 45 mm minimum. Assemble stiles and rails by both sigma deep penetration welding and mechanical fastening.

.2 Provide doors with snap-on stops having mechanically retained extruded neoprene or PVC gaskets. Stops on the exterior side of exterior doors shall be the lock-in temper proof type. No exposed screws permitted.

.3 Provide doors with mechanically retained mohair pile schegal weatherstripping to jambs and head.

.4 Provide cutouts, cover plates, reinforcement and provision for secure fastening in doors as required to receive hardware.

.5 Unless otherwise specified herein, the manufacturer of the door shall supply and install all finishing hardware associated with entrances specified under this Section.

.6 All lock cylinders and keys: supplied and installed under Section 08 71 00, Door Hardware.

.7 Provide swinging aluminum doors with concealed closers, offset pivots, cylinder dead locks, aluminum thresholds, door sweeps and push/pulls as selected by NRC Departmental Representative.

2.11 FABRICATION – SPANDREL, TRIM AND CLADDING FACINGS

.1 Fabricate the facings and support members in a manner which will provide an installation free of exposed fastenings, with sufficient support and allowance for thermal movement to prevent facing distortion.

.2 Fabricate facings flat, true, free of marks, without visible distortion and with edges straight and true. Fabricate aluminum with grain horizontal.

.3 Reinforce panels as required to prevent, warp, oil canning, buckling effect and to meet design. Weld marks shall not telegraph to the finished side.

.4 Provide inconspicuous, baffled weep holes to properly drain system to exterior.

.5 Fabricate sills, corner pieces and filler pieces of 3 mm thick plate aluminum to the profiles shown, by welding prior to application of finish. Make all planes true, and corners square and bend of minimum radius. Provide concealed clips for fastening plate assemblies in place.

.6 Spandrel: Fabricate from 3 mm thick minimum aluminum sheet brakeformed to profiles indicated, reinforced to prevent warp, oil canning and buckling effect.

.7 Profiled facings: Fabricate from 3 mm thick minimum aluminum sheet stamped to profiles indicated. Reinforce to prevent warp, oil canning and buckling effect.

2.12 FINISHES - PAINTING

.1 Steel at building interior and not exposed to view or to exterior environmental conditions shall be primed with primer for ferrous metal.

.2 Prior to installation, give a heavy protective coating of zinc chromate primer, bituminous paint, or baked-on primer to concealed surfaces of aluminum and galvanized steel in direct contact with structural steel, concrete or masonry.

.3 Paint welded, galvanized items where galvanizing has been removed for welding. Make good corrosion protection using two coats of touch-up primer for galvanized steel.

.4 Make good corrosion protection on steel primed with oil alkyd primer using primer for ferrous metal.

2.13 FINISHES - GALVANIZING

.1 Steel exposed to exterior conditions, that is on cold in winter side of air/vapour barrier, but not exposed to view, shall be blast cleaned and hot dip galvanized in accordance with CSA G164.

.2 Thread dimensions shall be such that nuts will thread over bolts without re-threading or chasing galvanized threads.

.3 Galvanize after fabrication where possible. Follow standard precautions to avoid embrittlement of the base metal by overpickling, overheating or during galvanizing.

2.14 FINISHES - ARCHITECTURAL ANODIC FINISH

.1 Provide anodic finish to AA-M12C22A41, Architectural Class I, clear, colourless coating of minimum 0.7 mil thick.

.2 Apply anodic finish to typical curtain wall framing, and other locations as indicated.

Part 3 Execution

3.1 EXAMINATION

.1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for aluminum curtain wall installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate in presence of NRC Departmental Representative.

.2 Verify dimensions, tolerances, and method of attachment with other work.

.3 Verify wall openings and adjoining air barrier and vapour retarder materials are ready to receive work of this Section.

.4 Inform NRC Departmental Representative of unacceptable conditions immediately upon discovery.

.5 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from NRC Departmental Representative.

3.2 INSTALLATION - GENERAL

.1 Erect all work plumb and true and in proper alignment and relationship to established lines and grades.

.2 Align and positively secure anchorage devices to prevent movement other than that designed for expansion and contraction.

.3 Take into consideration climatic conditions prevailing at time of installation. Provide sliding connection with Teflon washers or pads.

.4 Site located fixings shall be an approved material. Perform welding and drilling as required to install fixings. Bear cost of repair satisfactory to the NRC Departmental Representative of concrete chipped by drilling or fixing operations.

.5 Group components with shop applied finishes so that those which relate most closely to one another, with regard to colour and sheen, shall be installed adjacent to each other.

.6 Provide structural steel framing and supports required to support work of this Section unless indicated to be supplied under other Sections.

.7 Fill irregularly shaped voids and other areas, where shown, using glass fiber packing insulation.

.8 Supply and install firestop and smoke seal between structure and cladding work at edge of floor slabs. Place fire stop under 25% compression, use setting clips as required by authorities having jurisdiction.

.9 Seal hairline joints at junction of frame members. Gun-inject sealant from inside ensuring a continuous seal of the joint. Ensure that bead in the glazing space does not impair seating of glazing materials. Remove excess sealant which is forced onto face of frame assembly.

.10 Provide frame systems complete with spigots, and neoprene plugs for horizontals, spline gaskets, thermal break and filler pieces, as required air/vapour barrier to the interior and water barrier to the exterior.

.11 Provide flexible seals at expansion joints.

.12 Provide continuity of thermal and air/vapour barriers with adjacent thermal and air/vapour barrier systems.

.13 Gun-apply a continuous bead of sealant to all joints and air/vapour barrier junctions with adjacent construction. Liberally butter screw fastenings with sealant.

.14 Provide flexible, continuous air/vapour barrier seals between work of this Section and adjacent construction, and at deflection and expansion connections with adhesive and retain with continuous aluminum or galvanized steel plates or bars and non-corrosive mechanical fasteners. Vulcanize or overlap joints to ensure a continuous seal.

.15 Provide air-tight seals at penetrations in air/vapour barriers required for work of this and other Sections.

.16 Apply insulation to the cold-in-winter side of the metal air/vapour barriers erected. Cut insulation slightly over-size as required to ensure tight butt joints.

.17 Adhere stick clips to metal air/vapour barriers at 300 mm o.c. both ways. Support clips in place until adhesive has set unless welded clips are used. Notched trowel apply insulation adhesive over entire surface of barrier and around clips held with adhesive.

.18 As an alternative, gun weld apply pins to metal air/vapour barriers in lieu of stick clips, provided clips do not easily break off and weld burn-through does not occur.

.19 Press insulation boards firmly to barrier impaling them on clips without bending clips. Butt insulation boards tightly. Install retainers to clips.

.20 Isolate metal air/vapour barriers with thermal breaks and spacers as indicated.

.21 Protect exterior finished surfaces by installing snap-on caps only when building is closed in, and when the possibility of damage due to construction has been minimized, to the approval of the NRC Departmental Representative.

.22 Secure snap-on caps with concealed stainless steel fasteners, minimum two per cap.

.23 Supply and install galvanized formed steel coping supports.

.24 Supply and install sheet waterproofing membrane at copings and parapets as indicated. Lap, adhere, and seal joints in membrane in accordance with instructions of the membrane manufacturer to provide a watertight, continuous membrane.

.25 Gun-apply 3 continuous beads of sealant under extruded aluminum thresholds. Make bead diameter sufficient to ensure a full width seal. Remove excess sealant.

3.3 INSTALLATION - GLAZING

.1 Free rabbets, stops and glass edges of dust, dirt, moisture, oil and other foreign matter detrimental to glazing material adhesion. Ensure drainage holes are not blocked.

.2 Mask surfaces subject to staining, and wherever necessary to ensure neat appearance of the glazing bead. Remove masking as work progresses.

.3 Accurately size glass to fit openings allowing clearances following trade practices. Cut glass clean and carefully; nicks, damaged edge conditions will not be accepted. Replace all glass with nicked or damaged edges.

.4 If insulating glass units are supplied with channel edge banding, provide a continuous sealant bead to seal between glass and edge banding on interior surface.

.5 Replace defective materials and all materials damaged due to faulty installation, careless handling or other causes resulting from work of this Section.

.6 Remove glazing stop and replace in original locations, using original fasteners, securely set and accurately aligned.

.7 Use spacers, setting blocks and shims of proper size to support and hold glass in position independent of the glazing tape and gaskets.

.8 Place two setting blocks under each unit at the quarter points. Place spacers on all edges of glass, located directly opposite each other when on both sides of the glass, located at maximum 600 mm centres and maximum 300 mm from corners and uniformly spaced.

.9 Arrange spacers, setting blocks and shims so as to avoid blocking water transfer inside glazing pockets.

.10 Install preformed tapes to ensure complete contract on surface of glass and stops. Make joints only at corners of sash or frame. Fit tape accurately with tight joints, free from tension, without gaps and cracks.

.11 Install glazing gaskets in continuous lengths between corners, not stretched, and seal or vulcanize joints at corners to prevent entry of water and air.

.12 At top of sealed glass units, at mid point of rebate, supply and install 50 mm wide compressible closed cell neoprene foam pad to prevent convection currents occurring within the glazing pocket.

.13 Set glass properly centered with uniform bite and face and edge clearance, free from twist, warp or other distortion likely to develop stress.

.14 Handle and install glass in accordance with manufacturer's directions. Prevent nicks, abrasion and other damage likely to develop stress on edges.

.15 Install glazing materials to obtain complete seal over the full bite area of the unit and to be free from gaps, air bubbles and embedded foreign matter.

.16 Ensure water and air tight seal for glass between glazed element and frame flush with slight line.

.17 Perform glazing only when the temperature is above 4°C.

3.4 STRUCTURAL SEALANT - CLEANING

.1 Follow manufacturer’s requirements determined from adhesion tests.

.2 Use a clean, soft, absorbent, lint-free cloth. Use each piece of cloth only once.

.3 Do not use brush for cleaning operation.

.4 Pour solvent from container onto cloth to avoid contamination, do not dip cloth into solvent.

.5 Dry wipe immediately before solvent evaporates and dry on the substrate.

3.5 STRUCTURAL SEALANT - PRIMING

.1 Prime all surfaces to receive glazing materials unless recommended specifically to the contrary, in writing, by the sealant manufacturer as determined from adhesion tests.

.2 Use a clean, soft, absorbent, lint-free cloth. Use each piece of cloth only once.

.3 Apply a thin film (one pass) of primer, remove excess primer by wiping with a clean dry cloth.

3.6 INSTALLATION - SEALANTS

.1 Seal joints between frame assemblies and adjacent construction except where specified to be done under other Sections, and within glazed assemblies where required to maintain weathertightness and integrity of air/vapour barrier.

.2 Before structural sealant installation is commenced, site test the sealant for adhesion to substrates.

.3 Seal junctions in sheet metal air/vapour barriers and between air/vapour barrier and adjacent construction.

.4 Ensure ambient and surface temperatures are above 4°C and joint conditions are suitable for the materials to be installed.

.5 Ensure surfaces to be sealed are sound, dry, free from dirt, water, frost, loose scale, corrosion, or other contaminants which may adversely affect the performance of the sealants. Remove protective oil coatings and other oil or grease films.

.6 Perform cleaning to the extent required to achieve acceptable joint surfaces.

.7 Install joint filler strips as backup for sealant to provide optimum joint profile, but not less than 6 mm depth of sealant bead.

.8 Mask areas adjacent to the joints to prevent contamination of adjacent surfaces. Remove masking promptly after the joints has been completed.

.9 If recommended by the sealant manufacturer, prime joints to prevent staining, or to assist the bond.

.10 Apply primer with a brush which will permit all joint surfaces to be primed. Perform priming immediately before installation of sealant.

.11 Install materials in compliance with the recommendations of their manufacturer's.

.12 Do not exceed shelf life, and pot life of the materials and installation times, as stated in the manufacturer's instructions.

.13 Be familiar with the work life of the sealant to be used.

.14 Before any sealing is commenced, test the materials for indications of staining or poor adhesion.

.15 Sealants shall be of gun grade or knife grade consistency to suit the joint condition. Use gun nozzles of the proper sizes to suit the joints and the sealant material.

.16 Install sealant with pressure operated guns.

.17 Use sufficient pressure to fill all voids and joints full. Sealants shall bond to all sides of joint except where filler material is used. Where filler material is used, sealant shall bond to both sides of joint and shall not adhere to the filler material.

.18 Ensure the correct sealant depth is maintained. Superficial painting with a skin bead will not be accepted.

.19 Sealant installations shall be a full bead free from air pockets and embedded impurities and having smooth surfaces, free from ridges, wrinkles and sags.

.20 After joints have been completely filled tool them neatly to a slight concave surface.

.21 Cover all fasteners penetrating the air/vapour barriers with sealants.

3.7 INSTALLATION - ENTRANCES

.1 Use skilled mechanics for installation under supervision of manufacturer's representative. Complete installation in accordance with manufacturer's instructions and approved shop drawings.

.2 Install units plumb, level and in accurate alignment. Maintain clearances required for the operation of the units, make clearances uniform in width.

.3 Adjust operable parts to run smoothly and functioning correctly.

.4 Install weatherstripping as required to provide a weathertight assembly.

.5 Seal assemblies to adjacent construction.

3.8 ADJUSTMENTS

.1 Upon completion of the project and just prior to the handing over of the building to the Owner or at a time as directed, inspect, test and adjust installation.

.2 Inspect units for damage and correct same immediately.

.3 Test and adjust hardware and replace or repair faulty items.

.4 Adjust weatherstripping to leave each opening unit in its most weathertight position.

.5 Test all operable elements and ensure easy and smooth operation.

3.9 CLEANING

.1 Keep installed work clean as work progresses.

.2 Clean and make good to the approval of the NRC Departmental Representative, surfaces soiled or otherwise damaged in connection with the work of this Section.

.3 Replace finishes and materials that cannot be satisfactorily touched-up, cleaned or which have been damaged by improper cleaning materials and techniques.

.4 Wash down exposed surfaces as required using a solution of mild domestic detergent in warm water, applied with soft clean wiping cloths. Take special care to remove all dirt from corners.

.5 Remove excess sealant by the moderate use of cleaning solutions acceptable to the sealant manufacturer, and the fabricator of materials or finishes being cleaned.

.6 Where the accumulation of dirt does not respond to the washing or cleaning, refer the condition to the NRC Departmental Representative, with recommendations as to the remedial action required; but do not undertake any cleaning procedure of a more severe nature without the written approval of the NRC Departmental Representative.

.7 Immediately remove concrete and alkali wash-offs on surfaces to prevent etching of glass and metal.

.8 Remove temporary protective materials, labels and coatings.

.9 Upon completion of the work of this Section, remove all debris, equipment and excess material resulting from the work of this Section from the site.

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

.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.10 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by glazed aluminum curtain wall installation.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 08 11 00 - Metal Doors and Frames.

.2 Section 08 14 16 – Flush Wood Doors.

.3 Section 08 34 43 - Hinged Safety Glass Doors.

1.2 REFERENCES

.1 American National Standards Institute (ANSI) / Builders Hardware Manufacturers Association (BHMA)

.1 ANSI/BHMA A156.1-2000, American National Standard for Butts and Hinges.
.2 ANSI/BHMA A156.2-2003, Bored and Preassembled Locks and Latches.
.3 ANSI/BHMA A156.3-2001, Exit Devices.
.4 ANSI/BHMA A156.4-2000, Door Controls - Closers.
.5 ANSI/BHMA A156.5-2001, Auxiliary Locks and Associated Products.
.6 ANSI/BHMA A156.8-2005, Door Controls - Overhead Stops and Holders.
.7 ANSI/BHMA A156.10-1999, Power Operated Pedestrian Doors.
.8 ANSI/BHMA A156.13-2002, Mortise Locks and Latches Series 1000.
.9 ANSI/BHMA A156.15-2006, Release Devices - Closer Holder, Electromagnetic and Electromechanical.
.10 ANSI/BHMA A156.16-2002, Auxiliary Hardware.
.11 ANSI/BHMA A156.17-2004, Self-closing Hinges and Pivots.
.12 ANSI/BHMA A156.18-2006, Materials and Finishes.
.13 ANSI/BHMA A156.19-2002, Power Assist and Low Energy Power - Operated Doors.
.14 ANSI/BHMA A156.20-2006, Strap and Tee Hinges and Hasps.

.2 Canadian Steel Door and Frame Manufacturers' Association (CSDMA)

.1 CSDMA Recommended Dimensional Standards for Commercial Steel Doors and Frames - 2009.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for door hardware and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Samples:

.1 Submit for review and acceptance of each unit.

.2 Samples will be returned for inclusion into work.

.3 Identify each sample by label indicating applicable specification paragraph number, brand name and number, finish and hardware package number.

.4 After approval samples will be returned for incorporation in Work.

.3 Hardware List:

.1 Submit contract hardware list.

.2 Indicate specified hardware, including make, model, material, function, size, finish and other pertinent information.

.4 Test Reports: certified test reports showing compliance with specified performance characteristics and physical properties.

.5 Manufacturer's Instructions: submit manufacturer's installation instructions.

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 door hardware for incorporation into manual.

1.5 MAINTENANCE MATERIALS SUBMITTALS

.1 Extra Stock Materials:

.1 Supply maintenance data, parts list, and manufacturer's instructions for each type of door closers, locksets, door holders and all hardware specified for incorporation into maintenance manual.

.2 Tools:

.1 Supply 2 sets of wrenches for door closers locksets and fire exit hardware.

1.6 QUALITY ASSURANCE

.1 Regulatory Requirements:

.1 Hardware for doors in fire separations and exit doors certified by a Canadian Certification Organization accredited by Standards Council of Canada.

.2 Certificates: product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

1.7 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance 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 Package items of hardware including fastenings, separately or in like groups of hardware, label each package as to item definition and location.

.4 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 door hardware from nicks, scratches, and blemishes.

.3 Protect prefinished surfaces with wrapping strippable coating.

.4 Replace defective or damaged materials with new.

.5 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials.

Part 2 Products

2.1 HARDWARE REQUIREMENTS

.1 Hardware standards listed in Paragraph 2.2 shall be obtained through NRC standing offer program.

.2 NRC has a bonded locksmith for the NRC keying system on standing contract. See contract coordinator for information.

.3 All cylinders to be keyed by NRC bonded locksmith on standing offer contract.

.4 Contractor to be responsible for all associated costs for cylinders and keying of same with NRC bonded standing offer locksmith.

2.2 DOOR HARDWARE

.1 Locks and latches:

.1 Lockset: Yale AU-5407-L x 626.

.2 Latchset: Yale AU-5401-L x 626.

.2 Butts and hinges:

.1 Hinges: Interior Doors: Dorex 114.3mm x 101.6mm x 179 454 NRP X C15.

.2 Hinges: Exterior Doors: Dorex 114.3mm x 101.6mm x BB2222 NRP X C15.

.3 Strap and tee hinges and hasps: to ANSI/BHMA A156.20, designated by letter A and numeral identifiers listed in Hardware Schedule, size listed in Hardware Schedule in accordance with ANSI/BHMA A156.20, table I, finished to 602 (cadmium plated) or 603 (zinc plated).

.3 Exit devices: to ANSI/BHMA A156.3, grade 1, modern-narrow stile.

.4 Door Closers and Accessories:

.1 Door controls (closers): Interior Doors: Norton 1600BC-Reg x AL. parallel arm.

.2 Door controls (closers): Exterior Doors: LCN 4110 x AL.

.3 Door controls (holders): Hager Kick down 270C.S1, sprayed aluminum finish.

.5 Door Operators:

.1 Power-operated pedestrian doors: to ANSI/BHMA A156.10.

.2 Power assist and low energy power operated doors: to ANSI/BHMA A156.19.

.6 Architectural door trim: to ANSI/BHMA A156.6, as listed below.

.1 Door protection plates: kick plate type, 1.27 mm thick stainless steel 304.

.2 Push plates: 1.27 mm thick stainless steel 304.

.3 Push/Pull units: stainless steel 304.

.7 Auxiliary hardware: to ANSI/BHMA A156.16, as listed below.

.1 Door silencer: type neoprene, clear.

.2 Automatic flush bolts: type.

.8 Door bottom seal: heavy duty, door seal of extruded aluminum frame and solid closed cell neoprene, recessed in door bottom closed ends, adjustable automatic retract mechanism when door is open, clear anodized finish.

.9 Thresholds: 125mm wide x full width of door opening, extruded aluminum mill finish, serrated surface, with thermal break of rigid PVC, with lip and vinyl door seal insert.

.10 Weatherstripping:

.1 Head and jamb seal:

.1 Extruded aluminum frame and solid closed cell neoprene insert, clear anodized finish.

.2 Door bottom seal:

.1 Extruded aluminum frame and closed cell neoprene sweep, clear anodized finish.

.11 Astragal: extruded aluminum frame with vinyl insert.

.12 Barrier Free Pneumatic Door Operator:

.1 Heavy duty pneumatically assisted door closer, capable of multi-door operation, complete with actuators, control boxes, pneumatic tubing and compressed air source.

.2 Self-contained control box/compressor combination for independent operation of two door leaves.

.3 Control boxes: complete with electric strike relay.

.4 Mount operators on either push or pull sides of doors as required to place them inside rooms.

.5 Electrical box and actuator: Hardwired low voltage actuator with stainless steel 114 mm round plate, engraved blue filled with handicap symbol. Box 51 mm wide x 102 mm high x 50 mm deep single gang electrical box, flush mounted in wall, locations indicated.

.6 Supply switched line voltage to control box. Locate switch adjacent to box.

.7 Supply low voltage wiring to each actuator and 6 mm diameter air tubing to each operator.

.13 Sliding (Bypass) Door Hardware:

.1 Top mount hanger: Eight ball bearing, nylon tire wheels, one per door, concealed type.

.1 Vertical adjustment by threaded door top plate and locknut.

.2 Top mount track:

.1 Extruded aluminum, 6063T5 alloy width to suit door opening.

.3 Floor guides:

.1 Nylon, two per door.

.4 Door stop:

.1 Rubber, concealed in top mount track, two per door.

.5 Door pull:

.1 Extruded aluminum, 6063T5 alloy, recessed, one per door.

.6 Fascia:

.1 Extruded aluminum, 6063T5 alloy, width to suit door opening.

2.3 FASTENINGS

.1 Use only fasteners provided by manufacturer. Failure to comply may void warranties and applicable licensed labels.

.2 Supply screws, bolts, expansion shields and other fastening devices required for satisfactory installation and operation of hardware.

.3 Exposed fastening devices to match finish of hardware.

.4 Where pull is scheduled on one side of door and push plate on other side, supply fastening devices, and install so pull can be secured through door from reverse side. Install push plate to cover fasteners.

.5 Use fasteners compatible with material through which they pass.

2.4 KEYING

.1 Supply construction cores.

.2 Hand over permanent cores and keys to NRC Departmental Representative.

Part 3 Execution

3.1 INSTALLATION

.1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, and data sheets.

.2 Supply metal door and frame manufacturers with complete instructions and templates for preparation of their work to receive hardware.

.3 Supply manufacturers' instructions for proper installation of each hardware component.

.4 Install hardware to standard hardware location dimensions in accordance with CSDFMA Canadian Metric Guide for Steel Doors and Frames (Modular Construction).

.5 Where door stop contacts door pulls, mount stop to strike bottom of pull.

.6 Install key control cabinet.

.7 Use only manufacturer's supplied fasteners.

.1 Use of "quick" type fasteners, unless specifically supplied by manufacturer, is unacceptable.

.8 Remove construction cores locks when directed by NRC Departmental Representative.

.1 Install permanent cores and ensure locks operate correctly.

3.2 ADJUSTING

.1 Adjust door hardware, operators, closures and controls for optimum, smooth operating condition, safety and for weather tight closure.

.2 Lubricate hardware, operating equipment and other moving parts.

.3 Adjust door hardware to ensure tight fit at contact points with frames.

3.3 CLEANING

.1 Progress Cleaning:

.1 Leave Work area clean at end of each day.

.2 Clean hardware with damp rag and approved non-abrasive cleaner, and polish hardware in accordance with manufacturer's instructions.

.3 Remove protective material from hardware items where present.

.4 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.

.2 Waste Management: separate waste materials for reuse and recycling.

.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.4 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by door hardware installation.

3.5 SCHEDULE

.1 E01:

.1 Active Leaf:

.1 1 1/2 pairs hinges, 5 bearing, regular.

.2 Narrow stile exit device.

.3 Electric strike 12VDC (fail safe).

.4 Overhead door stop.

.5 Cylinder.

.6 Door closure.

.7 Door operator.

.8 Removable astragal

.9 Door contact

.10 Door Pull

.11 Interlocking threshold and weatherstrip.

.12 1 set weatherstripping

.2 Inactive Leaf:

.1 1 1/2 pairs hinges, 5 bearing, regular.

.2 Narrow stile exit device.

.3 Overhead door stop.

.4 Door closure.

.5 Manual flush bolt (bottom only).

.6 Constant latching bolt (top only).

.7 Door contact

.8 Door Pull
.9 Interlocking threshold and weatherstrip.
.10 1 set weatherstripping

.2 E04, E05, E07, E10:

.1 1 1/2 pairs hinges, 2 bearing, NRP.
.2 Narrow stile exit device.
.3 Overhead door stop.
.4 Door closure.
.5 2 kickplates width of door, 630mm high.
.6 Interlocking threshold and weatherstrip.
.7 1 set weatherstripping.
.8 Door silencers
.9 Door contact

.3 E02,E03:

.1 1 1/2 pairs hinges, 2 bearing, NRP.
.2 Narrow stile exit device.
.3 Overhead door stop.
.4 Door closure.
.5 2 kickplates width of door, 630mm high.
.6 Interlocking threshold and weatherstrip.
.7 1 set weatherstripping.
.8 Door silencers
.9 Door contact
.10 Electric strike 12VDC (fail safe)

.4 D021:

.1 Active Leaf:
.1 1 1/2 pairs hinges, 5 bearing, regular.
.2 Narrow stile exit device.
.3 Electric strike 12VDC (fail safe).
.4 Overhead door stop.
.5 Cylinder.
.6 Door closure.
.7 2 kickplates width of door, 630mm high.
.8 Removable Astragal
.9 Door contact
.10 Door Pull
.2 Inactive Leaf:
.1 1 1/2 pairs hinges, 5 bearing, regular.
.2 Narrow stile exit device.

.3 Overhead door stop.
.4 Door closure.
.5 2 kickplates width of door, 630mm high.
.6 Manual flush bolt (bottom only).
.7 Constant latching bolt (top only).
.8 Door contact
.9 Door Pull

.5 D038, D142:

.1 1 1/2 pairs hinges, 5 bearing, regular.
.2 Narrow stile exit device.
.3 Mortise lockset (Storeroom function), exterior side, D pull.
.4 Electric strike 12VDC (fail safe).
.5 Overhead door stop.
.6 Door closure.
.7 Door silencers

.6 D021a, D021b, D124a:

.1 1 1/2 pairs hinges, 5 bearing, regular.
.2 Narrow stile exit device.
.3 Electric strike 12VDC (fail safe).
.4 Overhead door stop.
.5 Door closure.
.6 Door silencers
.7 Door contact
.8 2 kickplates width of door, 630mm high.
.9 Door Pull on exterior side

.7 D022, D023:

.1 1 1/2 pairs hinges, 5 bearing, regular.
.2 Mortise lockset (Storeroom function).
.3 Overhead door stop.
.4 Cylinder.
.5 Door closure.
.6 Door silencers
.7 2 kickplates width of door, 630mm high.

.8 D024, D025:

.1 Active Leaf:
.1 1 1/2 pairs hinges, 5 bearing, regular.
.2 Mortise lockset (Storeroom function).
.3 Overhead door stop.

.4 Cylinder.
.5 Door closure.
.6 2 kickplates width of door, 630mm high.
.7 Removable Astragal

.2 Inactive Leaf:
.1 1 1/2 pairs hinges, 5 bearing, regular.
.2 Dummy set
.3 Overhead door stop.
.4 Door closure.
.5 2 kickplates width of door, 630mm high.
.6 Manual flush bolt (bottom only).
.7 Constant latching bolt (top only).

.9 D030, D033, D034, D136, D037, D027, D028, D029:

.1 1 1/2 pairs hinges, 2 bearing, regular.
.2 Mortise lockset (Storeroom function).
.3 Overhead door stop.
.4 Door closure
.5 Door silencers
.6 2 kickplates width of door, 630mm high.

.10 D141:

.1 1 1/2 pairs hinges, 2 bearing, NRP.
.2 Mortise lockset (Hotel function), no exterior.
.3 Overhead door stop.
.4 Cylinder.
.5 Door closure.
.6 2 kickplates width of door, 630mm high.
.7 Interlocking threshold and weatherstrip.
.8 Door silencers

.11 D130, D130a, D131, D131a, D132, D132a:

.1 1 1/2 pairs hinges, 5 bearing, regular.
.2 Mortise lockset (Classroom function).
.3 Overhead door stop.
.4 Cylinder.
.5 Door closure.
.6 2 kickplates width of door, 630mm high.
.7 Door silencers

.12 D129:

.1 1 1/2 pairs hinges, 5 bearing, regular.

.2 Mortise lockset (Storeroom function).
.3 Electric strike 12VDC (fail secure).
.4 Overhead door stop.
.5 Cylinder.
.6 Door closure.
.7 2 kickplates width of door, 630mm high.
.8 Door silencers
.9 Door operator

.13 D128:

.1 1 1/2 pairs hinges, 5 bearing, regular.
.2 Mortise lockset (Privacy function).
.3 Electric strike 12VDC (fail secure).
.4 Overhead door stop.
.5 Door closure.
.6 2 kickplates width of door, 630mm high.
.7 Door operator.
.8 Door silencers

.14 D125, D125a:

.1 Bottom rail lock mechanism, mortise cylinder, round bolt dead lock.
.2 Overhead door stop.
.3 Door closure.
.4 Top and floor bearing pivot, 180 degree action.
.5 Mortise lockset (Storeroom function).

.15 D123, D124:

.1 1 1/2 pairs hinges, 5 bearing, regular.
.2 Mortise lockset (Storeroom function).
.3 Electric strike 12VDC (fail secure).
.4 Overhead door stop.
.5 Cylinder.
.6 Door closure.
.7 2 kickplates width of door, 630mm high.
.8 Door operator.
.9 Door silencers
.10 Door contact

.16 D122:

.1 1 1/2 pairs hinges, 5 bearing, regular.
.2 Mortise lockset (Storeroom function).
.3 Overhead door stop.

.4 Cylinder.
.5 Door closure.
.6 2 kickplates width of door, 630mm high.
.7 Door operator.
.8 Door silencers
.9 Electric strike 12VDC (fail secure).

.17 D121:

.1 Active Leaf:
.1 1 1/2 pairs hinges, 5 bearing, regular.
.2 Mortise lockset (Storeroom function).
.3 Electric strike 12VDC (fail secure).
.4 Overhead door stop.
.5 Cylinder.
.6 Door closure.
.7 2 kickplates width of door, 630mm high.
.8 Door operator.
.9 Removable Astragal
.2 Inactive Leaf:
.1 1 1/2 pairs hinges, 5 bearing, regular.
.2 Dummy set
.3 Overhead door stop.
.4 Door closure.
.5 2 kickplates width of door, 630mm high.
.6 Manual flush bolt (bottom only).
.7 Constant latching bolt (top only).

.18 D121a, D121b

.1 Top mount hanger.
.2 Top mount track.
.3 Floor guides.
.4 Door stop.
.5 Door pull.
.6 Fascia.

.19 D026, D138, D139, D139a, D140, D140b, D031, D032, D035, D036, D036a, D126, D127:

.1 1 1/2 pairs hinges, 2 bearing, regular.
.2 Mortise lockset (Storeroom function).
.3 Overhead door stop.
.4 Door closure
.5 Door silencers

.6 2 kickplates width of door, 630mm high.

.20 D137:

.1 1 1/2 pairs hinges, 2 bearing, regular.
.2 Mortise lockset (Storeroom function).
.3 Overhead door stop.
.4 Door closure
.5 Door silencers
.6 Door contact
.7 Electric strike 12VDC (fail safe).
.8 2 kickplates width of door, 630mm high.

.21 D140a

.1 1 1/2 pairs hinges, 2 bearing, regular.
.2 Mortise lockset (Storeroom function).
.3 Overhead door stop.
.4 Door closure
.5 Door silencers
.6 Drop Threshold (STC rated door)
.7 Door Contact

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 08 11 00 - Metal Doors and Frames.

1.2 REFERENCES

.1 ASTM International

.1 ASTM E 84-10, Standard Test Method for Surface Burning Characteristics of Building Materials.

.2 ASTM E 330-02, Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference.

.2 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-12.1-M90, Tempered or Laminated Safety Glass.

.2 CAN/CGSB-12.3-M91, Flat, Clear Float Glass.

.3 CAN/CGSB-12.11-M90, Wired Safety Glass.

.4 CAN/CGSB-12.13-M91, Patterned Glass.

.3 Environmental Choice Program (ECP)

.1 CCD-045-95(R2005), Sealants and Caulking Compounds.

.4 Glass Association of North American (GANA)

.1 GANA Glazing Manual - 2008.

.2 GANA Laminated Glazing Reference Manual - 2009.

.5 South Coast Air Quality Management District (SCAQMD), California State, Regulation XI. Source Specific Standards

.1 SCAQMD Rule 1168-A2005, Adhesives and Sealants Applications.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 10 00 General Instrcuctions.

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for glass, sealants, and glazing accessories 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 Province of Ontario, Canada.

.4 Samples:

.1 Submit for review and acceptance of each unit.

.2 Samples will be returned for inclusion into work.

.3 Submit duplicate 300mm size samples of glazing and sealant material.

.5 Certificates: submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

.6 Test Reports: certified test reports showing compliance with specified performance characteristics and physical properties.

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 glazing for incorporation into manual.

1.5 QUALITY ASSURANCE

.1 Certificates: product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance 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 glazing and frames from nicks, scratches, and blemishes.

.3 Protect prefinished surfaces with wrapping, strippable coating.

.4 Replace defective or damaged materials with new.

.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.

1.7 AMBIENT CONDITIONS

.1 Ambient Requirements:

.1 Install glazing when ambient temperature is 10 degrees C minimum. Maintain ventilated environment for 24 hours after application.

.2 Maintain minimum ambient temperature before, during and 24 hours after installation of glazing compounds.

Part 2 Products

2.1 MATERIALS

.1 Flat Glass:

.1 Float glass: to CAN/CGSB-12.3, mirror glazing (selected), thickness as indicated on drawings.

.2 Sheet glass: to CAN/CGSB-12.2., thickness as indicated on drawings.

.3 Safety glass: to CAN/CGSB-12.1, transparent, thickness as indicated on drawings.

.1 Type 2-tempered.

.2 Class B-float.

.3 Category 1.

.4 Edge treatment: square.

.4 Silvered mirror glass: 6mm.

.1 Type 1A-float glass for normal use.

.5 Wired glass: to CAN/CGSB-12.11, thickness as indicated on drawings.

.1 Type 1-polished both sides (transparent).

.2 Wire mesh styles 1-diamond.

.6 Patterned glass: to CAN/CGSB-12.13, 6mm thick.

.1 Type 1-annealed.

.2 Styles A-figured one surface.

.3 Surface treatment: Ripple, vertical.

.4 Edge treatment: Square.

.2 Sealant: in accordance with Section 07 92 00 - Joint Sealants.

.1 VOC limit 250 g/L maximum to SCAQMD Rule 1168.

.1 VOC limit: 5 % maximum by weight to CCD-045.

.2 Ensure sealant does not contain chemical restrictions to CCD-045.

2.2 ACCESSORIES

.1 Setting blocks: neoprene Shore A durometer hardness to ASTM D 2240, to suit glazing method, glass light weight and area.

.2 Spacer shims: neoprene Shore A durometer hardness to ASTM D 2240, 75 mm long x one half height of glazing stop x thickness to suit application. Self adhesive on one face.

.3 Glazing tape:

.1 Preformed butyl compound with integral resilient tube spacing device; black colour.

.4 Glazing splines: resilient polyvinyl chloride, extruded shape to suit glazing channel retaining slot.

.5 Glazing clips: manufacturer's standard type.

.6 Lock-strip gaskets: to ASTM C 542.

.7 Mirror attachment accessories:

.1 Stainless steel clips.

Part 3 Execution

3.1 EXAMINATION

.1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for glazing installation in accordance with manufacturer's written instructions.

.1 Verify that openings for glazing are correctly sized and within tolerance.

.2 Verify that surfaces of glazing channels or recesses are clean, free of obstructions, and ready to receive glazing.

.3 Visually inspect substrate.

.4 Inform NRC Departmental Representative of unacceptable conditions immediately upon discovery.

.5 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from NRC Departmental Representative.

3.2 PREPARATION

.1 Clean contact surfaces with solvent and wipe dry.

.2 Seal porous glazing channels or recesses with substrate compatible primer or sealer.

.3 Prime surfaces scheduled to receive sealant.

3.3 INSTALLATION: EXTERIOR - DRY METHOD (PREFORMED GLAZING)

.1 Manufacturer's Instructions: comply with manufacturer's written data, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, and data sheets.

.2 Perform work in accordance with GANA Glazing Manual and GANA Laminated Glazing Reference Manual for glazing installation methods.

.3 Cut glazing tape to length; install on glazing light. Seal corners by butting tape and sealing junctions with sealant.

.4 Place setting blocks at 1/4 points, with edge block maximum 150 mm from corners.

.5 Rest glazing on setting blocks and push against fixed stop with sufficient pressure to attain full contact.

.6 Install removable stops without displacing glazing tape. Exert pressure for full continuous contact.

.7 Trim protruding tape edge.

3.4 INSTALLATION: EXTERIOR - WET METHOD (SEALANT AND SEALANT)

.1 Perform work in accordance with GANA Glazing Manual and GANA Laminated Glazing Reference Manual for glazing installation methods.

.2 Place setting blocks at 1/4 points and install glazing light or unit.

.3 Install removable stops with glazing centred in space by inserting spacer shims both sides at 600 mm intervals, 6 mm below sight line.

.4 Fill gaps between glazing and stops with sealant to depth of bite on glazing, maximum 9 mm below sight line to ensure full contact with glazing and continue air and vapour seal.

.5 Apply sealant to uniform line, flush with sight line. Tool or wipe sealant surface smooth.

3.5 INSTALLATION: INTERIOR - DRY METHOD (TAPE AND TAPE)

.1 Perform work in accordance with GANA Glazing Manual and GANA Laminated Glazing Reference Manual for glazing installation methods.

.2 Cut glazing tape to length and set against permanent stops, projecting 1.6 mm above sight line.

.3 Place setting blocks at 1/4 points, with edge block maximum 150 mm from corners.

.4 Rest glazing on setting blocks and push against tape for full contact at perimeter of light or unit.

.5 Place glazing tape on free perimeter of glazing in same manner described.

.6 Install removable stop without displacement of tape. Exert pressure on tape for full continuous contact.

.7 Knife trim protruding tape.

3.6 INSTALLATION: INTERIOR WET/DRY METHOD (TAPE AND SEALANT)

.1 Perform work in accordance with GANA Glazing Manual and GANA Laminated Glazing Reference Manual for glazing installation methods.

.2 Cut glazing tape to length and install against permanent stops, projecting 1.6 mm above sight line.

.3 Place setting blocks at 1/4 points, with edge block maximum 150 mm from corners.

.4 Rest glazing on setting blocks and push against tape to ensure full contact at perimeter of light or unit.

.5 Install removable stops, with spacer shims inserted between glazing and applied stops at 600 mm intervals, 6 mm below sight line.

.6 Fill gaps between light and applied stop with sealant to depth equal to bite on glazing, to uniform and level line.

.7 Trim protruding tape edge.

3.7 INSTALLATION: MIRRORS

.1 Set mirrors with adhesive, applied in accordance with adhesive manufacturer's instructions.

.2 Set mirrors with clips. Anchor rigidly to wall construction.

.3 Place plumb and level.

3.8 CLEANING

.1 Progress Cleaning:

.1 Leave Work area clean at end of each day.

.1 Remove traces of primer, caulking.

.2 Remove glazing materials from finish surfaces.

.3 Remove labels.

.4 Clean glass and mirrors using approved non-abrasive cleaner in accordance with manufacturer's instructions.

.2 Final Cleaning: upon completion remove surplus 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.

.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.9 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 After installation, mark each light with an "X" by using removable plastic tape or paste.

.1 Do not mark heat absorbing or reflective glass units.

.3 Repair damage to adjacent materials caused by glazing installation.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 07 21 16 - Blanket Insulation.

.2 Section 07 26 00 – Vapour Retarders.

.3 Section 07 92 00 - Joint Sealants.

.4 Section 07 84 00 - Firestopping.

.5 Section 08 11 00 - Metal doors and Frames.

.6 Section 09 22 16 - Non-Structural Metal Framing.

.7 Section 09 91 23 - Interior Painting.

1.2 REFERENCES

.1 ASTM International

.1 ASTM C 475-02(2007), Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board.

.2 ASTM C 514-04(2009e1), Standard Specification for Nails for the Application of Gypsum Board.

.3 ASTM C 840-08, Standard Specification for Application and Finishing of Gypsum Board.

.4 ASTM C 954-07, Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs From 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness.

.5 ASTM C 1002-07, Standard Specification for Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs.

.6 ASTM C 1047-09, Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base.

.7 ASTM C 1396/C 1396M-09a, Standard Specification for Gypsum Wallboard.

.2 Association of the Wall and Ceilings Industries International (AWCI)

.1 AWCI Levels of Gypsum Board Finish-97.

.3 South Coast Air Quality Management District (SCAQMD), California State, Regulation XI. Source Specific Standards

.1 SCAQMD Rule 1113-A2007, Architectural Coatings.

.2 SCAQMD Rule 1168-A2005, Adhesives and Sealants Applications.

.4 Underwriters' Laboratories of Canada (ULC)

.1 CAN/ULC-S102-07, Standard Method of Test of Surface Burning Characteristics of Building Materials and Assemblies.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for gypsum board assemblies 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 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 gypsum board assemblies materials level off ground, indoors, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect gypsum board assemblies from nicks, scratches, and blemishes.

.3 Protect from weather, elements and damage from construction operations.

.4 Handle gypsum boards to prevent damage to edges, ends or surfaces.

.5 Replace defective or damaged materials with new.

.4 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials.

1.5 AMBIENT CONDITIONS

.1 Maintain temperature 10 degrees C minimum, 21 degrees C maximum for 48 hours prior to and during application of gypsum boards and joint treatment, and for 48 hours minimumafter completion of joint treatment.

.2 Apply board and joint treatment to dry, frost free surfaces.

.3 Ventilation: ventilate building spaces as required to remove excess moisture that would prevent drying of joint treatment material immediately after its application.

Part 2 Products

2.1 MATERIALS

.1 Standard board: to ASTM C 1396/C 1396M regular, thickness as indicated on drawings x maximum practical length, ends square cut, edges squared.

.2 Water-resistant board: to ASTM C 1396/C 1396M regular, thickness as indicated on drawings x maximum practical length, ends square cut, edges squared.

.3 Metal furring runners, hangers, tie wires, inserts, anchors.

.4 Drywall furring channels: 0.5 mm core thickness galvanized steel channels for screw attachment of gypsum board.

.5 Resilient clips, drywall furring: 0.5 mm base steel thickness galvanized steel for resilient attachment of gypsum board.

.6 Steel drill screws: to ASTM C 954.

.7 Casing beads, corner beads, control joints and edge trim: to ASTM C 1047,zinc-coated by hot-dip process, 0.5 mm base thickness, perforated flanges, one piece length per location.

.8 Sealants: in accordance with Section 07 92 00 - Joint Sealants.

.1 VOC limit 250 g/L maximum to SCAQMD Rule 1168.

.2 Acoustic sealant: in accordance with Section 07 92 00 - Joint Sealants.

.9 Polyethylene: to CAN/CGSB-51.34, Type 2.

.10 Joint compound: to ASTM C 475, asbestos-free.

2.2 FINISHES

.1 Texture finish: asbestos-free standard white texture coating and primer-sealer, recommended by gypsum board manufacturer.

.1 Primer: VOC limit 50 g/L maximum to GS-11 SCAQMD Rule 1113.

Part 3 Execution

3.1 EXAMINATION

.1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for gypsum board assemblies installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate.

.2 Inform NRC 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 NRC Departmental Representative.

3.2 ERECTION

.1 Do application and finishing of gypsum board to ASTM C 840 except where specified otherwise.

.2 Do application of gypsum sheathing to ASTM C 1280.

.3 Erect hangers and runner channels for suspended gypsum board ceilings to ASTM C 840 except where specified otherwise.

.4 Support light fixtures by providing additional ceiling suspension hangers within 150 mm of each corner and at maximum 600 mm around perimeter of fixture.

.5 Install work level to tolerance of 1:1200.

.6 Frame with furring channels, perimeter of openings for access panels, light fixtures, diffusers, grilles.

.7 Install 19 x 64 mm furring channels parallel to, and at exact locations of steel stud partition header track.

.8 Furr for gypsum board faced vertical bulkheads within and at termination of ceilings.

.9 Furr above suspended ceilings for gypsum board fire and sound stops and to form plenum areas as indicated.

.10 Install wall furring for gypsum board wall finishes to ASTM C 840, except where specified otherwise.

.11 Furr openings and around built-in equipment, cabinets, access panels, on four sides. Extend furring into reveals. Check clearances with equipment suppliers.

.12 Furr duct shafts, beams, columns, pipes and exposed services where indicated.

3.3 APPLICATION

.1 Apply gypsum board after bucks, anchors, blocking, sound attenuation, electrical and mechanical work have been approved.

.2 Apply single, double layer gypsum board to metal furring or framing using screw fasteners for first layer and for second layer. Maximum spacing of screws 300 mm on centre.

.1 Single-Layer Application:

.1 Apply gypsum board on ceilings prior to application of walls to ASTM C 840.

.2 Apply gypsum board vertically or horizontally, providing sheet lengths that will minimize end joints.

.2 Double-Layer Application:

.1 Install gypsum board for base layer and exposed gypsum board for face layer.

.2 Apply base layer to ceilings prior to base layer application on walls; apply face layers in same sequence. Offset joints between layers at least 250 mm.

.3 Apply base layers at right angles to supports unless otherwise indicated.

.4 Apply base layer on walls and face layers vertically with joints of base layer over supports and face layer joints offset at least 250mm with base layer joints.

.3 Apply water-resistant gypsum board where wall tiles to be applied and adjacent to slop sinks, janitors closets. Apply water-resistant sealant to edges, ends, cut-outs which expose gypsum core and to fastener heads. Do not apply joint treatment on areas to receive tile finish.

.4 Apply 12 mm diameter bead of acoustic sealant continuously around periphery of each face of partitioning to seal gypsum board/structure junction where partitions abut fixed building components. Seal full perimeter of cut-outs around electrical boxes, ducts, in partitions where perimeter sealed with acoustic sealant.

.5 Install gypsum board on walls vertically to avoid end-butt joints. At stairwells and similar high walls, install boards horizontally with end joints staggered over studs, except where local codes or fire-rated assemblies require vertical application.

.6 Install gypsum board with face side out.

.7 Do not install damaged or damp boards.

.8 Locate edge or end joints over supports. Stagger vertical joints over different studs on opposite sides of wall.

3.4 INSTALLATION

.1 Erect accessories straight, plumb or level, rigid and at proper plane. Use full length pieces where practical. Make joints tight, accurately aligned and rigidly secured. Mitre and fit corners accurately, free from rough edges. Secure at 150mm on centre.

.2 Install casing beads where gypsum board butts against surfaces having no trim concealing junction and where indicated. Seal joints with sealant.

.3 Install insulating strips continuously at edges of gypsum board and casing beads abutting metal window and exterior door frames, to provide thermal break.

.4 Finish face panel joints and internal angles with joint system consisting of joint compound, joint tape and taping compound installed according to manufacturer's directions and feathered out onto panel faces.

.5 Gypsum Board Finish: finish gypsum board walls and ceilings to following levels in accordance with AWCI Levels of Gypsum Board Finish:

.1 Levels of finish:

.1 Level 2: embed tape for joints and interior angles in joint compound and apply one separate coat of joint compound over joints, angles, fastener heads and accessories; surfaces free of excess joint compound; tool marks and ridges are acceptable.

.2 Level 4: embed tape for joints and interior angles in joint compound and apply three separate coats of joint compound over joints, angles, fastener heads and accessories; surfaces smooth and free of tool marks and ridges.

.3 Level 5: embed tape for joints and interior angles in joint compound and apply three separate coats of joint compound over joints, angles, fastener heads and accessories; apply a thin skim coat of joint compound to entire surface; surfaces smooth and free of tool marks and ridges.

.6 Finish corner beads, control joints and trim as required with two coats of joint compound and one coat of taping compound, feathered out onto panel faces.

.7 Fill screw head depressions with joint and taping compounds to bring flush with adjacent surface of gypsum board so as to be invisible after surface finish is completed.

.8 Sand lightly to remove burred edges and other imperfections. Avoid sanding adjacent surface of board.

.9 Completed installation to be smooth, level or plumb, free from waves and other defects and ready for surface finish.

.10 Apply one coat of white primer sealer over surface to be textured. When dry apply textured finish in accordance with manufacturer's instructions.

.11 Mix joint compound slightly thinner than for joint taping.

.12 Apply thin coat to entire surface using trowel or drywall broad knife to fill surface texture differences, variations or tool marks.

.13 Allow skim coat to dry completely.

.14 Remove ridges by light sanding or wiping with damp cloth.

3.5 CLEANING

.1 Progress Cleaning:

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.

.2 Waste Management: separate waste materials for reuse and recycling.

.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.6 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by gypsum board assemblies installation.

3.7 SCHEDULES

.1 Construct fire rated assemblies where indicated.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 07 21 16 - Blanket Insulation.

.2 Section 07 92 00 - Joint Sealants.

.3 Section 08 11 00 - Metal Doors and Frames.

.4 Section 09 21 16 - Gypsum Board Assemblies.

1.2 REFERENCES

.1 American Society for Testing and Materials International, (ASTM).

.1 ASTM C 645-00, Specification for Nonstructural Steel Framing Members.

.2 ASTM C 754-00, Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products.

1.3 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials.

.2 Remove from site and dispose of packaging materials at appropriate recycling facilities.

.3 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard packaging material.

Part 2 Products

2.1 MATERIALS

.1 Non-load bearing channel stud framing: to ASTM C 645, stud size as indicated on drawings, roll formed from 0.53, 0.91 mm thickness hot dipped galvanized steel sheet, for screw attachment of gypsum board. Knock-out service holes at 460mm centres.

.2 Floor and ceiling tracks: to ASTM C 645, in widths to suit stud sizes, 32 mm flange height.

.3 Metal channel stiffener: 1.4 mm thick cold rolled steel, coated with rust inhibitive coating.

.4 Acoustical sealant: in accordance with Section 07 92 00.

Part 3 Execution

3.1 ERECTION

.1 Align partition tracks at floor and ceiling and secure at 600 mm on centre maximum.

.2 Install damp proof course under stud shoe tracks of partitions on slabs on grade.

.3 Place studs vertically at 600mm on centre and not more than 50 mm from abutting walls, and at each side of openings and corners. Position studs in tracks at floor and ceiling. Cross brace steel studs as required to provide rigid installation to manufacturer's instructions.

.4 Erect metal studding to tolerance of 1:1000.

.5 Attach studs to bottom and ceiling track using screws.

.6 Co-ordinate simultaneous erection of studs with installation of service lines. When erecting studs ensure web openings are aligned.

.7 Co-ordinate erection of studs with installation of door/window frames and special supports or anchorage for work specified in other Sections.

.8 Provide two studs extending from floor to ceiling at each side of openings wider than stud centres specified. Secure studs together, 50 mm apart using column clips or other approved means of fastening placed alongside frame anchor clips.

.9 Install heavy gauge single jamb studs at openings.

.10 Erect track at head of door/window openings and sills of sidelight/window openings to accommodate intermediate studs. Secure track to studs at each end, in accordance with manufacturer's instructions. Install intermediate studs above and below openings in same manner and spacing as wall studs.

.11 Frame openings and around built-in equipment, cabinets, access panels, on four sides. Extend framing into reveals. Check clearances with equipment suppliers.

.12 Provide 40 mm stud or furring channel secured between studs for attachment of fixtures behind lavatory basins, toilet and bathroom accessories, and other fixtures including grab bars and towel rails, attached to steel stud partitions.

.13 Install steel studs or furring channel between studs for attaching electrical and other boxes.

.14 Extend partitions to ceiling height except where noted otherwise on drawings.

.15 Maintain clearance under beams and structural slabs to avoid transmission of structural loads to studs. Use 50 mm leg ceiling tracks.

.16 Install continuous insulating strips to isolate studs from uninsulated surfaces.

.17 Install two continuous beads of acoustical sealant under studs and tracks around perimeter of sound control partitions.

3.2 CLEANING

.1 Upon completion of installation, remove surplus materials, rubbish, tools and equipment barriers.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 09 53 00.01 - Acoustical Suspension.

1.2 REFERENCES

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

.1 ASTM C 423-02a, Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method

.2 ASTM E 1264-98, Standard Classification for Acoustical Ceiling Products.

.3 ASTM E 1477-98a(2003), Standard Test Method for Luminous Reflectance Factor of Acoustical Materials by Use of Integrating-Sphere Reflectometers.

.2 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-92.1-M89, Sound Absorptive Prefabricated Acoustical Units.

.3 Canadian Standards Association (CSA International)

.1 CSA B111-1974(R2003), Wire Nails, Spikes and Staples.

.4 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

.5 Underwriter's Laboratories of Canada (ULC)

.1 CAN/ULC-S102-2003, Surface Burning Characteristics of Building Materials and Assemblies.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit samples in accordance with Section 01 33 00 - Submittal Procedures.

.2 Product Data: submit WHMIS MSDS.

.3 Submit duplicate full size samples of each type acoustical units.

1.4 QUALITY ASSURANCE

.1 Regulatory Requirements:

.1 Fire-resistance rated floor/ceiling and roof/ceiling assembly: certified by Canadian Certification Organization accredited by Standards Council of Canada.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Protect on site stored or installed absorptive material from moisture damage.

.2 Store extra materials required for maintenance, where directed by NRC Departmental Representative.

.3 Waste Management and Disposal:

.1 Separate waste materials for reuse and recycling.

.2 Remove from site and dispose of packaging materials at appropriate recycling facilities.

.3 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard packaging material in appropriate on-site bins for recycling.

1.6 ENVIRONMENTAL REQUIREMENTS

.1 Permit wet work to dry before beginning to install.

.2 Maintain uniform minimum temperature of 15 degrees C and humidity of 20-40% before and during installation.

.3 Store materials in work area 48 hours prior to installation.

1.7 EXTRA MATERIALS

.1 Provide extra materials of acoustic units.

.2 Provide acoustical units amounting to 2% of gross ceiling area for each pattern and type required for project.

.3 Ensure extra materials are from same production run as installed materials.

.4 Clearly identify each type of acoustic unit, including colour and texture.

.5 Deliver to NRC Departmental Representative, upon completion of the work of this section.

Part 2 Products

2.1 MATERIALS

.1 Basis of Design – Acoustic Tile Products: Refer to Section 00 01 30, List of Materials for complete list of acoustic tile products, designations, manufacturers, sizes and colour.

.1 Products by other manufacturers similar in function, design, performance, and construction complying with requirements of this Section may be incorporated into the Work subject to NRC Departmental Representative's acceptance, in accordance with the Contract substitution procedures.

.2 Staples, nails and screws: to CSA B111 non-corrosive finish as recommended by acoustic unit manufacturer.

.3 Polyethylene: to CAN/CGSB-51.34, 0.15 mm thick.

.4 Hold down clips: purpose made clips to secure tile to suspension system, approved for use in fire-rated systems.

Part 3 Execution

3.1 EXAMINATION

.1 Do not install acoustical panels and tiles until work above ceiling has been inspected by NRC Departmental Representative.

3.2 INSTALLATION

.1 Install acoustical panels and tiles in ceiling suspension system.

3.3 APPLICATION

.1 Install acoustic units to clean, dry and firm substrate.

.2 Install acoustical units with directional pattern running in same direction. Refer to reflected ceiling plan.

.3 Scribe acoustic units to fit adjacent work. Butt joints tight, terminate edges with moulding.

3.4 INTERFACE WITH OTHER WORK

.1 Co-ordinate with Section 09 53 00.01 - Acoustical Suspension.

.2 Co-ordinate ceiling work to accommodate components of other sections, such as light fixtures, diffusers, speakers, sprinkler heads, to be built into acoustical ceiling components.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 09 51 13 - Acoustical Panel Ceilings.

1.2 REFERENCES

.1 ASTM International

.1 ASTM C 635/C 635M-07, Standard Specifications for the Manufacture, Performance and Testing of Metal Suspension Systems for Acoustical Tile and Lay-In Panel Ceilings.

.2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for acoustical suspension and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Shop Drawings:

.1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.

.2 Submit reflected ceiling plans for special grid patterns as indicated.

.3 Indicate lay-out, insert and hanger spacing and fastening details, splicing method for main and cross runners, location of access splines change in level details, access door dimensions, and locations and acoustical unit support at ceiling fixture, lateral bracing and accessories.

.3 Samples:

.1 Submit for review and acceptance of each unit.

.2 Samples will be returned for inclusion into work.

.3 Submit one representative model of each type ceiling suspension system.

.4 Ceiling system to show basic construction and assembly, treatment at walls, recessed fixtures, splicing, interlocking, finishes, acoustical unit installation.

1.4 CLOSEOUT SUBMITTALS

.1 Operation and Maintenance Data: submit operation and maintenance data for acoustical suspension for incorporation into manual.

1.5 QUALITY ASSURANCE

.1 Fire-resistance rated suspension system: certified by a Canadian Certification Organization accredited by Standards Council of Canada.

.2 Certifications: submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance 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 acoustical ceiling tiles and tracks from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

.4 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials.

Part 2 Products

2.1 DESIGN CRITERIA

.1 Design Requirements: maximum deflection: 1/360th of span to ASTM C 635/ASTM C635M deflection test.

2.2 MATERIALS

.1 Intermediate duty system to ASTM C 635/ASTM C635M.

.2 Basic materials for suspension system: commercial quality cold rolled steel, zinc coated, mill finished.

.3 Suspension system: non fire rated, made up as follows:

.1 2 directional exposed tee bar grid.

.4 Exposed tee bar grid components: shop painted satin sheen, white. Components die cut. Main tee with double web, rectangular bulb and 25 mm rolled cap on exposed face. Cross tee with rectangular bulb; web extended to form positive interlock with main tee webs; lower flange extended and offset to provide flush intersection.

.5 Hanger wire: galvanized soft annealed steel wire:

.1 3.6 mm diameter for access tile ceilings.

.2 2.6 mm diameter for other ceilings.

.6 Hanger inserts: purpose made.

.7 Accessories: splices, clips, wire ties, retainers and wall moulding to complement suspension system components, as recommended by system manufacturer.

Part 3 Execution

3.1 EXAMINATION

.1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for acoustical ceiling tile and track installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate.

.2 Inform NRC 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 NRC Departmental Representative.

3.2 INSTALLATION

.1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, and data sheets.

.2 Installation: to ASTM C 636/C 636M except where specified otherwise.

.3 Install suspension system to manufacturer's instructions and Certification Organizations tested design requirements.

.4 Do not erect ceiling suspension system until work above ceiling has been inspected and approved by NRC Departmental Representative.

.5 Secure hangers to overhead structure using attachment methods as recommended by manufacturer.

.6 Install hangers spaced at maximum 1200 mm centres and within 150 mm from ends of main tees.

.7 Lay out system according to reflected ceiling plan.

.8 Ensure suspension system is co-ordinated with location of related components.

.9 Install wall moulding to provide correct ceiling height.

.10 Completed suspension system to support super-imposed loads, such as lighting fixtures, diffusers, grilles and speakers.

.11 Support at light fixtures, diffusers with additional ceiling suspension hangers within 150 mm of each corner and at maximum 600 mm around perimeter of fixture.

.12 Attach cross member to main runner to provide rigid assembly.

.13 Frame at openings for light fixtures, air diffusers, speakers and at changes in ceiling heights.

.14 Install access splines to provide 50% ceiling access.

.15 Finished ceiling system to be square with adjoining walls and level within 1:1000.

3.3 CLEANING

.1 Progress Cleaning:

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.

.1 Touch up scratches, abrasions, voids and other defects in painted surfaces.

.3 Waste Management: separate waste materials for reuse and recycling.

.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.4 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by acoustical suspension installation.

END OF SECTION

Part 1 General

1.1 REFERENCES

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

.1 ASTM F 1066-04, Standard Specification for Vinyl Composition Floor Tile.

.2 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-25.20-95, Surface Sealer for Floors.

.2 CAN/CGSB-25.21-95, Detergent-Resistant Floor Polish.

.3 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

.4 South Coast Air Quality Management District (SCAQMD), California State

.1 SCAQMD Rule 1168-05, Adhesives and Sealants Applications.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Provide product data in accordance with Section 01 33 00 - Submittal Procedures.

.3 Provide samples in accordance with Section 01 33 00 - Submittal Procedures.

.1 Submit duplicate tile in size specified, 300 mm long base, nosing, feature strips, treads, edge strips.

.4 Closeout Submittals:

.1 Provide maintenance data for resilient flooring for incorporation into manual.

1.3 ENVIRONMENTAL REQUIREMENTS

.1 Maintain air temperature and structural base temperature at flooring installation area above 20 degrees C for 48 hours before, during and for 48 hours after installation.

1.4 MAINTENANCE

.1 Extra Materials:

.1 Provide maintenance materials of resilient tile flooring, base and adhesive.

.2 Provide 2 m^2 of each colour, pattern and type flooring material required for this project for maintenance use.

.3 Extra materials from same production run as installed materials.

.4 Identify each container of floor tile and each container of adhesive.

.5 Deliver to NRC Departmental Representative, upon completion of the work of this section.

.6 Store where directed by NRC Departmental Representative.

Part 2 Products

2.1 MATERIALS

.1 Basis of Design – Resilient Tile Flooring: Refer to Section 00 01 30, List of Materials for complete list of products, designations, manufacturers, sizes and colour.

.1 Products by other manufacturers similar in function, design, performance, and construction complying with requirements of this Section may be incorporated into the Work subject to NRC Departmental Representative's acceptance, in accordance with the Contract substitution procedures.

.2 Primers and adhesives: waterproof, recommended by flooring manufacturer for specific material on applicable substrate, above, at or below grade.

.1 Flooring adhesives:

.1 Adhesive: maximum VOC limit 50 g/L to SCAQMD Rule 1168.

.2 Cove base adhesives:

.1 Adhesive: maximum VOC limit 50 g/L to SCAQMD Rule 1168.

.3 Sub-floor filler and leveller: as recommended by flooring manufacturer for use with their product.

.4 Metal edge strips: aluminum extruded, smooth, mill finish polished with lip to extend under floor finish, shoulder flush with top of adjacent floor finish.

.5 Sealer: type recommended by flooring manufacturer.

.6 Wax: type recommended by flooring manufacturer.

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 INSPECTION

.1 Ensure concrete floors are dry, by using test methods recommended by tile manufacturer.

3.3 SUB-FLOOR TREATMENT

.1 Remove existing resilient flooring.

.2 Remove or treat old adhesives to prevent residual, old flooring adhesives from bleeding through to new flooring and/or interfering with the bonding of new adhesives.

.3 Clean floor and apply filler; trowel and float to leave smooth, flat hard surface. Prohibit traffic until filler cured and dry.

.4 Remove sub-floor ridges and bumps. Fill low spots, cracks, joints, holes and other defects with sub-floor filler.

.5 Prime, Seal concrete sub-floor to flooring manufacturer's printed instructions.

3.4 TILE APPLICATION

.1 Provide high ventilation rate, with maximum outside air, during installation, and for 48 to 72 hours after installation. If possible, vent directly to outside. Do not let contaminated air recirculate through district or whole building air distribution system. Maintain extra ventilation for at least one month following building occupation.

.2 Apply adhesive uniformly using recommended trowel in accordance with flooring manufacturer's instructions. Do not spread more adhesive than can be covered by flooring before initial set takes place.

.3 Install flooring as indicated on drawings.

.4 As installation progresses, and after installation, roll flooring in 2 directions including resilient tile with 45 kg minimum roller to ensure full adhesion.

.5 Cut tile and fit neatly around fixed objects.

.6 Install feature strips and floor markings where indicated. Fit joints tightly.

.7 Install flooring in pan type floor access covers. Maintain floor pattern.

.8 Continue flooring through areas to receive movable type partitions without interrupting floor pattern.

.9 Terminate flooring at centerline of door in openings where adjacent floor finish or colour is dissimilar.

.10 Install metal edge strips at unprotected or exposed edges where flooring terminates.

3.5 BASE APPLICATION

.1 Lay out base to keep number of joints at minimum. Base joints at maximum length available or at internal or premoulded corners.

.2 Clean substrate and prime with one coat of adhesive.

.3 Apply adhesive to back of base.

.4 Set base against wall and floor surfaces tightly by using 3 kg hand roller.

.5 Install straight and level to variation of 1:1000.

.6 Scribe and fit to door frames and other obstructions. Use premoulded end pieces at flush door frames.

.7 Cope internal corners. Use premoulded corner units for right angle external corners. Use formed straight base material for external corners of other angles, minimum 300 mm each leg. Wrap around toeless base at external corners.

.8 Install toeless type base before installation of carpet on floors.

3.6 CLEANING

.1 Remove excess adhesive from floor, base and wall surfaces without damage.

.2 Clean, seal and wax floor and base surface to flooring manufacturer's instructions. In carpeted areas clean, seal and wax base surface before carpet installation.

3.7 PROTECTION

.1 Protect new floors from time of final set of adhesive, after initial waxing and until final waxing, final inspection.

.2 Prohibit traffic on floor for 48 hours after installation.

.3 Use only water-based coating for linoleum.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 American Association of Textile Chemists and Colorists (AATCC)

- .1 AATCC Test Method 16-2004, Colorfastness to Light.
- .2 AATCC Test Method 134-2006, Electrostatic Propensity of Carpets.
- .3 AATCC Test Method 171-2005, Carpets: Cleaning of; Hot Water Extraction Method.
- .4 AATCC Test Method 175-2008, Stain Resistance: Pile Floor Coverings.
- .5 AATCC Test Method 189-2007, Fluorine Content of Carpet Fibers.

.2 ASTM International

- .1 ASTM D 297-93(2006), Standard Test Methods for Rubber Products-Chemical Analysis.
- .2 ASTM D 1335-05, Standard Test Method for Tuft Bind of Pile Yarn Floor Coverings.
- .3 ASTM D 3574-08, Standard Test Methods for Flexible Cellular Materials - Slab, Bonded, and Molded Urethane Foams.
- .4 ASTM D 3936-05, Standard Test Method for Resistance to Delamination of the Secondary Backing of Pile Yarn Floor Covering.

.3 Canadian General Standards Board (CGSB)

- .1 CAN/CGSB-4.2 No. 22-2004, Textile Test Methods – Colour fastness to Rubbing (Crocking).
- .2 CAN/CGSB-4.2 No.27.6M-2004, Textile Test Methods - Flame Resistance - Methemine Tablet Test for Textile Floor Coverings.
- .3 CAN/CGSB-4.2 No.77.1-94/ISO 4919:2000, Textile Test Methods - Carpets - Determination of Tuft Withdrawal Force.
- .4 CAN/CGSB-4.129-93(R1997), Carpets for Commercial Use.

.4 Carpet and Rug Institute (CRI)

- .1 CRI Carpet Installation Standard 2009.
- .2 CRI Green Label Indoor Air Quality Testing Program.
- .3 CRI Green Label Plus Indoor Air Quality Testing Program.

.5 Health Canada / Workplace Hazardous Materials Information System (WHMIS)

- .1 Material Safety Data Sheets (MSDS).

.6 National Floor Covering Association (NFCA)

- .1 National Floor Covering Specification Manual 2007.

.7 South Coast Air Quality Management District (SCAQMD), California State, Regulation XI. Source Specific Standards

.1 SCAQMD Rule 1113-A2007, Architectural Coatings.

.2 SCAQMD Rule 1168-A2005, Adhesives and Sealants Applications.

.8 Underwriters' Laboratories of Canada (ULC)

.1 CAN/ULC-S102-07, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.

.2 CAN/ULC-S102.2-07, Standard Method of Test for Surface Burning Characteristics of Flooring, Floor Coverings and Miscellaneous Materials and Assemblies.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for each carpet tile, adhesive carpet protection subfloor patching compound and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Submit 2 copies of WHMIS MSDS.

.2 Shop Drawings:

.1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.

.2 Information on shop drawings to indicate:

.1 Nap: direction, open edges, special patterns.

.2 Cutouts: show locations where cutouts are required.

.3 Edgings: show location of edge moldings and edge bindings.

.3 Samples:

.1 Submit for review and acceptance of each unit.

.2 Samples will be returned for inclusion into work.

.3 Submit duplicate samples of each type of carpet tile specified and duplicate tiles for each colour selected.

.4 Certificates: submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

.5 Test and Evaluation Reports:

.1 Certified test reports showing compliance with specified performance characteristics and physical properties.

.6 Manufacturer's Instructions: submit manufacturer's installation and storage instructions.

1.3 CLOSEOUT SUBMITTALS

.1 Operation and Maintenance Data: submit operation and maintenance data for installed products for incorporation into manual.

.2 Warranty Documentation: submit warranty documents specified.

1.4 MAINTENANCE MATERIAL SUBMITTALS

.1 Extra stock materials: deliver to Owner extra materials from same production run as products installed. Package products with protective covering and identify with descriptive labels.

.1 Quantity: provide minimum 5% of:

.1 Carpet tile.

.2 Carpet base.

.3 Adhesives.

.2 Delivery, storage and protection: comply with Owner's requirements for delivery and storage of extra materials.

1.5 QUALITY ASSURANCE

.1 Qualifications:

.1 Manufacturer: capable of providing field service representation during construction and approving application method.

.2 Flooring Installer:

.1 Experienced in performing work of this Section who has specialized in installation of work similar to that required for this project.

.2 Certified by carpet manufacturer prior to tender or bid submission.

.3 Must not sub-contract labour without written approval of NRC Departmental Representative.

.4 Responsible for proper product installation, including floor testing and preparation as specified and in accordance with carpet manufacturer's written instructions.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance 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 materials protected from exposure to harmful weather conditions and at temperature conditions recommended by manufacturer.

.3 Store and protect carpet tile and adhesive in original containers or wrapping with manufacturer's seals and labels intact.

.4 Store and protect carpet tile and accessories in location as directed by NRC Departmental Representative.

.5 Store carpet and adhesive at minimum temperature of 18 degrees C and relative humidity of maximum 65% for minimum of 48 hours before installation.

.6 Prevent damage to materials during handling and storage. Keep materials under cover and free from dampness.

.7 Safety: comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage, and disposal of hazardous materials.

.8 Replace defective or damaged materials with new.

.4 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials.

1.7 SITE CONDITIONS

.1 Ambient Conditions:

.1 Moisture: ensure substrate is within moisture limits and alkalinity limits recommended by manufacturer. Prepare moisture testing and provide report to NRC Departmental Representative.

.2 Temperature: maintain ambient temperature of not less than 18 degrees C from 48 hours before installation to at least 48 hours after completion of work.

.3 Relative humidity: maintain between 10% and 65% for 48 hours before, during and 48 hours after installation.

.4 Ventilation:

.1 NRC Departmental Representative will co-ordinate operation of ventilation system during installation of carpet.

.2 Ventilate enclosed spaces. Provide fans with HEPA filters.

.3 Provide continuous ventilation during and after carpet application. Run ventilation system 24 hours per day during installation; provide continuous ventilation for 7 days after completion of carpet installation.

.5 Install carpet after space is enclosed and weatherproof, wet-work in space is completed and nominally dry, work above ceilings is complete.

1.8 WARRANTY

.1 Manufacturer's warranty: submit, for NRC Departmental Representative's acceptance, manufacturer's standard warranty document executed by authorized company official. Manufacturer's warranty is in addition to and does not limit other rights Owner may have under Contract Documents.

.2 Warranty period: 1 year, commencing on date of substantial performance of work.

.1 Warranty covers labour and repair or replacement of defective components for 1 year after date of substantial performance.

Part 2 Products

2.1 MATERIALS

.1 Manufacturers:

.1 Ensure manufacturer has minimum 5 years experience in manufacturing components similar to or exceeding requirements of project.

.2 Description:

.1 Sustainability Characteristics:

.2 Adhesives: VOC limit 50 g/L maximum to SCAQMD Rule 1168 GS-36.

.3 Primer, Sealer: in accordance with manufacturer's recommendations for surface conditions:

.1 VOC limit: 100 g/L maximum to SCAQMD Rule 1113

.3 Basis of Design – Carpet Tile Products: Refer to Section 00 01 30, List of Materials for complete list of carpet tile products, designations, manufacturers, sizes and colour.

.1 Products by other manufacturers similar in function, design, performance, and construction complying with requirements of this Section may be incorporated into the Work subject to NRC Departmental Representative’s acceptance, in accordance with the Contract substitution procedures.

2.2 PERFORMANCE

.1 Flammability: certified for flammability to Health Canada regulations under "Hazardous Products - Carpet Regulations", Part II of Schedule 1.

.2 Flame Spread: maximum flame spread rating 300, maximum smoke developed classification 500, when tested to CAN/ULC-S102.2.

.3 Smoke Development: 450 or less per ASTM E 662.

.4 Dry Breaking Strength: to ASTM D 2661, minimum acceptable tear strength in both length and width:

.1 11.3 kg for carpets installed by glue down installation.

.5 Wear: maximum 10% of pile face fiber by weight for 10 years.

.6 Edge Ravel: none for 10 years.

.7 Static Resistance: permanent static control to AATCC 134, 3000 V maximum at 20% RH and 22 degrees C.

.8 Static Generation: less than 3.0 kV per AATCC 134 for 10 years.

.9 Tuft Bind: Tuft Lock: to ASTM D 1335 CAN/CGSB-4.129, minimum acceptable 1.6 kilograms for cut pile product 3.6 for loop pile product.

.10 De-lamination of Secondary Backing: Lamination Strength of Secondary Backing: to ASTM D 3936, minimum acceptable peel strength of 1.6 kg/25 mm.

.11 Stain resistance: to AATCC 175, 8.

.12 Soil Resistance: 350 ppm fluorine minimum Fluorine Durability Level to AATCC 189.

.13 Colourfastness to light: to CAN/CGSB-4.2 No.18.3 AATCC 16.

.14 Colourfastness to atmosphere: to AATCC 129 and AATCC 23.

.15 Colourfastness to crocking: to CAN/CGSB-4.2 No. 22.

.16 Indoor Air Quality Certification: certified to CRI Green Label Plus IAQ requirements.

2.3 TILE CUSHION BACKING

.1 Density: urethane 224 kg/m^3; EVA and PVC 240 kg/m^3 to ASTM D 3574.

.2 Compression force deflection, minimum: urethane 34.5 kN/m^2 to ASTM D 3574.

.3 Compression deflection, minimum: EVA and PVC 48.3 kN/m^2 to ASTM D 1667.

.4 Compression set at 50%, maximum: urethane 15% to ASTM D 3574.

.5 Compression set at 25%, maximum: EVA and PVC 10% to ASTM D 3574.

.6 Ash content, maximum: urethane 50%; EVA and PVC 50% to ASTM D 297.

2.4 ACCESSORIES

.1 Base WB1:

.1 Resilient Base: Johnsonite.

.2 Edge Strips:

.1 Metal:

.1 Designed for carpet being installed.

.2 Floor flange minimum 38 mm wide, face minimum 16 mm wide.

.3 Finish: clear anodic coating.

.3 Adhesive:

.1 Multi-purpose Adhesive Type: recommended by carpet tile manufacturer for direct glue down installation.

.2 On site application VOC limit: 50g/L maximum to SCAQMD Rule 1168.

.3 Adhesive in compliance with CCD-152.

.4 Carpet protection: non-staining heavy duty kraft paper.

.5 Concrete floor sealer, primer:

.1 As recommended by manufacturer.

Part 3 Execution

3.1 INSTALLERS

.1 Use experienced and qualified technicians to carry out assembly and installation of tile carpet.

3.2 EXAMINATION

.1 Examine conditions, substrates and work to receive work of this Section.

.2 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for carpet tile installation in accordance with manufacturer's written instructions.

.1 Inform NRC Departmental Representative of unacceptable conditions immediately upon discovery.

.2 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from NRC Departmental Representative.

3.3 PREPARATION

.1 Subfloor Preparation:

.1 Inspect concrete and determine special care required to make it a suitable for carpet.

.2 Fill and level cracks 3 mm wide or protrusions over 0.8 mm with appropriate and compatible patching compound.

.3 Comply with manufacturer's written recommendations for maximum patch thickness.

.4 Prime large patch areas with compatible primer.

.5 Ensure concrete substrates are cured, clean and dry.

.6 Ensure concrete substrates are free of paint, dirt, grease, oil, curing or parting agents, and other contaminates, including sealers, that interfere with the bonding of adhesive.

.7 Where powdery or porous concrete surface is encountered, apply primer compatible with adhesive to provide a suitable surface for glue-down installation.

.2 Surface Preparation: prepare surface in accordance with manufacturer's written recommendations.

.1 Prepare floor surfaces in accordance with CRI Carpet Installation Standard.

.3 Tile Carpeting Preparation:

.1 Pre-condition carpeting: following manufacturer's written instructions.

3.4 INSTALLATION

.1 Install carpet tiles in accordance with manufacturer's written instructions, and CRI Carpet Installation Standard.

.2 Co-ordinate tile carpeting work with work of other trades, for proper time and sequence to avoid construction delays.

.3 Install carpet tile after finishing work is completed but before demountable office partitions and telephone and electrical pedestal outlets are installed.

.4 Install carpet tile as per manufacturer's recommendation: horizontal ashlar.

.5 Snugly join carpet tiles in completed installation.

.1 Measure distance covered by 11 carpet tiles (10 joints) and ensure distance is in compliance with manufacturer specifications.

.2 Do not trap yarn between carpet tiles.

.6 Ensure finished installation presents smooth wearing surface free from conspicuous seams, burring and other faults.

.7 Use material from same dye lot.

.1 Ensure colour, pattern and texture match within visual areas.

.2 Maintain constant pile direction.

.8 Fit around architectural, mechanical, electrical and telephone outlets, and furniture fitments, around perimeter of rooms into recesses, and around projections.

.9 Extend carpet tiles into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.

.10 Install carpet tiles smooth and free from bubbles, puckers, and other defects.

.11 Protect exposed carpet tile edges at transition to other flooring materials with suitable transition strips.

3.5 CLEANING

.1 Progress Cleaning:

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.

.1 Vacuum carpets clean immediately after completion of installation.

.2 Waste Management: separate waste materials for reuse and recycling.

.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.6 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Prohibit traffic on carpet for period of 24 hours minimum after installation and until adhesive is cured.

.3 Install carpet protection to satisfaction of NRC Departmental Representative.

.4 Repair damage to adjacent materials caused by tile carpeting installation.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 Environmental Protection Agency (EPA)

.1 Test Method for Measuring Total Volatile Organic Compound Content of Consumer Products, Method 24 (for Surface Coatings).

.2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

.3 The Master Painters Institute (MPI)

.1 Architectural Painting Specification Manual - February 2004.

.2 Standard GPS-1-05, MPI Green Performance Standard for Painting and Coatings.

.4 National Fire Code of Canada.

.5 Society for Protective Coatings (SSPC)

.1 Systems and Specifications, SSPC Painting Manual 2005.

1.2 QUALITY ASSURANCE

.1 Qualifications:

.1 Contractor: to have a minimum of five years proven satisfactory experience. When requested, provide list of last three comparable jobs including, job name and location, specifying authority, and project manager.

.2 Qualified journeypersons as defined by local jurisdiction to be engaged in painting work

.3 Apprentices: may be employed provided they work under direct supervision of qualified journeyperson in accordance with trade regulations.

.4 Conform to latest MPI requirements for exterior painting work including preparation and priming.

.5 Materials: in accordance with MPI Painting Specification Manual "Approved Product" listing and from a single manufacturer for each system used.

.6 Paint materials such as linseed oil, shellac, and turpentine to be highest quality product of an approved manufacturer listed in MPI Painting Specification Manual and to be compatible with other coating materials as required.

.7 Retain purchase orders, invoices and documents to prove conformance with noted MPI requirements when requested by NRC Departmental Representative.

.8 Standard of Acceptance:

.1 Walls: No defects visible from a distance of 1000 mm at 90 degrees to surface.

.2 Soffits: No defects visible from floor at 45 degrees to surface when viewed using final lighting source.

.3 Final coat to exhibit uniformity of colour and uniformity of sheen across full surface area.

1.3 SCHEDULING

.1 Submit work schedule for various stages of painting to NRC Departmental Representative for approval. Submit schedule minimum of 48 hours in advance of proposed operations.

.2 Obtain written authorization from NRC Departmental Representative for changes in work schedule.

.3 Schedule painting operations to prevent disruption of occupants in and about building.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

.1 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Submit WHMIS MSDS - Material Safety Data Sheets.

.2 Upon completion, submit records of products used. List products in relation to finish system and include the following:

.1 Product name, type and use.

.2 Manufacturer's product number.

.3 Colour numbers.

.4 MPI Environmentally Friendly classification system rating.

.5 Manufacturer's Material Safety Data Sheets (MSDS).

.3 Provide samples:

.1 Submit duplicate 200 x 300 mm sample panels of each paint with specified paint or coating in colours, gloss/sheen and textures required to MPI Painting Specification Manual standards submitted on the following substrate materials:

.1 3 mm plate steel for finishes over metal surfaces.

.2 13 mm birch plywood for finishes over wood surfaces.

.3 50 mm concrete block for finishes over concrete or concrete masonry surfaces.

.4 13 mm gypsum board for finishes over gypsum board and other smooth surfaces.

.5 10 mm cedar hardboard siding plywood for finishes over wood surfaces.

.2 When approved, samples shall become acceptable standard of quality for appropriate on-site surface with one of each sample retained on-site.

.3 Submit full range of available colours where colour availability is restricted.

1.5 MAINTENANCE

.1 Submit one, four litre can of each type and colour of primer, finish coating. Identify colour and paint type in relation to established colour schedule and finish system.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials:

.1 Deliver and store materials in original containers, sealed, with labels intact.

.2 Labels: to indicate:

.1 Manufacturer's name and address.

.2 Type of paint or coating.

.3 Compliance with applicable standard.

.4 Colour number in accordance with established colour schedule.

.3 Remove damaged, opened and rejected materials from site.

.4 Provide and maintain dry, temperature controlled, secure storage.

.5 Observe manufacturer's recommendations for storage and handling.

.6 Store materials and supplies away from heat generating devices.

.7 Store materials and equipment in well ventilated area with temperature range 7 degrees C to 30 degrees C.

.8 Store temperature sensitive products above minimum temperature as recommended by manufacturer.

.9 Keep areas used for storage, cleaning and preparation, clean and orderly to approval of NRC Departmental Representative. After completion of operations, return areas to clean condition to approval of NRC Departmental Representative.

.10 Remove paint materials from storage only in quantities required for same day use.

.11 Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling storage, and disposal of hazardous materials.

.12 Fire Safety Requirements:

.1 Provide one 9 kg Type ABC dry chemical fire extinguisher adjacent to storage area.

.2 Store oily rags, waste products, empty containers and materials subject to spontaneous combustion in ULC approved, sealed containers and remove from site on a daily basis.

.3 Handle, store, use and dispose of flammable and combustible materials in accordance with the National Fire Code of Canada.

.2 Waste Management and Disposal:

.1 Separate waste materials for reuse and recycling.

.2 Paint, finishes and related materials (thinners, solvents, etc.) are regarded as hazardous products and are subject to regulations for disposal. Information on these controls can be obtained from Provincial Ministries of Environment and Regional levels of Government.

.3 Material which cannot be reused must be treated as hazardous waste and disposed of in an appropriate manner.

.4 Place materials defined as hazardous or toxic waste, including used sealant and adhesive tubes and containers, in containers or areas designated for hazardous waste.

.5 To reduce the amount of contaminants entering waterways, sanitary/storm drain systems or into the ground the following procedures shall be strictly adhered to:

.1 Retain cleaning water for water-based materials to allow sediments to be filtered out.

.2 Retain cleaners, thinners, solvents and excess paint and place in designated containers and ensure proper disposal.

.3 Return solvent and oil soaked rags used during painting operations for contaminant recovery, proper disposal, or appropriate cleaning and laundering.

.4 Dispose of contaminants in an approved legal manner in accordance with hazardous waste regulations.

.5 Empty paint cans are to be dry prior to disposal or recycling (where available).

.6 Where paint recycling is available, collect waste paint by type and provide for delivery to recycling or collection facility.

.7 Set aside and protect surplus and uncontaminated finish materials: Deliver to or arrange collection for verifiable re-use or re-manufacturing.

.8 Close and seal tightly partly used sealant and adhesive containers and store protected in well ventilated fire-safe area at moderate temperature.

1.7 AMBIENT CONDITIONS

.1 Heating, Ventilation and Lighting:

.1 Ventilate enclosed spaces.

.2 Do not perform painting work unless adequate and continuous ventilation and sufficient heating facilities are in place to maintain ambient air and substrate temperatures above 10 degrees C for24 hours before, during and after paint application until paint has cured sufficiently.

.3 Where required, provide continuous ventilation for seven days after completion of application of paint.

.4 Co-ordinate use of existing ventilation system with NRC Departmental Representative and ensure its operation during and after application of paint as required.

.5 Provide temporary ventilating and heating equipment where permanent facilities are not available or supplemental ventilating and heating equipment if ventilation and heating from existing system is inadequate to meet minimum requirements.

.6 Perform no painting work unless a minimum lighting level of 323 Lux is provided on surfaces to be painted. Adequate lighting facilities to be provided by General Contractor.

.2 Temperature, Humidity and Substrate Moisture Content Levels:

.1 Unless specifically pre-approved by specifying body, Paint Inspection Agency and, applied product manufacturer, perform no painting work when:

.1 Ambient air and substrate temperatures are below 10 degrees C.

.2 Substrate temperature is over 32 degrees C unless paint is specifically formulated for application at high temperatures.

.3 Substrate and ambient air temperatures are expected to fall outside MPI or paint manufacturer's prescribed limits.

.4 Relative humidity is above 85 % or when dew point is less than 3 degrees C variance between air/surface temperature.

.5 Rain or snow are forecast to occur before paint has thoroughly cured or when it is foggy, misty, raining or snowing at site.

.2 Perform no painting work when maximum moisture content of substrate exceeds:

.1 12% for concrete and masonry (clay and concrete brick/block).

.2 15% for wood.

.3 12% for plaster and gypsum board.

.3 Conduct moisture tests using a properly calibrated electronic Moisture Meter, except test concrete floors for moisture using a simple "cover patch test".

.4 Test concrete, masonry and plaster surfaces for alkalinity as required.

.3 Surface and Environmental Conditions:

.1 Apply paint finish in areas where dust is no longer being generated by related construction operations or when wind or ventilation conditions are such that airborne particles will not affect quality of finished surface.

.2 Apply paint to adequately prepared surfaces and to surfaces within moisture limits noted herein.

.3 Apply paint when previous coat of paint is dry or adequately cured.

.4 Apply paint finishes when conditions forecast for entire period of application fall within manufacturer's recommendations.

.5 Do not apply paint when:

.1 Temperature is expected to drop below 10 degrees C before paint has thoroughly cured.

.2 Substrate and ambient air temperatures are expected to fall outside MPI or paint manufacturer's limits.

.3 Surface to be painted is wet, damp or frosted.

.6 Provide and maintain cover when paint must be applied in damp or cold weather. Heat substrates and surrounding air to comply with temperature and humidity conditions specified by manufacturer. Protect until paint is dry or until weather conditions are suitable.

.7 Schedule painting operations such that surfaces exposed to direct, intense sunlight are scheduled for completion during early morning.

.8 Remove paint from areas which have been exposed to freezing, excess humidity, rain, snow or condensation. Prepare surface again and repaint.

.9 Paint occupied facilities in accordance with approved schedule only. Schedule operations to approval of NRC Departmental Representative such that painted surfaces will have dried and cured sufficiently before occupants are affected.

Part 2 Products

2.1 MATERIALS

.1 Paint materials listed in latest edition of MPI Approved Products List (APL) are acceptable for use on this project.

.2 Paint materials for paint systems: to be products of single manufacturer.

.3 Paints, coatings, adhesives, solvents, cleaners, lubricants, and other fluids, to be as follows:

.1 Do not contain methylene chloride, chlorinated hydrocarbons, toxic metal pigments.

.4 Water-borne surface coatings must be manufactured and transported in a manner that steps of processes, including disposal of waste products arising therefrom, will meet requirements of applicable governmental acts, by-laws and regulations including, for facilities located in Canada, Fisheries Act and Canadian Environmental Protection Act (CEPA).

.5 Water-borne surface coatings must not be formulated or manufactured with aromatic solvents, formaldehyde, halogenated solvents, mercury, lead, cadmium, hexavelant chromium or their compounds.

.6 Water-borne surface coatings and recycled water-borne surface coatings must have flash point of 61.0 degrees C or greater.

.7 Both water-borne surface coatings and recycled water-borne surface coatings must be made by a process that does not release:

.1 Matter in undiluted production plant effluent generating a 'Biochemical Oxygen Demand' (BOD) in excess of 15 mg/L to a natural watercourse or a sewage treatment facility lacking secondary treatment.

.2 Total Suspended Solids (TSS) in undiluted production plant effluent in excess of 15 mg/L to a natural watercourse or a sewage treatment facility lacking secondary treatment.

.8 Water-borne paints and stains, recycled water-borne surface coatings and water borne varnishes must meet a minimum "Environmentally Friendly" E2 rating.

.9 Recycled water-borne surface coatings must contain 50 % post-consumer material by volume.

.10 Recycled water-borne surface coatings must not contain:

.1 Lead in excess of 600.0 ppm weight/weight total solids.

.2 Mercury in excess of 50.0ppm weight/weight total product.

.3 Cadmium in excess of 1.0ppm weight/weight total product.

.4 Hexavelant chromium in excess of 3.0 ppm weight/weight total product.

.5 Organochlorines or polychlorinated biphenyls (PCBS) in excess of 1.0ppm weight/weight total product.

.11 The following must be performed on each batch of consolidated post-consumer material before surface coating is reformulated and canned. These tests must be performed at a laboratory or facility which has been accredited by the Standards Council of Canada.

.1 Lead, cadmium and chromium are to be determined using ICP-AES (Inductively Coupled Plasma - Atomic Emission Spectroscopy) technique no. 6010 as defined in EPA SW-846.

.2 Mercury is to be determined by Cold Vapour Atomic Absorption Spectroscopy using Technique no. 7471 as defined in EPA SW-846.

.3 Organochlorines and PCBs are to be determined by Gas Chromatography using Technique no. 8081 as defined in EPA SW-846.

2.2 COLOURS

.1 NRC Departmental Representative will provide Colour Schedule after Contract award.

.2 Colour schedule will be based upon selection of five base colours and three accent colours. No more than eight colours will be selected for entire project and no more than three colours will be selected in each area.

.3 Selection of colours will be from manufacturer’s full range of colours.

.4 Where specific products are available in restricted range of colours, selection will be based on limited range.

.5 Second coat in three coat system to be tinted slightly lighter colour than top coat to show visible difference between coats.

2.3 MIXING AND TINTING

.1 Perform colour tinting operations prior to delivery of paint to site. On-site tinting of painting materials is allowed only with NRC Departmental Representative's written permission.

.2 Mix paste, powder or catalyzed paint mixes in accordance with manufacturer's written instructions.

.3 Add thinner to paint manufacturer's recommendations. Do not use kerosene or organic solvents to thin water-based paints.

.4 Thin paint for spraying according in accordance with paint manufacturer's instructions. If directions are not on container, obtain instructions in writing from manufacturer and provide copy of instructions to NRC Departmental Representative.

.5 Re-mix paint in containers prior to and during application to ensure break-up of lumps, complete dispersion of settled pigment, and colour and gloss uniformity.

2.4 GLOSS/SHEEN RATINGS

.1 Paint gloss: defined as sheen rating of applied paint, in accordance with following values:

Gloss Level / Category	Units @ 60 Degrees	Units @ 85 Degrees
G1 - matte finish	0 to 5	max. 10
G2 - velvet finish	0 to 10	10 to 35
G3 - eggshell finish	10 to 25	10 to 35
G4 - satin finish	20 to 35	min. 35
G5 - semi-gloss finish	35 to 70	
G6 - gloss finish	70 to 85	
G7 - high gloss finish	> 85	

.2 Gloss level ratings of painted surfaces as specified and as noted on Finish Schedule.

2.5 EXTERIOR PAINTING SYSTEMS

.1 Asphalt Surfaces: zone/traffic marking for drive and parking areas, etc.

.1 EXT 2.1A - Latex zone/traffic marking finish.

.2 EXT 2.1B - Alkyd zone/traffic marking finish.

.2 Structural Steel and Metal Fabrications:

.1 EXT 5.1A - Quick dry enamel finish.

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 EXAMINATION

.1 Exterior repainting work: inspected by MPI Accredited Paint Inspection Agency (inspector) acceptable to specifying authority and local Painting Contractor's Association. Painting contractor to notify Paint Inspection Agency minimum of one week prior to commencement of work and provide copy of project repainting specification and Finish Schedule.

.2 Exterior surfaces requiring repainting: inspected by both painting contractor and Paint Inspection Agency who will notify NRC Departmental Representative in writing of defects or problems, prior to commencing repainting work, or after surface preparation if unseen substrate damage is discovered.

.3 Where assessed degree of surface degradation of DSD-1 to DSD-3 before preparation of surfaces for repainting is revealed to be DSD-4 after preparation, repair or replacement of such unforeseen defects discovered are to be corrected, as mutually agreed, before repainting is started.

.4 Where "special" repainting or recoating system applications (i.e. elastomeric coatings) or non-MPI listed products or systems are to be used, paint or coating manufacturer to provide as part of work, certification of surfaces and conditions for specific paint or coating system application as well as on site supervision, inspection and approval of their paint or coating system application as required at no additional cost to NRC Departmental Representative.

3.3 PREPARATION

.1 Perform preparation and operations for exterior painting in accordance with MPI Maintenance Repainting Manual except where specified otherwise.

.2 Apply paint materials in accordance with paint manufacturer's written application instructions.

.3 Clean and prepare exterior surfaces to be repainted in accordance with MPI Maintenance Repainting Manual requirements. Refer to the MPI Manual in regard to specific requirements and as follows:

.1 Remove dust, dirt, and surface debris by vacuuming, wiping with dry, clean cloths or compressed air.

.2 Wash surfaces with a biodegradable detergent and bleach where applicable and clean warm water using a stiff bristle brush to remove dirt, oil and other surface contaminants.

.3 Rinse scrubbed surfaces with clean water until foreign matter is flushed from surface.

.4 Allow surfaces to drain completely and allow to dry thoroughly. Allow sufficient drying time and test surfaces using electronic moisture meter before commencing work.

.5 Use water-based cleaners in place of organic solvents where surfaces will be repainted using water based paints.

.6 Many water-based paints cannot be removed with water once dried. Minimize use of kerosene or such organic solvents to clean up water-based paints.

.4 Clean metal surfaces to be repainted by removing rust, dirt, oil, grease and foreign substances in accordance with MPI requirements. Remove such contaminates from surfaces, pockets and corners to be repainted by brushing with clean brushes, blowing with clean dry compressed air, or brushing/vacuum cleaning as required.

.5 Prevent contamination of cleaned surfaces by salts, acids, alkalis, other corrosive chemicals, grease, oil and solvents before priming and between applications of remaining coats. Touch-up, spot prime, and apply primer, paint, or pretreatment as soon as possible after cleaning and before deterioration occurs.

.6 Sand and dust between coats as required to provide adequate adhesion for next coat and to remove defects visible from a distance up to 1000 mm.

3.4 EXISTING CONDITIONS

.1 Investigate existing substrates for problems related to proper and complete preparation of surfaces to be painted. Report to Departmental Representative DCC Representative damages, defects, unsatisfactory or unfavourable conditions before proceeding with work.

3.5 PROTECTION

.1 Protect existing building surfaces and adjacent structures from paint spatters, markings and other damage by suitable non-staining covers or masking. If damaged, clean and restore such surfaces as directed by NRC Departmental Representative.

.2 Protect items that are permanently attached such as Fire Labels on doors and frames.

.3 Protect factory finished products and equipment.

.4 Protect passing pedestrians, building occupants and general public in and about building.

.5 Remove light fixtures, surface hardware on doors, and other surface mounted equipment, fittings and fastenings prior to undertaking painting operations. Store items and re-install after painting is completed.

.6 Move and cover exterior furniture and portable equipment as necessary to carry out painting operations. Replace as painting operations progress.

.7 As painting operations progress, place "WET PAINT" signs in pedestrian and vehicle traffic areas to approval of NRC Departmental Representative.

3.6 APPLICATION

.1 Method of application to conform to manufacturer's application instructions unless specified otherwise.

.2 Apply coats of paint as continuous film of uniform thickness. Repaint thin spots or bare areas before next coat of paint is applied.

.3 Allow surfaces to dry and properly cure after cleaning and between subsequent coats for minimum time period as recommended by manufacturer.

.4 Sand and dust between coats to remove visible defects.

.5 Finish surfaces both above and below sight lines as specified for surrounding surfaces, including such surfaces as projecting ledges.

.6 Finish top, bottom, edges and cutouts of doors after fitting as specified for door surfaces.

3.7 MECHANICAL/ ELECTRICAL EQUIPMENT

.1 Unless otherwise specified, paint exterior exposed conduits, piping, hangers, duct work and other mechanical and electrical equipment with colour and finish to match adjacent surfaces, except as noted otherwise.

.2 Touch up scratches and marks on factory painted finishes and equipment with paint as supplied by manufacturer of equipment.

.3 Do not paint over nameplates.

.4 Paint fire protection piping red.

.5 Paint steel electrical light standards. Do not paint outdoor transformers and substation equipment.

3.8 CLEANING

.1 General.

.1 Remove paint where spilled, splashed, splattered or sprayed as work progresses using means and materials that are not detrimental to affected surfaces.

3.9 RESTORATION

.1 Clean and re-install hardware items removed before undertaken painting operations.

.2 Remove protective coverings and warning signs as soon as practical after operations cease.

.3 Remove paint splashings on exposed surfaces that were not painted. Remove smears and spatter immediately as operations progress, using compatible solvent.

.4 Protect freshly completed surfaces from paint droppings and dust to approval of NRC Departmental Representative. Avoid scuffing newly applied paint.

.5 Restore areas used for storage, cleaning, mixing and handling of paint to clean condition as approved by NRC Departmental Representative.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 Department of Justice Canada (Jus)

.1 Canadian Environmental Protection Act (CEPA), 1999, c. 33

.2 Environmental Protection Agency (EPA)

.1 EPA Test Method for Measuring Total Volatile Organic Compound Content of Consumer Products, Method 24 - 1995, (for Surface Coatings).

.3 Health Canada / Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

.4 Master Painters Institute (MPI)

.1 MPI Architectural Painting Specifications Manual, 2004.

.5 National Fire Code of Canada - 1995

.6 Society for Protective Coatings (SSPC)

.1 SSPC Painting Manual, Volume Two, 8th Edition, Systems and Specifications Manual.

.7 Transport Canada (TC)

.1 Transportation of Dangerous Goods Act (TDGA), 1992, c. 34

1.2 QUALITY ASSURANCE

.1 Qualifications:

.1 Contractor: minimum of five years proven satisfactory experience. Provide list of last three comparable jobs including, job name and location, specifying authority, and project manager.

.2 Journeymen: qualified journeymen who have "Tradesman Qualification Certificate of Proficiency" engaged in painting work.

.3 Apprentices: working under direct supervision of qualified trades person in accordance with trade regulations.

1.3 SCHEDULING

.1 Submit work schedule for various stages of painting to NRC Departmental Representative for review. Submit schedule minimum of 48 hours in advance of proposed operations.

.2 Obtain written authorization from NRC Departmental Representative for changes in work schedule.

.3 Schedule painting operations to prevent disruption of occupants.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

.1 Product Data:

.1 Submit product data and instructions for each paint and coating product to be used.

.2 Submit product data for the use and application of paint thinner.

.3 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS). Indicate VOCs during application and curing.

.2 Samples:

.1 Submit full range colour sample chips to indicate where colour availability is restricted.

.2 Submit duplicate 200 x 300 mm sample panels of each paint with specified paint or coating in colours, gloss/sheen and textures required to MPI Architectural Painting Specification Manual standards submitted on following substrate materials:

.1 3 mm plate steel for finishes over metal surfaces.

.2 13 mm birch plywood for finishes over wood surfaces.

.3 50 mm concrete block for finishes over concrete or concrete masonry surfaces.

.4 13 mm gypsum board for finishes over gypsum board and other smooth surfaces.

.3 Retain reviewed samples on-site to demonstrate acceptable standard of quality for appropriate on-site surface.

.4 Test reports: submit certified test reports for paint from approved independent testing laboratories, indicating compliance with specifications for specified performance characteristics and physical properties.

.1 Lead, cadmium and chromium: presence of and amounts.

.2 Mercury: presence of and amounts.

.3 Organochlorines and PCBs: presence of and amounts.

.5 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.6 Manufacturer's Instructions:

.1 Submit manufacturer's installation and application instructions.

.7 Closeout Submittals: submit maintenance data for incorporation into manual and include the following:

.1 Product name, type and use.

.2 Manufacturer's product number.

.3 Colour numbers.

.4 MPI Environmentally Friendly classification system rating.

1.5 MAINTENANCE

.1 Extra Materials:

.1 Deliver to extra materials from same production run as products installed. Package products with protective covering and identify with descriptive labels.

.2 Quantity: provide one - one four litre can of each type and colour of primer, finish coating. Identify colour and paint type in relation to established colour schedule and finish system.

.3 Delivery, storage and protection: comply with NRC Departmental Representative requirements for delivery and storage of extra materials.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Packing, Shipping, Handling and Unloading:

.1 Pack, ship, handle and unload materials in accordance with manufacturer's written instructions.

.2 Acceptance at Site:

.1 Identify products and materials with labels indicating:

.1 Manufacturer's name and address.

.2 Type of paint or coating.

.3 Compliance with applicable standard.

.4 Colour number in accordance with established colour schedule.

.3 Remove damaged, opened and rejected materials from site.

.4 Storage and Protection:

.1 Provide and maintain dry, temperature controlled, secure storage.

.2 Store materials and supplies away from heat generating devices.

.3 Store materials and equipment in well ventilated area with temperature range 7 degrees C to 30 degrees C.

.5 Store temperature sensitive products above minimum temperature as recommended by manufacturer.

.6 Keep areas used for storage, cleaning and preparation clean and orderly. After completion of operations, return areas to clean condition.

.7 Remove paint materials from storage only in quantities required for same day use.

.8 Fire Safety Requirements:

.1 Provide one 9 kg Type ABC dry chemical fire extinguisher adjacent to storage area.

.2 Store oily rags, waste products, empty containers and materials subject to spontaneous combustion in ULC approved, sealed containers and remove from site on a daily basis.

.3 Handle, store, use and dispose of flammable and combustible materials in accordance with National Fire Code of Canada requirements.

.9 Waste Management and Disposal:

.1 Separate waste materials for reuse and recycling.

.2 Remove from site and dispose of packaging materials at appropriate recycling facilities.

.3 Collect and separate for disposal paper plastic polystyrene corrugated cardboard packaging material in appropriate on-site bins for recycling.

.4 Separate for reuse and recycling and place in designated containers Steel, Metal, Plastic waste.

.5 Place materials defined as hazardous or toxic in designated containers.

.6 Handle and dispose of hazardous materials in accordance with Regional and Municipal, regulations.

.7 Ensure emptied containers are sealed and stored safely.

.8 Unused paint, coating materials must be disposed of at official hazardous material collections site.

.9 Paint, stain and wood preservative finishes and related materials (thinners, and solvents) are regarded as hazardous products and are subject to regulations for disposal. Information on these controls can be obtained from Provincial Ministries of Environment and Regional levels of Government.

.10 Material which cannot be reused must be treated as hazardous waste and disposed of in an appropriate manner.

.11 Place materials defined as hazardous or toxic waste, including used sealant and adhesive tubes and containers, in containers or areas designated for hazardous waste.

.12 To reduce the amount of contaminants entering waterways, sanitary/storm drain systems or into ground follow these procedures:

.1 Retain cleaning water for water-based materials to allow sediments to be filtered out.

.2 Retain cleaners, thinners, solvents and excess paint and place in designated containers and ensure proper disposal.

.3 Return solvent and oil soaked rags used during painting operations for contaminant recovery, proper disposal, or appropriate cleaning and laundering.

.4 Dispose of contaminants in approved legal manner in accordance with hazardous waste regulations.

.5 Empty paint cans are to be dry prior to disposal or recycling (where available).

.13 Where paint recycling is available, collect waste paint by type and provide for delivery to recycling or collection facility.

.14 Set aside and protect surplus and uncontaminated finish materials. Deliver to or arrange collection for verifiable re-use or re-manufacturing.

1.7 SITE CONDITIONS

.1 Heating, Ventilation and Lighting:

.1 Ventilate enclosed spaces.

.2 Provide heating facilities to maintain ambient air and substrate temperatures above 10 degrees C for 24 hours before, during and after paint application until paint has cured sufficiently.

.3 Provide continuous ventilation for seven days after completion of application of paint.

.4 Coordinate use of existing ventilation system with NRC Departmental Representative and ensure its operation during and after application of paint as required.

.5 Provide temporary ventilating and heating equipment where permanent facilities are not available or supplemental ventilating and heating equipment if ventilation and heating from existing system is inadequate to meet minimum requirements.

.6 Provide minimum lighting level of 323 Lux on surfaces to be painted.

.2 Temperature, Humidity and Substrate Moisture Content Levels:

.1 Unless pre-approved written approval by product manufacturer, perform no painting when:

.1 Ambient air and substrate temperatures are below 10 degrees C.

.2 Substrate temperature is above 32 degrees C unless paint is specifically formulated for application at high temperatures.

.3 Substrate and ambient air temperatures are not expected to fall within MPI or paint manufacturer's prescribed limits.

.4 The relative humidity is under 85% or when the dew point is more than 3 degrees C variance between the air/surface temperature. Paint should not be applied if the dew point is less than 3 degrees C below the ambient or surface temperature. Use sling psychrometer to establish the relative humidity before beginning paint work.

.5 Rain or snow are forecast to occur before paint has thoroughly cured or when it is foggy, misty, raining or snowing at site.

.6 Ensure that conditions are within specified limits during drying or curing process, until newly applied coating can itself withstand 'normal' adverse environmental factors.

.2 Perform painting work when maximum moisture content of the substrate is below:

.1 Allow new concrete and masonry to cure minimum of 28 days.

.2 15% for wood.

.3 12% for plaster and gypsum board.

.3 Test for moisture using calibrated electronic Moisture Meter. Test concrete floors for moisture using "cover patch test".

.4 Test concrete, masonry and plaster surfaces for alkalinity as required.

.3 Surface and Environmental Conditions:

.1 Apply paint finish in areas where dust is no longer being generated by related construction operations or when wind or ventilation conditions are such that airborne particles will not affect quality of finished surface.

.2 Apply paint to adequately prepared surfaces and to surfaces within moisture limits.

.3 Apply paint when previous coat of paint is dry or adequately cured.

.4 Additional interior application requirements:

.1 Apply paint finishes when temperature at location of installation can be satisfactorily maintained within manufacturer's recommendations.

.2 Apply paint in occupied facilities during silent hours only. Schedule operations to approval of NRC Departmental Representative such that painted surfaces will have dried and cured sufficiently before occupants are affected.

Part 2 Products

2.1 MATERIALS

.1 Paint materials listed in the MPI Approved Products List (APL) are acceptable for use on this project.

.2 Provide paint materials for paint systems from single manufacturer.

.3 Conform to latest MPI requirements for interior painting work including preparation and priming.

.4 Materials (primers, paints, coatings, varnishes, stains, lacquers, fillers, thinners, solvents, etc.) in accordance with MPI Architectural Painting Specification Manual "Approved Product" listing.

.5 Linseed oil, shellac, and turpentine: highest quality product from approved manufacturer listed in MPI Architectural Painting Specification Manual, compatible with other coating materials as required.

.6 Paints, coatings, adhesives, solvents, cleaners, lubricants, and other fluids:

.1 Do not contain methylene chloride, chlorinated hydrocarbons, toxic metal pigments.

.7 Formulate and manufacture water-borne surface coatings with no aromatic solvents, formaldehyde, halogenated solvents, mercury, lead, cadmium, hexavalent chromium or their compounds.

.8 Flash point: 61.0 degrees C or greater for water-borne surface coatings and recycled water-borne surface coatings.

.9 Ensure manufacture and process of both water-borne surface coatings and recycled water-borne surface coatings does not release:

.1 Matter in undiluted production plant effluent generating 'Biochemical Oxygen Demand' (BOD) in excess of 15 mg/L to natural watercourse or sewage treatment facility lacking secondary treatment.

.2 Total Suspended Solids (TSS) in undiluted production plant effluent in excess of 15 mg/L to natural watercourse or a sewage treatment facility lacking secondary treatment.

.10 Water-borne paints and stains, recycled water-borne surface coatings and water borne varnishes to meet minimum "Environmentally Friendly" E2 rating.

.11 Recycled water-borne surface coatings to contain 50 % post-consumer material by volume.

.12 Recycled water-borne surface coatings must not contain:

.1 Lead in excess of 600.0 ppm weight/weight total solids.

.2 Mercury in excess of 50.0ppm weight/weight total product.

.3 Cadmium in excess of 1.0ppm weight/weight total product.

.4 Hexavelant chromium in excess of 3.0 ppm weight/weight total product.

.5 Organochlorines or polychlorinated biphenyls (PCBS) in excess of 1.0 ppm weight/weight total product.

2.2 COLOURS

.1 NRC Departmental Representative will provide Colour Schedule after Contract award.

.2 Colour schedule will be based upon selection of five base colours and three accent colours. No more than eight colours will be selected for entire project and no more than three colours will be selected in each area.

.3 Selection of colours from manufacturer’s full range of colours.

.4 Where specific products are available in restricted range of colours, selection based on limited range.

.5 Second coat in three coat system to be tinted slightly lighter colour than top coat to show visible difference between coats.

2.3 MIXING AND TINTING

.1 Perform colour tinting operations prior to delivery of paint to site.

.2 Mix paste, powder or catalyzed paint mixes in accordance with manufacturer's written instructions.

.3 Use and add thinner in accordance with paint manufacturer's recommendations. Do not use kerosene or similar organic solvents to thin water-based paints.

.4 Thin paint for spraying in accordance with paint manufacturer's instructions.

.5 Re-mix paint in containers prior to and during application to ensure break-up of lumps, complete dispersion of settled pigment, and colour and gloss uniformity.

2.4 GLOSS/SHEEN RATINGS

.1 Paint gloss is defined as sheen rating of applied paint, in accordance with following values:

	Gloss @ 60 Degrees	Sheen @ 85 Degrees
Gloss Level 1- Matte Finish (flat)	Max. 5	Max. 10
Gloss Level 2 - Velvet-Like Finish	Max. 10	10 to 35
Gloss Level 3 - Eggshell Finish	10 to 25	10 to 35
Gloss Level 4 - Satin-Like Finish	20 to 35	min. 35
Gloss Level 5 - Traditional Semi-Gloss Finish	35 to 70	
Gloss Level 6 - Traditional Gloss	70 to 85	
Gloss Level 7 - High Gloss Finish	More than 85	

2.5 INTERIOR PAINTING SYSTEMS

.1 Concrete vertical surfaces: including horizontal soffits:

.1 INT 3. 1A - Latex finish (over sealer).

.2 Concrete horizontal surfaces: floors and stairs:

.1 INT 3.2C - Epoxy finish.

.3 Concrete masonry units: smooth and split face block and brick:

.1 INT 4.2A - Latex finish.

.4 Structural steel and metal fabrications: columns, beams, joists:

.1 INT 5.1A - Quick dry enamel semi-gloss finish.

.5 Steel - high heat: (boilers, furnaces, heat exchangers, breeching, pipes, flues, stacks, etc., with temperature range as noted):

.1 INT 5.2A - Heat resistant enamel finish, maximum 205 degrees C.

.2 INT 5.2B - Heat resist ant aluminum paint finish, maximum 427 degrees C.

.3 INT 5.2C - Inorganic zinc rich coating, maximum 400 degrees C.

.4 INT 5.2D - High heat resistant coating, maximum 593 degrees C.

.6 Galvanized metal: doors, frames, railings, misc. steel, pipes, overhead decking, and ducts.

.1 INT 5.3A - Latex finish.

.2 INT 5.3D - Epoxy finish (over epoxy primer).

.7 Plaster and gypsum board: gypsum wallboard, drywall, "sheet rock type material", and textured finishes:

.1 INT 9.2A - Latex finish (over latex sealer).

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 data sheet.

3.2 GENERAL

.1 Perform preparation and operations for interior painting in accordance with MPI Architectural Painting Specifications Manual except where specified otherwise.

.2 Apply paint materials in accordance with paint manufacturer's written application instructions.

3.3 EXAMINATION

.1 Investigate existing substrates for problems related to proper and complete preparation of surfaces to be painted. Report to NRC Departmental Representative damages, defects, unsatisfactory or unfavourable conditions before proceeding with work.

.2 Conduct moisture testing of surfaces to be painted using properly calibrated electronic moisture meter, except test concrete floors for moisture using simple "cover patch test". Do not proceed with work until conditions fall within acceptable range as recommended by manufacturer.

.3 Maximum moisture content as follows:

.1 Stucco, plaster and gypsum board: 12%.

.2 Concrete: 12%.

.3 Clay and Concrete Block/Brick: 12%.

.4 Wood: 15%.

3.4 PREPARATION

.1 Protection:

.1 Protect existing building surfaces and adjacent structures from paint spatters, markings and other damage by suitable non-staining covers or masking. If damaged, clean and restore surfaces as directed by NRC Departmental Representative.

.2 Protect items that are permanently attached such as Fire Labels on doors and frames.

.3 Protect factory finished products and equipment.

.4 Protect passing pedestrians, building occupants and general public in and about the building.

.2 Surface Preparation:

.1 Remove electrical cover plates, light fixtures, surface hardware on doors, bath accessories and other surface mounted equipment, fittings and fastenings prior to undertaking painting operations. Identify and store items in secure location and re-installed after painting is completed.

.2 Move and cover furniture and portable equipment as necessary to carry out painting operations. Replace as painting operations progress.

.3 Place "WET PAINT" signs in occupied areas as painting operations progress. Signs to approval of NRC Departmental Representative.

.3 Clean and prepare surfaces in accordance with MPI Architectural Painting Specification Manual requirements. Refer to MPI Manual in regard to specific requirements and as follows:

.1 Remove dust, dirt, and other surface debris by vacuuming, wiping with dry, clean cloths or compressed air.

.2 Wash surfaces with a biodegradable detergent and bleach where applicable and clean warm water using a stiff bristle brush to remove dirt, oil and other surface contaminants.

.3 Rinse scrubbed surfaces with clean water until foreign matter is flushed from surface.

.4 Allow surfaces to drain completely and allow to dry thoroughly.

.5 Prepare surfaces for water-based painting, water-based cleaners should be used in place of organic solvents.

.6 Use trigger operated spray nozzles for water hoses.

.7 Many water-based paints cannot be removed with water once dried. Minimize use of mineral spirits or organic solvents to clean up water-based paints.

.4 Prevent contamination of cleaned surfaces by salts, acids, alkalis, other corrosive chemicals, grease, oil and solvents before prime coat is applied and between applications of remaining coats. Apply primer, paint, or pretreatment as soon as possible after cleaning and before deterioration occurs.

.5 Where possible, prime non-exposed surfaces of new wood surfaces before installation. Use same primers as specified for exposed surfaces.

.1 Apply vinyl sealer to MPI #36 over knots, pitch, sap and resinous areas.

.2 Apply wood filler to nail holes and cracks.

.3 Tint filler to match stains for stained woodwork.

.6 Sand and dust between coats as required to provide adequate adhesion for next coat and to remove defects visible from a distance up to 1000 mm.

.7 Clean metal surfaces to be painted by removing rust, loose mill scale, welding slag, dirt, oil, grease and other foreign substances in accordance with MPI requirements. Remove traces of blast products from surfaces, pockets and corners to be painted by brushing with clean brushes blowing with clean dry compressed air or vacuum cleaning.

.8 Touch up of shop primers with primer as specified.

3.5 APPLICATION

.1 Method of application to conform to manufacturer's application instructions unless specified otherwise.

.2 Brush and Roller Application:

.1 Apply paint in uniform layer using brush and/or roller type suitable for application.

.2 Work paint into cracks, crevices and corners.

.3 Paint surfaces and corners not accessible to brush using spray, daubers and/or sheepskins. Paint surfaces and corners not accessible to roller using brush, daubers or sheepskins.

.4 Brush and/or roll out runs and sags, and over-lap marks. Rolled surfaces free of roller tracking and heavy stipple.

.5 Remove runs, sags and brush marks from finished work and repaint.

.3 Spray application:

.1 Provide and maintain equipment that is suitable for intended purpose, capable of atomizing paint to be applied, and equipped with suitable pressure regulators and gauges.

.2 Keep paint ingredients properly mixed in containers during paint application either by continuous mechanical agitation or by intermittent agitation as frequently as necessary.

.3 Apply paint in uniform layer, with overlapping at edges of spray pattern. Back roll first coat application.

.4 Brush out immediately all runs and sags.

.5 Use brushes and rollers to work paint into cracks, crevices and places which are not adequately painted by spray.

.4 Use dipping, sheepskins or daubers only when no other method is practical in places of difficult access.

.5 Apply coats of paint continuous film of uniform thickness. Repaint thin spots or bare areas before next coat of paint is applied.

.6 Allow surfaces to dry and properly cure after cleaning and between subsequent coats for minimum time period as recommended by manufacturer.

.7 Sand and dust between coats to remove visible defects.

.8 Finish surfaces both above and below sight lines as specified for surrounding surfaces, including such surfaces as tops of interior cupboards and cabinets and projecting ledges.

.9 Finish inside of cupboards and cabinets as specified for outside surfaces.

.10 Finish closets and alcoves as specified for adjoining rooms.

.11 Finish top, bottom, edges and cutouts of doors after fitting as specified for door surfaces.

3.6 MECHANICAL/ ELECTRICAL EQUIPMENT

.1 Second Floor: paint exposed ductwork and other mechanical and electrical equipment.

.2 Boiler room, mechanical and electrical rooms: paint exposed conduits, piping, hangers, ductwork and other mechanical and electrical equipment.

.3 Other unfinished areas: leave exposed conduits, piping, hangers, ductwork and other mechanical and electrical equipment in original finish and touch up scratches and marks.

.4 Touch up scratches and marks on factory painted finishes and equipment with paint as supplied by manufacturer of equipment.

.5 Do not paint over nameplates.

.6 Keep sprinkler heads free of paint.

.7 Paint inside of ductwork where visible behind grilles, registers and diffusers with primer and one coat of matt black paint.

.8 Paint fire protection piping red.

.9 Paint disconnect switches for fire alarm system and exit light systems in red enamel.

.10 Paint natural gas piping yellow.

.11 Paint both sides and edges of backboards for telephone and electrical equipment before installation. Leave equipment in original finish except for touch-up as required, and paint conduits, mounting accessories and other unfinished items.

.12 Do not paint interior transformers and substation equipment.

3.7 SITE TOLERANCES

.1 Walls: no defects visible from a distance of 1000 mm at 90 degrees to surface.

.2 Ceilings: no defects visible from floor at 45 degrees to surface when viewed using final lighting source.

.3 Final coat to exhibit uniformity of colour and uniformity of sheen across full surface area.

3.8 FIELD QUALITY CONTROL

.1 Standard of Acceptance:

.1 Walls: no defects visible from a distance of 1000 mm at 90 degrees to surface.

.2 Ceilings: no defects visible from floor at 45 degrees degrees to surface when viewed using final lighting source.

.3 Final coat to exhibit uniformity of colour and uniformity of sheen across full surface area.

.2 Advise NRC Departmental Representative when surfaces and applied coating is ready for inspection. Do not proceed with subsequent coats until previous coat has been approved.

.3 Cooperate with inspection firm and provide access to areas of work.

.4 Retain purchase orders, invoices and other documents to prove conformance with noted MPI requirements when requested by NRC Departmental Representative.

3.9 RESTORATION

.1 Clean and re-install hardware items removed before undertaken painting operations.

.2 Remove protective coverings and warning signs as soon as practical after operations cease.

.3 Remove paint splashings on exposed surfaces that were not painted. Remove smears and spatter immediately as operations progress, using compatible solvent.

.4 Protect freshly completed surfaces from paint droppings and dust to approval of NRC Departmental Representative. Avoid scuffing newly applied paint.

.5 Restore areas used for storage, cleaning, mixing and handling of paint to clean condition as approved by NRC Departmental Representative.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 05 51 29 - Metal Stairs and Ladders.

1.2 REFERENCES

.1 The Master Painters Institute (MPI)

.1 Exterior Structural Steel and Metal Fabrications, 07.

.1 EXT 5.1D, Alkyd.

.2 EXT 5.1G, Polyurethane, Pigmented (over epoxy zinc rich primer and high build epoxy).

.3 EXT 5.4, Aluminum.

.2 The Society for Protective Coatings (SSPC)

.1 SSPC-SP 1-82(R2004), Solvent Cleaning.

.2 SSPC-SP 2-82(R2004), Hand Tool Cleaning.

.3 SSPC-SP 3-82(R2004), Power Tool Cleaning.

.4 SSPC-SP 6/NACE No. 3-07, Commercial Blast Cleaning.

.5 SSPC-SP 7/NACE No. 4-07, Brush-off Blast Cleaning.

.6 SSPC-Vis-1-89, Visual Standard for Abrasive Blast Cleaned Steel (Standard Reference Photographs) Editorial Changes September 1, 2000 (Steel Structures Painting Manual, Chapter 2 - Surface Preparation Specs.).

.7 SSPC-SP 10/NACE No. 2-07, Near White Blast Cleaning.

.8 SSPC-PA 204, Measurement of Dry Coat Thickness with Magnetic Gauges.

.9 SSPC Good Painting Practices, Volume 1, 4th Edition.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 00 10 00 General Instructions.

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for painting exterior metal surfaces and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Submit 2 copies of WHMIS MSDS.

.3 Samples:

.1 Submit for review and acceptance of each unit.

.2 Samples will be returned for inclusion into work.

.4 Certificates: submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

1.4 QUALITY ASSURANCE

.1 Certificates: product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance 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 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials.

Part 2 Products

2.1 MATERIALS

.1 Paint:

.1 Primer: MPI EXT 5.1C, primer, marine for steel.

.1 Primer for second coat: tinted sufficiently off finish colour of first coat to show where second coat is applied.

.2 Tinting material: compatible with primer and not detrimental to its service life.

.2 Enamel: MPI EXT 5.1G, enamel, alkyd, marine, exterior; first coat grey, colour No. 501-205; second coat grey, colour No. 501-203. Colours to match FS-595B. If majority of paint application is to be by brushing, use paint to MPI EXT 5.1D.

Part 3 Execution

3.1 EXAMINATION

.1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for painting exterior metal surfaces installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate.

.2 Carry out tests to determine existence of lead base paint on existing exterior metal surfaces.

.3 If lead exists stop work and report findings to NRC Departmental Representative.

.4 Inform NRC Departmental Representative of unacceptable conditions immediately upon discovery.

.5 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from NRC Departmental Representative.

3.2 PREPARATION

.1 Remove existing loose and rusted paint from exterior metal surfaces.

.2 New metal surfaces:

.1 Clean surfaces of new metal to be painted by removing rust, loose mill scale, welding slag, dirt, oil, grease and foreign substances in accordance with the following:

.1 Commercial blast cleaning: to SSPC-SP 6.

.2 Solvent cleaning: to SSPC-SP 1.

.3 Hand tool cleaning: to SSPC-SP 2.

.4 Power tool cleaning: to SSPC-SP 3.

.5 Brush-off blast cleaning: to SSPC-SP 7.

.6 Near White Blast Cleaning: to SSPC-SP 10/NACE No. 2.

.3 Metal surfaces to be repainted:

.1 Clean surfaces by removing loose, cracked, brittle or non-adherent paint, rust, loose mill scale, welding slag, dirt, oil, grease and other foreign substances in accordance with following.

.1 Commercial blast cleaning: to SSPC-SP 6.

.2 Brush-off blast cleaning: to SSPC-SP 7.

.3 Solvent cleaning: to SSPC-SP 1.

.4 Hand tool cleaning: to SSPC-SP 2.

.5 Power tool cleaning: to SSPC-SP 3.

.2 Commercial blast clean rusted and bare metal surfaces where existing paint system has failed.

.3 Brush-off blast clean remaining metal surfaces to be painted.

.4 Scrape edges of old paint back to sound material where remaining paint is thick and sound, feather exposed edges.

.4 Compressed air to be free of water and oil before reaching nozzle.

.5 Remove traces of blast products from surfaces, pockets and corners to be painted by brushing with clean brushes, by blowing with clean dry compressed air, or by vacuum cleaning.

.6 Prior to starting paint application ensure degree of cleanliness of surfaces is to SSPC-Vis 1.

.1 Apply primer, paint, or pretreatment after surface has been cleaned and before deterioration of surface occurs.

.2 Clean surfaces again if rusting occurs after completion of surface preparation.

.7 Mixing paint:

.1 Do not dilute or thin paint for brush application.

.2 Mix ingredients in container before and during use and ensure breaking up of lumps, complete dispersion of settled pigment, and uniform composition.

.3 Do not mix or keep paint in suspension by means of air bubbling through paint.

.4 Thin paint for spraying according to manufacturer's written instructions. If directions are not on container, obtain instructions in writing from manufacturer and provide copy of instructions to NRC Departmental Representative.

.8 Number of paint coats: 4.

.1 New metal surfaces.

.1 Shop: 2 primer coats to minimum dry film thickness of 35 microns per coat.

.2 Field: 2 alkyd enamel coats to minimum dry film thickness of 25 microns per coat.

.2 Repainting existing metal surfaces.

.1 One primer coat to minimum dry film thickness of 35 microns to bare and commercial sand blasted areas.

.2 Two Alkyd enamel coats to minimum dry film thickness of 25 microns per coat.

3.3 APPLICATION

.1 Manufacturer's Instructions: comply with manufacturer's written data, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, and data sheets.

.2 Apply paint by spraying, brushing, or combination of both. Use sheepskins or daubers when no other method is practical in places of difficult access.

.3 Caulk open seams at contact surfaces of built up members before second undercoat of primer is applied.

.4 Where surface to be painted is not under cover, do not apply paint when:

.1 Air temperature is below 5 degrees C or when temperature is expected to drop to 0 degrees C before paint has dried.

.2 Temperature of surface is over 50 degrees C unless paint is specifically formulated for application at high temperatures.

.3 Fog or mist occur at site; it is raining or snowing; there is danger of rain or snow; relative humidity is above 85%.

.4 Surface to be painted is wet, damp or frosted.

.5 Previous coat is not dry.

.5 Supply cover when paint must be applied in damp or cold weather. Supply, shelter, or heat surface and surrounding air to comply with temperature and humidity conditions specified. Protect until paint is dry or until weather conditions are suitable.

.6 Remove paint from areas which have been exposed to freezing, excess humidity, rain, snow or condensation. Prepare surface again and repaint.

.7 Apply each coat of paint as continuous film of uniform thickness. Repaint thin spots or bare areas before next coat of paint is applied.

.8 Brush application:

.1 Work paint into cracks, crevices and corners and paint surfaces not accessible to brushes by spray, daubers or sheepskins.

.2 Brush out runs and sags.

.3 Remove runs, sags and brush marks from finished work and repaint.

.9 Spray application:

.1 Provide and maintain equipment that is suitable for intended purpose, capable of properly atomizing paint to be applied, and equipped with suitable pressure regulators and gauges.

.2 Provide traps or separators to remove oil and water from compressed air and drain periodically during operations.

.3 Keep paint ingredients properly mixed in spray pots or containers during paint application either by continuous mechanical agitation or by intermittent agitation as frequently as necessary.

.4 Apply paint in uniform layer, with overlapping at edges of spray pattern.

.5 Brush out immediately runs and sags.

.6 Use brushes to work paint into cracks, crevices and places which are not adequately painted by spray. In areas not accessible to spray gun, use brushes, daubers or sheepskins.

.7 Remove runs, sags and brush marks from finished work and repaint.

.10 Shop painting:

.1 Do shop painting after fabrication and before damage to surface occurs from weather or other exposure.

.2 Spray paint contact surfaces of field assembled, bolted, friction type joints with primer coat only. Do not brush primer after spraying.

.3 Do not paint metal surfaces which are to be embedded in concrete.

.4 Paint metal surfaces to be in contact with wood with either full paint coats specified or three shop coats of specified primer.

.5 Do not paint metal within 50 mm of edge to be welded. Give unprotected steel one coat of boiled linseed oil or other approved primer after shop fabrication is completed.

.6 Remove weld spatter before painting. Remove weld slag and flux by methods as specified in paragraph 3.2.3 Metal Surfaces to be Repainted.

.7 Protect machine finished or similar surfaces that are not to be painted but that do require protection, with coating of rust inhibitive petroleum, molybdenum disulphide, or other coating.

.8 Copy previous erection marks and weight marks on areas that have been shop painted.

.11 Field painting:

.1 Paint steel structures as soon as practical after erection.

.2 Touch up metal which has been shop coated with same type of paint and to same thickness as shop coat. This touch-up to include cleaning and painting of field connections, welds, rivets, nuts, washers, bolts, and damaged or defective paint and rusted areas.

.3 Field paint surfaces (other than joint contact surfaces) which are accessible before erection but which are not to be accessible after erection.

.4 Apply final coat of paint after concrete work is completed . If concreting or other operations damage paint, clean and repaint damaged area. Remove concrete spatter and droppings before paint is applied.

.5 Where painting does not meet with requirements of specifications, and when so directed by NRC Departmental Representative remove defective paint, thoroughly clean affected surfaces and repaint in accordance with these specifications.

.12 Handling painted metal:

.1 Handle painted metal after paint has dried, or when necessary for handling for painting or stacking for drying.

.2 Scrape off and touch up paint which is damaged in handling, with same number of coats and kinds of paint as were previously applied to metal.

3.4 FIELD QUALITY CONTROL

.1 Site Tests, Inspections:

.1 Upon completion of the painting procedures test for dry film reading and evaluate the results as per SSPC-PA 2.

3.5 CLEANING

.1 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.

.2 Waste Management: separate waste materials for reuse and recycling.

.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.6 PROTECTION

.1 Protect painted surfaces from damage during construction.

.2 Protection of surfaces:

.1 Protect surfaces not to receive paint.

.2 Prevent contamination of cleaned surfaces by salts, acids, alkalis, corrosive chemicals, grease, oil and solvents before prime coat is applied and between applications of remaining coats of paint. Remove contaminants from surface and apply paint immediately.

.3 Protect cleaned and freshly painted surfaces from dust.

.3 Repair damage to adjacent materials caused by painting exterior metal surface application installation.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 05 50 00 - Metal Fabrications.

.2 Section 06 10 00 - Metal Rough Carpentry.

.3 Section 10 28 10 - Toilet and Bath Accessories.

1.2 REFERENCES

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

.1 ASTM A 167-2004, Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.

.2 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-71.20-M88, Adhesive, Contact, Brushable.

.3 Canadian Standards Association (CSA International)

.1 CSA-B651-04, Accessible Design for the Built Environment.

.4 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

.5 South Coast Air Quality Management District (SCAQMD), California State

.1 SCAQMD Rule 1168-05, Adhesives and Sealants Applications.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Submit manufacturer's printed product literature for toilet partitions or components, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:

.1 Indicate fabrication details, plans, elevations, hardware, and installation details.

.4 Samples:

.1 Submit duplicate 300 x 300mm samples of panel showing finish on both sides, two finished edges and core construction.

.2 Submit duplicate representative samples of each hardware item, including brackets, fastenings and trim.

.5 Closeout Submittals:

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

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Manufacturer's written instructions.

.2 Protect finished laminated plastic surfaces during shipment and installation. Do not remove until immediately prior to final inspection.

.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 MATERIALS

.1 Basis of Design – Laminated plastic toilet partitions: Refer to Section 00 01 30, List of Materials for washroom partitions (PTN1) and urinal partitions (PTN2) products, designations, manufacturers, sizes and colour.

.1 Products by other manufacturers similar in function, design, performance, and construction complying with requirements of this Section may be incorporated into the Work subject to NRC Departmental Representative’s acceptance, in accordance with the Contract substitution procedures.

.2 Laminated plastic sheets: From manufacturer's range.

.3 Laminated plastic adhesive: to CAN/CGSB-71.20.

.1 Maximum VOC limit 250 g/L to SCAQMD Rule 1168.

.2 Urea-formaldehyde free.

.4 Stainless steel sheet metal: to ASTM A 167 A240, Type 302, clear finish.

.5 Headrails: 25mm x 41mm, clear anodized, extruded aluminum, anti-grip design.

.6 Pilaster shoe: 0.8 mm stainless steel, 75 mm high.

.7 Attachment: stainless steel tamper proof type screws and bolts.

2.2 COMPONENTS

.1 Hinges:

.1 Heavy duty, nylon bushings.

.2 Material/finish: stainless steel.

.3 Swing: As indicated on drawings.

.4 Return movement: gravity.

.5 Adjustable to hold door open at any angle up to 90 degrees.

.6 Emergency access feature.

.2 Latch set: built-in, combination latch, door-stop, keeper and bumper, stainless steel, emergency access feature.

.3 Wall and connecting brackets: stainless steel extrusion or casting.

.4 Coat hook: combination hook and rubber door bumper, stainless steel.

.5 Door pull: Barrier-free type suited for out-swinging doors, stainless steel.

2.3 FABRICATION

.1 Doors, panels and screens: 25 mm thick, composite plastic laminate panels, to sizes indicated.

.2 Pilasters: 32 mm thick, constructed same as door, to sizes indicated.

.3 Laminate plastic to core material ensuring core and laminate profiles coincide to provide continuous support and bond over entire surface.

.4 Finish edges of composite laminated plastic panels with laminated plastic strip channel edging and mitre corners.

.1 Chamfer exposed edges uniformly at approximately 20 degrees.

.5 Provide formed and closed edges for doors, panels and pilasters.

.1 Mitre and weld corners and grind smooth.

.6 Provide internal reinforcement at areas of attached hardware and fittings.

.1 Temporarily mark location of reinforcement for grab bars.

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 Ensure supplementary anchorage, if required, is in place.

.2 Do work in accordance with CSA-B651.

3.3 ERECTION

.1 Partition erection:

.1 Install partitions secure, plumb and square.

.2 Leave 12 mm space between wall and panel or end pilaster.

.3 Anchor mounting brackets to masonry or concrete surfaces using screws and shields: to hollow walls using bolts and toggle type anchors.

.4 Attach panel and pilaster to brackets with through type sleeve bolt and nut.

.5 Provide for adjustment of floor variations with screw jack through steel saddles made integral with pilaster. Conceal floor fixings with stainless steel shoes.

.6 Equip each door with hinges, latch set, and each stall with coat hook mounted on door. Adjust and align hardware for proper function. Set door open position at 30 degrees to front. Install door bumper.

.7 Install hardware grab bars.

.2 Floor supported and overhead braced partition erection:

.1 Attach pilasters to floor with pilaster supports and level, plumb, and tighten installation with levelling device.

.2 Secure pilaster shoes in position.

.3 Secure headrail to pilaster face with not less than two fasteners per face.

.4 Set tops of doors parallel with overhead brace when doors are in closed position.

.3 Floor supported partition erection:

.1 Secure pilasters to floor with pilaster supports anchored with minimum 50mm penetration in structural floor.

.2 Level, plumb and tighten installation with levelling device.

.3 Secure pilaster shoes in position.

.4 Set tops of doors level with tops of pilasters when doors are in closed position.

.4 Screen erection:

.1 Provide urinal stall screens consisting of panel as specified for toilet compartments.

.2 Anchor screen panels to walls with 3 panel brackets.

3.4 CLEANING

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

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 05 50 00 - Metal Fabrications.

.2 Section 06 10 00 - Rough Carpentry.

.3 Section 10 21 13.13 - Metal Toilet Compartments.

1.2 REFERENCES

.1 ASTM International

.1 ASTM A 167-99(2009), Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.

.2 ASTM B 456-03, Standard Specification for Electrodeposited Coatings of Copper Plus Nickel Plus Chromium and Nickel Plus Chromium.

.3 ASTM A 653/A 653M-09, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

.4 ASTM A 924/A 924M-09, Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.

.2 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-1.81-M90, Air Drying and Baking Alkyd Primer for Vehicles and Equipment.

.2 CAN/CGSB-1.88-92, Gloss Alkyd Enamel, Air Drying and Baking.

.3 CGSB 31-GP-107MA-90, Non-inhibited Phosphoric Acid Base Metal Conditioner and Rust Remover.

.3 CSA International

.1 CAN/CSA-B651-04, Accessible Design for the Built Environment.

.2 CAN/CSA-G164-M92(R2003), Hot Dip Galvanizing of Irregularly Shaped Articles.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Product Data:

.1 Provide manufacturer's printed product literature and data sheets and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Shop Drawings:

.1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Canada.

.2 Indicate size and description of components, base material, surface finish inside and out, hardware and locks, attachment devices, description of rough-in-frame, building-in details of anchors for grab bars .

1.4 CLOSEOUT SUBMITTALS

.1 Provide maintenance data for toilet and bath accessories for incorporation into manual.

1.5 MAINTENANCE MATERIAL SUBMITTALS

.1 Tools:

.1 Provide special tools required for assembly, disassembly or removal for toilet and bath accessories.

.2 Deliver special tools to NRC Departmental Representative.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance 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 toilet and bathroom accessories from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

.4 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials.

Part 2 Products

2.1 MATERIALS

.1 Sheet steel: to ASTM A 653/A 653M with ZF001 designation zinc coating.

.2 Stainless steel sheet metal: to ASTM A 167, Type 302, withclear finish.

.3 Stainless steel tubing: Type 302, commercial grade, seamless welded, 1.2 mm wall thickness.

.4 Fasteners: concealed screws and bolts hot dip galvanized, exposed fasteners to match face of unit. Expansion shields fibre, lead or rubber as recommended by accessory manufacturer for component and its intended use.

2.2 COMPONENTS

.1 Toilet tissue dispenser: Owner supplied.

.2 Paper towel dispenser: Owner supplied.

.3 Soap dispenser: Owner supplied.

.4 Grab bars: 30 mm diameter x 1.6 mm wall tubing of stainless steel, 38 mm diameter wall flanges, concealed screw attachment, flanges welded to tubular bar, provided with steel back plates and all accessories. Knurl bar at area of hand grips. Grab bar material and anchorage to withstand downward pull of 2.2 kN.

.5 Tilt mirror: wall mounted unit, fixed framed mirror 6 mm, stainless steel frame with integral shelf.

.6 Diaper changing station: surface mounted wall unit, polyethylene insert, moulded-in steel-on-steel hinge assembly, moulded-in integral support mechanism, 851 mm wide x 584 mm high, concealed gas shock, security lock, tamper resistant hardware, steel backer plate, diaper bag hook, liner dispenser, safety belt, safety instructions in both official languages, labeled with universally accepted symbol "changing station".

.1 Acceptable Material:

.1 Rubbermaid Horizontal Change Station 7818-88.

.7 Feminine napkin/tampon dispenser: stainless steel, semi-recessed unit including rough-in frame, min capacity 15 napkins and 20 tampons, free operation, key locked, continuous hinge front panel.

.8 Feminine napkin disposal bin: stainless steel, semi-recessed unit including rough-in frame, continuous hinged door, self closing, embossed with "napkin disposal", "receptacle de serviette-sanitaire", removable stainless steel receptacles fitted with spring clip for deodorizer block.

.9 Electronic dryer: power controlled by infrared admitting, receiving electronic control device positioned to dryer on when hands are placed under nozzle. Operation to continue for no more than 80 seconds of continued use.

.1 Acceptable Material:

.1 Dyson Airblade db Hand Dryer.

2.3 FABRICATION

.1 Weld and grind joints of fabricated components flush and smooth. Use mechanical fasteners only where approved.

.2 Wherever possible form exposed surfaces from one sheet of stock, free of joints.

.3 Brake form sheet metal work with 1.5 mm radius bends.

.4 Form surfaces flat without distortion. Maintain flat surfaces without scratches or dents.

.5 Back paint components where contact is made with building finishes to prevent electrolysis.

.6 Hot dip galvanize concealed ferrous metal anchors and fastening devices to CAN/CSA-G164.

.7 Shop assemble components and package complete with anchors and fittings.

.8 Deliver inserts and rough-in frames to job site at appropriate time for building-in. Provide templates, details and instructions for building in anchors and inserts.

.9 Provide steel anchor plates and components for installation on studding and building framing.

2.4 FINISHES

.1 Chrome and nickel plating: to ASTM B 456, satin finish.

.2 Baked enamel: condition metal by applying one coat of metal conditioner to CGSB 31-GP-107Ma, apply one coat Type 2 primer to CAN/CGSB-1.81 and bake, apply two coats Type 2 enamel to CAN/CGSB-1.88 and bake to hard, durable finish. Sand between final coats. Colour selected from standard range by NRC Departmental Representative.

.3 Manufacturer's or brand names on face of units not acceptable.

Part 3 Execution

3.1 EXAMINATION

.1 Verification of Conditions: verify that conditions of substrates and surfaces to receive toilet and bathroom accessories previously installed under other Sections or Contracts are acceptable for product installation in accordance with manufacturer's instructions prior to toilet and bathroom accessories installation.

.2 Inform NRC 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 from NRC Departmental Representative.

3.2 INSTALLATION

.1 Install and secure accessories rigidly in place as follows:

.1 Stud walls: install steel back-plate to stud prior to plaster or drywall finish. Provide plate with threaded studs or plugs.

.2 Hollow masonry units, existing plaster or drywall: use toggle bolts drilled into cell or wall cavity.

.3 Solid masonry, marble, stone or concrete: use bolt with lead expansion sleeve set into drilled hole.

.4 Toilet and shower compartments: use male to female through bolts.

.2 Install grab bars on built-in anchors provided by bar manufacturer.

.3 Use tamper proof screws/bolts for fasteners.

.4 Fill units with necessary supplies shortly before final acceptance of building.

3.3 ADJUSTING

.1 Adjust toilet and bathroom accessories components and systems for correct function and operation in accordance with manufacturer's written instructions.

.2 Lubricate moving parts to operate smoothly and fit accurately.

3.4 CLEANING

.1 Progress Cleaning:

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.

.3 Waste Management: separate waste materials for reuse and recycling.

.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.5 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by toilet and bathroom accessories installation.

3.6 SCHEDULE

.1 Locate accessories where indicated and as follows. Exact locations determined by NRC Departmental Representative.

.2 Combination towel dispenser/waste receptacles: one in each washroom. Maximum height of dispenser and operable part from floor 1200 mm.

.3 Soap dispenser: one at each wash basin.

.4 Hand dryer: one in each washroom. Maximum height of dispenser and operable part from floor 1200 mm.

.5 Grab bar: where indicated. Height of grab bar from floor 750 mm. Side grab bar: maximum distance from rear wall 300 mm, minimum distance passed front edge of toilet 450 mm.

.6 Tilt mirror: one at each accessible wash basin, height of bottom edge of mirror from floor 1000 mm.

.7 Diaper changing station: where indicated.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 03 30 00 - Cast in Place Concrete.

.2 Section 08 33 23.01 - Overhead Coiling Doors and Grilles.

.3 Section 11 13 19.13 - Loading Dock Levelers.

1.2 REFERENCES

.1 ASTM International

.1 ASTM D 624-00(2007), Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers.

.2 ASTM D 1171-99(2007), Standard Test Method for Rubber Deterioration-Surface Ozone Cracking Outdoors or Chamber (Triangular Specimens).

.3 ASTM D 2632-01(2008), Standard Test Method for Rubber Property-Resilience by Vertical Rebound.

.2 Green Seal Environmental Standards (GS)

.1 GS-11-2008, 2nd Edition, Paints and Coatings.

.2 GS-36-00, Commercial Adhesives.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 00 10 00 General Instructions.

.2 Product Data:

.1 Submit manufacturer's printed product literature and data sheets for loading dock bumpers 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 Province of Ontario.

.2 Indicate on drawings:

.1 Dimensions and required clearances.

.2 Fastening methods for dock bumpers.

.4 Samples:

.1 Submit duplicate samples of 300 mm long sections of dock bumpers.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance 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 loading dock bumpers from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

.4 Packaging Waste Management: remove for reuse and return by manufacturer pallets, crates, padding, and packaging materials.

Part 2 Products

2.1 MATERIALS

.1 Description:

.1 Sustainability Characteristics:

.1 Primers, Paints: in accordance with manufacturer's recommendations for surface conditions.

.1 Primer: maximum VOC limit 250 g/L to GS-11.

.2 Paints: maximum VOC limit 250 100 50 g/L to GS-11

.2 Rubberized Dock Bumpers:

2.2 MANUFACTURED UNITS

.1 Laminated Dock Bumper:

.1 Nylon impregnated heavy duty industrial rubber pads sized to suit opening.

.1 Pads punched to receive 19 mm steel supporting rods.

Part 3 Execution

3.1 EXAMINATION

.1 Verification of Conditions: verify conditions of substrates and surfaces previously installed under other Sections or Contracts are acceptable for loading dock bumper installation in accordance with manufacturer's instructions prior to loading dock bumper installation.

.1 Visually inspect substrate.

.2 Inform NRC 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 from NRC Departmental Representative.

3.2 INSTALLATION

.1 No assembly required for pre-manufactured unit.

.1 Install loading dock bumper as indicated.

3.3 CLEANING

.1 Progress Cleaning:

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.

.3 Waste Management: separate waste materials for reuse and recycling.

.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.4 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by loading dock bumper installation.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 03 30 00 - Cast in Place Concrete.

.2 Section 08 33 23.01 - Overhead Coiling Doors and Grilles.

.3 Section 11 13 13 - Loading Dock Bumpers.

1.2 REFERENCES

.1 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-1.40-97, Anticorrosive Structural Steel Alkyd Primer.

.2 Green Seal Environmental Standards

.1 Standard GS-03-93, Anti-Corrosive Paints.
.2 Standard GS-11-97, Architectural Paints.
.3 Standard GS-36-00, Commercial Adhesives.

.3 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

.4 The Master Painters Institute (MPI)

.1 Architectural Painting Specification Manual - February 2004.
.1 MPI # 79, Primer, Alkyd, Anticorrosive for Metal.
.2 MPI EXT 5.1A to Z, Structural Steel and Metal Fabrications.

.5 ANSI MH29.1 - Industrial Scissor Lifts.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Section 00 10 00 General Instructions.

.2 Product Data:

.1 Submit manufacturer's printed product literature and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
.2 Submit two copies WHMIS MSDS - Material Safety Data Sheets.

.3 Shop Drawings:

.1 Indicate:
.1 Dimensions of pit and required clearances.
.2 Arrangement of jacks mechanical linkages and valves and piping, with sizes and working pressure.

.3 Details of motor, pump and operating station, showing names of manufacturers, type or style designations, part numbers, and hp and rpm of motor.

.4 Factory test data of cylinder containing complete information covering test, cylinder material, inside and outside diameters and maximum test pressure.

.5 Details of electrical equipment.

.4 Quality control submittals: submit following in accordance with Section 01 45 00 - Quality Control.

.1 Manufacturer's Instructions: submit manufacturer's installation instructions and special handling criteria, installation sequence, cleaning procedures.

.5 Closeout Submittals:

.1 Provide operation and maintenance data for dock levelers for incorporation into manual specified in Section 01 78 00 - Closeout Submittals and include:

.1 Complete description and sequence of operation together with wiring diagrams showing electrical connections, manufacturer's instructions covering maintenance requirements, and parts catalogue giving complete list of repair and replacement parts with cuts and identifying numbers.

.2 Dimensioned drawing of dock leveler installation as installed.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Packing, shipping, handling and unloading:

.1 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.2 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.

1.5 EXTRA MATERIALS

.1 Provide complete set of tools necessary to maintain and adjust every part of dock leveler.

Part 2 Products

2.1 EQUIPMENT

.1 Hydraulic unit:

.1 Provide pit installed, free standing, stationary remote controlled electro-hydraulic, single scissor dock lift with maximum capacity of moving or roll-over live load of 2722kg.

.2 Platform to lower itself to bottom position, level with grade and with lip behind bumpers, when truck moves away. Platform to raise to interior loading dock level.

.3 Provide manual override to be used in case of power failure, and allow lip to remain extended if desired.

.4 Each unit supplied with power pack consisting of all major components including:

.1 Piston type hydraulic cylinders, motor, high-pressure gear pump, manifold, oil filters and oil reservoir; a pressure relief valve, load holding check valve, fixed pressure compensated flow control valve and poppet-type lowering solenoid valve. Oil filter located in the valve manifold (oil reservoir). Connections suitable for pit mounting

.5 Power characteristics: 240 VAC, 3-5 hp.

.6 Make cylinder of seamless steel piping with bore turned and polished and with positive stop ring to prevent plunger from leaving cylinder.

.1 Provide top and bottom mountings to ensure positive alignment and to prevent binding in any position of ramp platform.

.7 Equip lifting jack assembly with bearings for vertical stability, oil inlet connections, stuffing box with suitable packing and plunger wipe, and packing gland.

.8 Have cylinder factory tested at pressure of 2.8 MPa minimum.

.9 Provide electric power unit consisting of motor and direct-connected pump, wiring, conduit, oil piping and accessories.

.10 Provide overload protection for motor, and pressure relief valve in pump bypassing oil back to reservoir.

.1 Provide check valve, continuous-duty solenoid valve and flexible hose.

.11 Oil Reservoir:

.1 Make oil reservoir integral with torque tube assembly or separate welded steel tank, galvanized inside and out.

.2 Equip reservoir with strainer assembly and overflow and drain connections and protected vent opening.

.3 Provide initial filling of oil for system.

.2 Lift platform:

.1 Platform size: 1524mm wide by 3048mm long with 914 mm wide hinged lip. Lowered height 356mm. Vertical travel 1500mm.

.2 Construct platform sections of non-skid high tensile checkered steel floor plate not less than 10mm thick. Platform sides to have min 200mm toe guard protection.

.3 Construct platform base of sectional steel box members including automatic compensation for out-of-level vehicles.

.4 Hinged bridge: Provide lip with piano hinge type of non-skid high tensile checkered steel floor plate, with bevelled edge and lifting chain.

.5 Make leveler flexible with sufficient members to compensate for out-of-level vehicle condition of 100 mm maximum with not more than 15 mm differential between two flexible members in extreme condition.

.6 Use members of heavy structural shapes, rigidly welded and reinforced for concentrated wheel loads.

.7 No obstruction to protrude above platform floor surface of leading edge of leveler that will prevent closing of overhead doors installed over lift platform, or hinder operations.

.8 Make side members of lift platform to function as protective steel plate skirts on each side of lift platform front to back, when leveler platform is in fully raised position.

.9 Construct underframe of lift platform of rigid construction and supported by scissor lifting mechanism at two widely separated points to prevent tilting, deflection or distortion of platform when concentrated wheel loads, up to and including maximum moving or roll-over load, are imposed on position of platform. .

.10 Provide two laminated fabric reinforced bumpers for each unit.

.3 Operating station:

.1 Install wall mounted operating station where indicated.

.2 Provide two operating positions, clearly and permanently marked "UP", "DOWN".

.3 Operate by push-buttons for each position.

.1 Return operating handle to "OFF" position when released while moving lift in any direction, and stop lift in position at moment of release pushbuttons stop motion when released.

.4 Operate limit switches or similar devices at extreme positions of lift travel to protect power system and mechanism from damage.

.5 Provide automatic safety lock to limit downward travel of lift platform to maximum 50 mm in event trailer or truck moves away from lift while carrying load up to maximum capacity.

.6 Accessories.

.7 Fall safe control: equip lift with velocity fuse in hydraulic system to prevent platform free fall.

.8 Maintenance strut: steel folding strut to prevent accidental collapse of lift and lip during maintenance.

.9 Automatic overhead door security: automatic locking mechanism to lift to prevent unauthorized lowering of dock lift and access to building between lowered lift and underside of closed door.

.10 Provide weather seals on both sides of platform.

.11 Provide steel tapered toe guards.

.12 Provide safety stripping four sides of unit.

.13 Provide removable & deck mounted railings of 38mm dia. steel pipe, 1070mm high on long sides. Sockets to be level with platform, safety chain to be fitted at open ends.

.14 Provide Accordion safety skirting

.4 Finish:

.1 Paint slip resistant exposed ferrous metal work unless otherwise specified.

.2 Free surfaces of rust and coat with rust resistant paint.

.3 Clean but do not paint surfaces to be field welded.

.4 Apply two coats of anticorrosive structural steel alkyd primer MPI # 79 to CAN/CGSB-1.40 MPI EXT 5.1 to surfaces of structural members and frame of ramp excepting finished or working surfaces.

.1 Primer: maximum VOC limit 250 g/L to Standard GC-03.

.5 Apply heavy coat of bituminous paint to concealed surfaces before building-in.

.1 Coating: maximum VOC limit 250 g/L to Standard GS-11 to SCAQMD Rule 1113.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

.1 Install dock lift unit in accordance with manufacturer's instructions. Set square and level.

.2 Install electrical motors, controller units, pushbutton stations, relays and other electrical equipment required for proper operation.

.3 Touch up shop primer to bolts, welds, and burned or scratched surfaces at completion of installation.

.4 Adjust dock lift operating components to ensure smooth continuous raising and lowering of platform and balanced operation.

.5 Deck surface in normal raised position is to be level and flush with surface of surrounding interior dock surface. Anchor unit securely.

3.3 FIELD QUALITY CONTROL

.1 Site Tests: conduct operating tests for approval of NRC Departmental Representative including:

.1 Operation to maximum limits of travel in "UP" and "DOWN", directions.

.2 Demonstration of speed limitations.

.3 Demonstration of proper functioning of out-of-level compensation.

.4 Demonstration of lip function

.5 Demonstration of loading capacity.

.6 Any other test required by NRC Departmental Representative to ensure full compliance with specification requirements.

END OF SECTION

Part 1 General

1.1 SUBMITTALS

.1 Samples: For the following products, in manufacturer's standard sizes:

.1 Floor Grille: Assembled section of floor grille.

.2 Frame Members: Sample of each type and finish/colour.

.2 Product Data: Product data for each type of floor grid and frame specified, including manufacturer's specifications and installation instructions.

.3 Shop drawings:

.1 Prepare shop drawings in sufficient detail showing layout of grid and frame.

.2 Indicate field measurements on Shop Drawings.

.3 Include construction details, material descriptions including thicknesses, dimensions of individual components and profiles, divisions between grille sections, finishes, anchorages, joints and accessories.

.4 Maintenance data in the form of manufacturer's printed instructions for cleaning and maintaining floor grids.

1.2 COORDINATION

.1 Coordinate size and location of recesses in concrete to receive floor grilles and frames.

1.3 PROJECT CONDITIONS

.1 Field measurements: Check actual openings for grids by accurate field measurements before fabrication. Record actual measurements on final shop drawings. Coordinate fabrication schedule with construction progress to avoid delay of work.

.2 Coordinate frame installation with concrete construction to ensure recess and frame anchorage are accurate and that the base is level and flat. Defer frame installation until building enclosure is complete and related interior finish work is in progress.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver materials to the project site ready for use and fabricated in as large sections and assemblies as practical, in unopened original factory packaging clearly labelled to identify model and manufacturer.

Part 2 Products

2.1 FOOT GRILLES

.1 Basis of Design:

.1 Floor Grids: extruded one piece 6105-T5 aluminum alloy, serrated tread rails to be joined mechanically by 6106-T6 aluminum alloy, key lock bars, welding or bolting shall not be permitted. Rail finish to be clear anodized. Acceptable model G8 Pedigrid SA as manufactured by Construction Specialties.

.2 Grid Frames: DP – Deep Pit Series with Drain Pan Frame shall be 4-3/16" (106.4mm) deep with 1/2" (12.7mm) exposed surfaces in 6063-T5 aluminum alloy. These assemblies shall rest upon a continuous vinyl cushion with additional support members 32" (0.81m) on center maximum. At every 24" (0.61m) along the support member, staggered side to side, is a 6063-T5 aluminum alloy adjustable support leg. A 16 gauge aluminum pan complete with a 2" (50.8mm) I.P.S. drain and stainless steel strainer to be provided by manufacturer. A 2" (50.8mm) pipe and drain trap shall be furnished under the plumbing contract. Frame finish to be clear anodized.

.3 Entrance Floor grilles by other manufacturers similar in function, design, performance, and construction complying with requirements of this specification section may be incorporated into the Work subject to NRC Departmental Representative's acceptance in accordance with the Contract Substitution procedures.

.2 Coat all surfaces of aluminum and stainless steel in contact with concrete with bitumastic paint.

2.2 FABRICATION

.1 Verify site dimensions prior to fabrication. Fabricate work square, true, straight, level and free of distortion with joints closely fitted and properly secured.

.2 Fabricate frames in maximum single lengths, corners mitred. Where lengths exceed manufacturer's standard, join frames in hairline joints and equally spaced.

.3 Coat frame surfaces in contact with concrete with one coat of isolation coating.

.4 Where floor recess exceeds manufacturer's recommended maximum size, join adjacent matting units symmetrically and space joints away from normal traffic lines.

Part 3 Execution

3.1 EXAMINATION

.1 Examine surfaces receiving the work of this Section. Ensure that there are no ill prepared work that will adversely affect the performance of work of this Section. Do not proceed with work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

.1 Install work in accordance with manufacturer's instructions.

.2 Locate, align and level frames in floor recess with top flush with adjacent finished floor.

.3 Vacuum floor recess before installing mats.

.4 Provide adequate reinforcing and anchorage to ensure a rigid installation.

.5 Set grille in frames, square, true, straight and level with framing members.

.6 Maintain uniform gap between mats and frame, at maximum 3 mm.

3.3 PROTECTION

.1 Promptly upon completion of work cover finished surfaces and protect exposed corners and areas vulnerable to damage by persons or by the movement of materials, tools or equipment. Remove covers when directed by NRC Departmental Representative.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 American National Standards Institute (ANSI)

.1 ANSI A208.1-09, Particleboard.

.2 American National Standards Institute (ANSI)/Business and International Furniture Manufacturers Association (BIFMA) International

.1 ANSI/BIFMA X5.1-11, American National Standard for Office Furnishings, General Purpose Office Chairs - Tests.

.2 ANSI/BIFMA X5.6-10, American National Standard for Office Furnishings - Panel Systems.

.3 BIFMACMD-1-09, BIFMA Chair Measuring Device.

.3 ASTM International

.1 ASTM C 297/C 297M-04(2010), Standard Test Method for Flatwise Tensile Strength of Sandwich Constructions.

.4 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-44.227-2008, Freestanding Office Desk Products and Components.

.2 CAN/CGSB-44.232-2008, Task Chairs for Office Work Environments.

.5 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

.6 Underwriters' Laboratories Canada (ULC)

.1 CAN/ULC-S102-2010, Standard Method of Test for Surfaces Burning Characteristics of Building Materials and Assemblies.

.7 Underwriters' Laboratories (UL)

.1 UL 1286-2008(R2011), Standard for Office Furnishings.

1.2 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 furniture and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Submit 2 copies of WHMIS MSDS.

1.3 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 33 00 Submittal Procedures.

.2 Operation and Maintenance Data: submit operation and maintenance data for furniture for incorporation into manual.

.3 Supply part numbers of furniture to allow for replacement of worn or damaged furniture parts.

.4 Supply instructions detailing procedures for repairing or replacing worn furniture parts.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance 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 furniture from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

.4 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials.

1.5 WARRANTY

.1 Submit written assurance that replacement parts will be available for minimum of 5 years following discontinuation of product manufacture.

.2 Ensure warranties provide for repair rather than replacement.

Part 2 Products

2.1 MATERIALS

.1 Wood: visible wood free from open knots and defects.

.1 Wood veneers: applied to furniture 0.7 minimum mm thick.

.2 Certified Wood to: CAN/CSA-Z809 or FSC or SFI.

.3 Adhesives used to apply wood veneers capable of achieving tensile strength of 552 kPa minimum when tested to ASTM C 297.

2.2 DESKS

.1 Office desks products and components: to CAN/CGSB-44.227.

.2 Type of finish: to CAN/CGSB-44.227, laminates.

.3 Components to be interchangeable right-to-left and left-to right.

.4 Provide cord and cable management capability with reusable covers for each grommet.

.5 Horizontal work surfaces: to CAN/CGSB-44.227.

- .1 Specular gloss: no more than 45 units.
- .2 Width and depth dimensions:
  - .1 Width: 914mm.
  - .2 Depth: 457mm.
  - .3 Fixed height: 730 +/- 25 mm when measured from the floor.
  - .4 Incremental adjustment: no more than 25 mm.
- .3 Type of supports: legs complete with levelling mechanism with vertical adjustment of at least 25 mm.

.6 Preparation for delivery: to CAN/CGSB-44.227 conform to normal commercial practice.

2.3 FREESTANDING MOBILE STORAGE UNITS

.1 Office desks products and components: to CAN/CGSB-44.227.

.2 Type of finish: to CAN/CGSB-44.227, laminates.

.3 Mobile: 381mm x 457mm x 635mm height.

.4 Box/file configuration. File drawer includes file hanging rails.

.5 Casters: minimum of four carpet casters with locking device on two front casters.

.6 Lockable.

2.4 FREESTANDING MOBILE CHECK IN COUNTER

.1 Counter products and components: to CAN/CGSB-44.227.

.2 Type of finish: to CAN/CGSB-44.227, laminates.

.3 Mobile: 600mm x 1500mm x 1200mm height (2 no) and 600mm x 800mm x 1200mm height (1no)

.4 High level transaction counter 300mm deep, standard surface 600mm deep. Box/file configuration.

.5 Casters: minimum of four heavy duty carpet casters with locking device on all casters.

.6 Lockable.

2.5 STEEL SHELVING UNIT

.1 Steel shelving unit, 18” /450mmx 48”/1220mm x 97”/2460mm, equal to Item #WB796381 by global industrial.ca.

.1 Roll-formed, ribbed steel shelves with box beam reinforced edges.
.2 Quad clips to secure shelves to uprights with adjustment on 1" centers.
.3 Heavy duty 14 gauge steel uprights support shelves.
.4 Closed side and back panels retain loads.
.5 Gray baked enamel with anticorrosion undercoat.
.6 Unit includes 4 uprights, 5 shelves, 4 quad clips per shelf, 1 back and 2 side panels plus all required nuts and bolts.

2.6 GANGED SEATING

.1 Waiting Area Seating: to ANSI/BIWFMA X5.1 and CAN/CGSB-44.232.

.1 Type II: non-tilt seat: fixed back.
.2 Features: to CAN/CGSB-44.232.
.3 Upholstery: to CAN/CGSB-44.232.
.1 Fabric to meet heavy duty rating for abrasion resistance. To be selected by NRC Departmental Representative from manufacturer's standard range.
.4 Armrests: to CAN/CGSB-44.232.
.1 Supply chair with fixed armrests.
.5 Preparation for delivery: conform to normal commercial practice.

.2 Acceptable Material.

.1 Bernu Aero Wood by Arconas:
.1 Area 125: Wood seat and back, die-cast aluminium supports, legs, arms and beam.
.2 Arm: Cantalever type, with moulded urethane pad.
.3 Ganged layout as indicated on drawings.

.3 Acceptable Material.

.1 Bernu Aero by Arconas:
.1 Area 135: Contoured steel pan with foam pad seat and back, die-cast aluminium supports, legs, arms and beam.
.2 Arm: Cantalever type, with moulded urethane pad.
.3 Ganged layout as indicated on drawings.

2.7 JANITOR'S CART

.1 Acceptable Material:

.1 Rubbermaid: 6173-88 Cleaning Cart.

.2 Two (2) in total.

2.8 FABRICATION

.1 Manufacture furniture to allow for dismantling and replacing of worn or defective components and recycling options following first use.

.1 Fabricate furniture to allow for remanufacturing or refurbishing of furniture following first use.

.2 Seal exposed surfaces of particleboard constructed with urea formaldehyde adhesives to contain formaldehyde emissions.

Part 3 Execution

3.1 NOT USED

.1 Not used.

END OF SECTION

Part 1 General

1.1 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 and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop drawings:

.1 Drawings to show:

.1 Mounting arrangements.

.2 Operating and maintenance clearances.

.2 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.

.3 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.

1.2 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 Operation and maintenance manual approved by, and final copies deposited with, NRC Departmental Representative before final inspection.

.2 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.

.3 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.

.4 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.

.4 Testing, adjusting and balancing reports as specified in Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.

.5 Approvals:

.1 Submit [2] copies of draft Operation and Maintenance Manual to NRC Departmental Representative for approval. Submission of individual data will not be accepted unless directed by NRC Departmental Representative.

.2 Make changes as required and re-submit as directed by NRC Departmental Representative.

.6 Additional data:

.1 Prepare and insert into operation and maintenance manual additional data when need for it becomes apparent during specified demonstrations and instructions.

.7 Site records:

.1 NRC Departmental Representative will provide [1] set of reproducible mechanical drawings. Provide sets of white prints as required for each phase of work. Mark changes as work progresses and as changes occur. Include changes to existing mechanical systems, control systems and low voltage control wiring.

.2 Transfer information weekly to reproducibles, revising reproducibles to show work as actually installed.

.3 Use different colour waterproof ink for each service.

.4 Make available for reference purposes and inspection.

.8 As-Built drawings:

.1 Prior to start of Testing, Adjusting and Balancing for HVAC, 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 NRC Departmental Representative for approval and make corrections as directed.

.4 Perform testing, adjusting and balancing for HVAC using as-built drawings.

.5 Submit completed reproducible as-built drawings with Operating and Maintenance Manuals.

.9 Submit copies of as-built drawings for inclusion in final TAB report.

1.3 MAINTENANCE MATERIAL SUBMITTALS

.1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

.2 Furnish spare parts as follows:

.1 One set of packing for each pump.

.2 One casing joint gasket for each size pump.

.3 One head gasket set for each heat exchanger.

.4 One glass for each gauge glass.

.5 One filter cartridge or set of filter media for each filter or filter bank in addition to final operating set.

.3 Provide one set of special tools required to service equipment as recommended by manufacturers.

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

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.

.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 from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

.4 Packaging Waste Management: remove for reuse and return of pallets, crates, padding, packaging materials as specified in Construction Waste Management Plan in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

Part 2 Products

2.1 MATERIALS

.1 HVAC R Equipment:

.1 Refrigerant:

.1 HCFC based refrigerant.

.2 HFC based refrigerant.

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 NRC Departmental Representative.

.2 Inform NRC 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 NRC Departmental Representative.

3.2 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.

3.3 SYSTEM CLEANING

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

3.4 TEMPORARY USE OF SYSTEMS

.1 Building HVAC systems are not to be used for heating or cooling during construction.

3.5 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 - ACTION AND INFORMATIONAL SUBMITTALS.

.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.

3.6 DEMONSTRATION

.1 NRC Departmental Representative will use equipment and systems for test purposes prior to acceptance. Supply labour, material, and instruments required for testing.

.2 Trial usage to apply to following equipment and systems:

.1 Chiller

.2 Cooling Tower

.3 Air handlers

.4 Pumps

.5 Automation system

.3 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.

.4 Use operation and maintenance manual, as-built drawings, and audio visual aids as part of instruction materials.

.5 Instruction duration time requirements as specified in appropriate sections.

.6 NRC Departmental Representative will record these demonstrations on video tape for future reference.

3.7 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 recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.8 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 REFERENCES

.1 Department of National Defence Canada (DND)/Infrastructure and Environment/Construction and Property Services

.1 Canadian Forces Fire Marshal (CFFM).

.2 Fire Commissioner of Canada (FC)

1.2 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 fire extinguishing systems and include product characteristics, performance criteria, physical size, finish and limitations.

1.3 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

.2 Operation and Maintenance Data: submit operation and maintenance data for dry chemical fire extinguishing systems for incorporation into manual.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.

.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 fire extinguishing systems from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

.4 Develop Construction Waste Management Plan related to Work of this Section

.5 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, packaging materials as specified in Construction Waste Management Plan in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

Part 2 Products

2.1 COMPONENTS

.1 UL listed dry chemical fire extinguisher. 3-A: 40-B:C

- .1 Steel cylinder, plated brass valve, stainless steel handle/lever
- .2 Complete with wall-bracket mounting.

.2 Fire extinguisher cabinets:

- .1 Recessed cabinets with glass door and full piano hinge, flush stainless steel latch, finished with baked enamel paint.
  - .1 National Fire Equipment CE-950-3
  - .2 229mmx610mmx152mm

Part 3 Execution

3.1 INSTALLATION

.1 Install in accordance with National Fire Code and Authority Having Jurisdiction.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Submit manufacturer's printed product literature, specifications and data sheet for fixtures and equipment.

.2 Submit WHMIS MSDS in accordance with Section 02 81 01 - Hazardous Materials. Indicate VOC's for adhesive and solvents during application and curing.

.3 Shop Drawings.

.1 Submit shop drawings to indicate:

.1 Equipment, including connections, fittings, control assemblies and ancillaries. Identify whether factory or field assembled.

.2 Wiring and schematic diagrams.

.3 Dimensions and recommended installation.

.4 Pump performance and efficiency curves.

.4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.5 Instructions: submit manufacturer's installation instructions.

.6 Manufacturers' Field Reports: manufacturers' field reports specified.

.7 Closeout submittals: submit maintenance and engineering data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals, include:

.1 Manufacturers name, type, model year, capacity and serial number.

.2 Details of operation, servicing and maintenance.

.3 Recommended spare parts list with names and addresses.

1.3 QUALITY ASSURANCE

.1 Pre-Installation Meeting:.

.1 Convene pre-installation meeting one week prior to beginning work of this Section.

.1 Verify project requirements.

.2 Review installation and substrate conditions.

.3 Co-ordination with other building subtrades.

.4 Review manufacturer's installation instructions and warranty requirements.

.2 Health and Safety:

.1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Waste Management and Disposal:

.1 Separate waste materials for recycling in accordance with Section 01 47 19 - Construction/Demolition Waste Management and Disposal.

.2 Remove from site and dispose of packaging materials at appropriate recycling facilities.

.3 Collect and separate for disposal paper plastic polystyrene corrugated cardboard packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.

.4 Divert unused metal materials from landfill to metal recycling facility as approved by NRC Departmental Representative.

.5 Unused sealant materials must not be disposed of into sewer system, into streams, lakes, onto ground or in other location where it will pose health or environmental hazard.

.6 Fold up metal and plastic banding, flatten and place in designated area for recycling.

Part 2 Products

2.1 DOMESTIC HOT WATER CIRCULATING PUMPS

.1 Capacity: as indicated.

.2 Construction: closed-coupled, in-line centrifugal, all bronze construction, stainless steel shaft, stainless steel or bronze shaft sleeve, two oil lubricated bronze sleeves or ball bearings. Design for 57kPa and 105 degrees C continuous service.

.3 Motor: drip-proof, with thermal overload protection.

.4 Supports: provide as recommended by manufacturer.

2.2 SUMP PUMP SUBMERSIBLE

.1 Capacity: as indicated.

.2 Construction: duplex CSA approved, housing epoxy coated cast iron, bronze fitted stainless steel stainless steel shaft, non-clog bronze impeller, mechanical shaft seal.

.3 Motor: hermetically sealed, with automatic overload protection.

.4 Control: mercury switches and duplex control box.

2.3 BILGE AND SEWAGE PUMP

.1 Capacity: as indicated.

.2 Construction: duplex, vertical extended shaft, single stage centrifugal, designed to handle 50 mm solids and for sump depth as indicated bronze fitted.

.3 Motor: drip-proof, with overload and under voltage protection.

.4 Control: copper ball float operated heavy duty switch. Starter switch on cover plate. Automatic electric alternator with selector relays to alternate or activate both pumps. Adjustable float stops on stainless steel rod.

.5 Alarm: audible and visual alarm located as indicated controlled by float or pressure operated switch.

.6 Sump: fibreglass reinforced plastic one piece, to manufacturers standard, with heavy bituminous coating inside and out.

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 data sheet.

3.2 INSTALLATION

.1 Make piping and electrical connections to pump and motor assembly and controls as indicated.

.2 Ensure pump and motor assembly do not support piping.

.3 Align vertical pit mounted pump assembly after mounting and securing cover plate.

3.3 FIELD QUALITY CONTROL

.1 Site Tests/Inspection:

.1 Check power supply.

.2 Check starter protective devices.

.2 Start-up, check for proper and safe operation.

.3 Check settings and operation of hand-off-auto selector switch, operating, safety and limit controls, audible and visual alarms, over-temperature and other protective devices.

.4 Adjust flow from water-cooled bearings.

.5 Adjust impeller shaft stuffing boxes, packing glands.

3.4 START-UP

.1 General:

.1 In accordance with Section 01 91 13 - General Commissioning (Cx) Requirements: General Requirements, supplemented as specified herein.

.2 Procedures:

.1 Check power supply.

.2 Check starter O/L heater sizes.

.3 Start pumps, check impeller rotation.

.4 Check for safe and proper operation.

.5 Check settings, operation of operating, limit, safety controls, over-temperature, audible/visual alarms, other protective devices.

.6 Test operation of hands-on-auto switch.

.7 Test operation of alternator.

.8 Adjust leakage through water-cooled bearings.

.9 Adjust shaft stuffing boxes.

.10 Adjust leakage flow rate from pump shaft stuffing boxes to manufacturer's recommendations.

.11 Check base for free-floating, no obstructions under base.

.12 Run-in pumps for 12 continuous hours.

.13 Check installation, operation of mechanical seals, packing gland type seals. Adjust as necessary.

.14 Adjust alignment of piping and conduit to ensure full flexibility.

.15 Eliminate causes of cavitation, flashing, air entrainment.

.16 Measure pressure drop across strainer when clean and with flow rates as finally set.

.17 Replace seals if pump used to degrease system or if pump used for temporary heat.

.18 Verify lubricating oil levels.

3.5 PERFORMANCE VERIFICATION (PV) PRESSURE BOOSTER PUMPS

.1 General:

.1 In accordance with Section 01 91 13 - General Commissioning (Cx) Requirements: General Requirements, supplemented as specified.

.2 Obtain manufacturer's approval, before performing PV, to ensure warranties remain intact.

.3 Application tolerances:

.1 Flow: +/- 10%.

.2 Pressure: Plus 20%, minus 5%.

.4 PV procedures:

.1 Open pump balancing valve fully.

.2 Measure differential pressure (DP) across pump.

.3 Measure amperage and voltage and compare with manufacturer's data sheets and motor nameplate data.

.4 If suction is different size than discharge connection, add velocity head correction factor to DP.

.5 Mark this DP on manufacturer's pump curve.

.6 If flow rate is higher than specified, slow close balancing valve until specified DP is reached.

.7 Repeat measurements of amps and volts. Compare with manufacturer's data sheets.

.8 Calculate BHP and compare with nameplate data.

3.6 PV - SANITARY PUMPS

.1 Application tolerances:

.1 Flow: plus 10%; minus 0%.

.2 Pressure: plus 10%; Minus 5%.

.2 PV Procedures:

.1 Fill sump at rate slower than capacity of pump #1.

.2 Record levels at which pump #1 starts and stops. Determine flow rate by observing time taken to down water level.

.3 Fill sump at rate faster than capacity of pump #1 but slower than capacities of pumps #1 and #2 operating in parallel.

.4 Record levels at which pumps start and stop - water level rising and water level falling.

.5 Verify operation of alternator.

.6 Adjust water level controls as necessary.

.7 Fill sump at rate faster than capacities of pumps #1 and #2 operating in parallel.

.8 Record levels at pump starts and stops - water level rising and falling.

.9 Check operation of alternator.

.10 Adjust level controls as necessary.

.11 Check level at which high water level alarm starts and stops. Adjust as necessary.

.3 Check removability of pumps for servicing without interfering with installation or operation of other equipment.

.4 Verify non-clog capability and maximum size of solids, using procedures recommended by manufacturer.

3.7 REPORTS

.1 In accordance with Section 01 91 13 - General Commissioning (Cx) Requirements: reports, supplemented as specified.

.2 Include:

.1 PV results on approved PV Report Forms.

.2 Product Information report forms.

.3 Pump performance curves (family of curves) with final point of actual performance.

3.8 TRAINING

.1 In accordance with Section 01 91 13 - General Commissioning (Cx) Requirements: Training of O M Personnel, supplemented as specified.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 American National Standards Institute (ANSI)/American Society of Mechanical Engineers International (ASME)

- .1 ANSI/ASME B16.15- 06 , Cast Bronze Threaded Fittings, Classes 125 and 250.
- .2 ANSI/ASME B16.18- 01 , Cast Copper Alloy Solder Joint Pressure Fittings.
- .3 ANSI/ASME B16.22- 01 , Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
- .4 ANSI/ASME B16.24- 01 , Cast Copper Alloy Pipe Flanges and Flanged Fittings, Class 150, 300, 400, 600, 900, 1500 and 2500.

.2 ASTM International Inc.

- .1 ASTM A307- 07b , Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
- .2 ASTM A536- 84(2004)e1 , Standard Specification for Ductile Iron Castings.
- .3 ASTM B88M- 05 , Standard Specification for Seamless Copper Water Tube (Metric).

.3 American National Standards Institute/American Water Works Association (ANSI)/(AWWA)

- .1 ANSI/AWWA C111/A21.11- 07 , Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.

.4 Canadian Standards Association (CSA International)

- .1 CSA B242- 05 , Groove and Shoulder Type Mechanical Pipe Couplings.

.5 Department of Justice Canada (Jus)

- .1 Canadian Environmental Protection Act, 1999, c. 33 (CEPA).

.6 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

- .1 Material Safety Data Sheets (MSDS).

.7 Manufacturer's Standardization Society of the Valve and Fittings Industry (MSS).

- .1 MSS-SP-67- 02a , Butterfly Valves.
- .2 MSS-SP-70- 06 , Gray Iron Gate Valves, Flanged and Threaded Ends.
- .3 MSS-SP-71- 05 , Gray Iron Swing Check Valves, Flanged and Threaded Ends.
- .4 MSS-SP-80- 03 , Bronze Gate, Globe, Angle and Check Valves.

.8 National Research Council (NRC)/Institute for Research in Construction

- .1 NRCC 38728, National Plumbing Code of Canada (NPC) - 1995 .

.9 Transport Canada (TC)

- .1 Transportation of Dangerous Goods Act, 1992, c. 34 (TDGA).

1.2 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 datasheets for insulation and adhesives, and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Closeout Submittals:

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

1.3 DELIVERY, STORAGE AND HANDLING

.1 Packaging Waste Management: remove for return of pallets crates padding packaging materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

.2 Place materials defined as hazardous or toxic in designated containers.

.3 Handle and dispose of hazardous materials in accordance with CEPA, TDGA, Regional and Municipal regulations.

Part 2 Products

2.1 PIPING

.1 Domestic hot, cold and recirculation systems, within building.

.1 Above ground: copper tube, hard drawn, type L: to ASTM B88M.

.2 Buried or embedded: copper tube, soft annealed, type K: to ASTM B88M, in long lengths and with no buried joints.

2.2 FITTINGS

.1 Bronze pipe flanges and flanged fittings, Class 150: to ANSI/ASME B16.24.

.2 Cast bronze threaded fittings, Class 125: to ANSI/ASME B16.15.

.3 Cast copper, solder type: to ANSI/ASME B16.18.

.4 Wrought copper and copper alloy, solder type: to ANSI/ASME B16.22.

.5 NPS 2 and larger: ANSI/ASME B16.18 or ANSI/ASME B16.22 roll grooved to CSA B242.

.6 NPS 1 and smaller : wrought copper to ANSI/ASME B16.22. Suitable for operating pressure to 1380 kPa.

2.3 JOINTS

.1 Bolts, nuts, hex head and washers: to ASTM A307, heavy series.

.2 Solder: 95/5 tin copper alloy.

.3 Teflon tape: for threaded joints.

.4 Dielectric connections between dissimilar metals: dielectric fitting, complete with thermoplastic liner.

2.4 GATE VALVES

.1 NPS 2 and under, soldered:

.1 Rising stem: to MSS-SP-80, Class 125, 860 kPa, bronze body, screw-in bonnet, solid wedge disc as specified Section 23 05 23.01 - Valves - Bronze.

.2 NPS 2 and under, screwed:

.1 Rising stem: to MSS-SP-80, Class 125, 860 kPa, bronze body, screw-in bonnet, solid wedge disc as specified Section 23 05 23.01 - Valves - Bronze.

.3 NPS 2 1/2 and over, in mechanical rooms, flanged:

.1 Rising stem: to MSS-SP-70, Class 125, 860 kPa, flat flange faces, cast-iron body, OS Y bronze trim specified Section 23 05 23.02 - Valves - Cast Iron.

.4 NPS 2 1/2 and over, other than mechanical rooms, flanged:

.1 Non-rising stem: to MSS-SP-70, Class 125, 860 kPa, flat flange faces, cast-iron body, bronze trim, bolted bonnet specified Section 23 05 23.02 - Valves - Cast Iron: Gate, Globe, Check.

2.5 GLOBE VALVES

.1 NPS2 and under, soldered:

.1 To MSS-SP-80, Class 125, 860 kPa, bronze body, renewable composition disc, screwed over bonnet as specified Section 23 05 23.01 - Valves - Bronze.

.2 Lockshield handles: as indicated.

.2 NPS 2 and under, screwed:

.1 To MSS-SP-80, Class 150, 1 MPa, bronze body, screwed over bonnet, renewable composition disc as specified Section 23 05 23.01 - Valves - Bronze.

.2 Lockshield handles: as indicated.

2.6 SWING CHECK VALVES

.1 NPS 2 and under, soldered:

.1 To MSS-SP-80, Class 125, 860 kPa, bronze body, bronze swing disc, screw in cap, regrindable seat as specified Section 23 05 23.01 - Valves - Bronze.

.2 NPS 2 and under, screwed:

.1 To MSS-SP-80, Class 125, 860 kPa, bronze body, bronze swing disc, screw in cap, regrindable seat as specified Section 23 05 23.01 - Valves - Bronze.

.3 NPS 2 1/2 and over, flanged:

.1 To MSS-SP-71, Class 125, 860 kPa, cast iron body, flat flange faces, regrindable seat, bronze disc, bolted cap specified Section 23 05 23.02 - Valves - Cast Iron: Gate, Globe, Check.

2.7 BALL VALVES

.1 NPS 2 and under, screwed:

.1 Class 150.

.2 Forged Brass body, chrome plated brass ball, PTFE adjustable packing, brass gland and PTFE seat, steel lever handle as specified Section 23 05 23.01 - Valves - Bronze.

.2 NPS 2 and under, soldered:

.1 To ANSI/ASME B16.18, Class 150.

.2 Bronze body, chrome plated brass ball, PTFE adjustable packing, brass gland and PTFE seat, steel lever handle, with NPT to copper adaptors as specified Section 23 05 23.01 - Valves - Bronze.

2.8 BUTTERFLY VALVES

.1 NPS 2-1/2 and over, wafer:

.1 To MSS-SP-67, Class 200.

.2 Cast iron body, ductile iron chrome plated disc, stainless steel stem, EPT liner.

.3 Lever operated , NPS8 and over, gear operated.

.2 NPS 2-1/2 and over, grooved ends:

.1 Class 300 psig CWP, bubble tight shut-off, bronze body EPDM coated ductile iron disc with integrally cast stem.

.2 Operator:

.1 NPS 4 and under: lever handle.

.2 NPS 6 and over: gear operated.

Part 3 Execution

3.1 APPLICATION

.1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 INSTALLATION

.1 Install in accordance with NPC.

.2 Install pipe work in accordance with Section 23 05 05 - Installation of Pipework, supplemented as specified herein.

.3 Assemble piping using fittings manufactured to ANSI standards.

.4 Install CWS piping below and away from HWS and HWC and other hot piping so as to maintain temperature of cold water as low as possible.

.5 Connect to fixtures and equipment in accordance with manufacturer's written instructions unless otherwise indicated.

.6 Buried tubing:

.1 Lay in well compacted washed sand in accordance with AWWA Class B bedding.

.2 Bend tubing without crimping or constriction. Minimize use of fittings.

3.3 VALVES

.1 Isolate equipment, fixtures and branches with ball valves.

.2 Balance recirculation system using lockshield globe valves. Mark settings and record on as-built drawings on completion.

3.4 PRESSURE TESTS

.1 Conform to requirements of Section 21 05 01 - Common Work Results for Mechanical.

.2 Test pressure: greater of 1 times maximum system operating pressure or 860 kPa.

3.5 FLUSHING AND CLEANING

.1 Flush entire system for 8 h. Ensure outlets flushed for 2 hours. Let stand for 24 hours, then draw one sample off longest run. Submit to testing laboratory to verify that system is clean copper to Federal potable water guidelines. Let system flush for additional 2 hours, then draw off another sample for testing.

3.6 PRE-START-UP INSPECTIONS

.1 Systems to be complete, prior to flushing, testing and start-up.

.2 Verify that system can be completely drained.

.3 Ensure that pressure booster systems are operating properly.

.4 Ensure that air chambers, expansion compensators are installed properly.

3.7 DISINFECTION

.1 Flush out, disinfect and rinse system to approval of NRC Departmental Representative.

.2 Upon completion, provide laboratory test reports on water quality for NRC Departmental Representative approval.

3.8 START-UP

.1 Timing: start up after:

.1 Pressure tests have been completed.

.2 Disinfection procedures have been completed.

.3 Certificate of static completion has been issued.

.4 Water treatment systems operational.

.2 Provide continuous supervision during start-up.

.3 Start-up procedures:

.1 Establish circulation and ensure that air is eliminated.

.2 Check pressurization to ensure proper operation and to prevent water hammer, flashing and/or cavitation.

.3 Bring HWS storage tank up to design temperature slowly.

.4 Monitor piping HWS and HWC piping systems for freedom of movement, pipe expansion as designed.

.5 Check control, limit, safety devices for normal and safe operation.

.4 Rectify start-up deficiencies.

3.9 PERFORMANCE VERIFICATION

.1 Scheduling:

.1 Verify system performance after pressure and leakage tests and disinfection are completed, and Certificate of Completion has been issued by authority having jurisdiction.

.2 Procedures:

.1 Verify that flow rate and pressure meet Design Criteria.

.2 TAB HWC in accordance with Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.

.3 Adjust pressure regulating valves while withdrawal is maximum and inlet pressure is minimum.

.4 Sterilize HWS and HWC systems for Legionella control.

.5 Verify performance of temperature controls.

.6 Verify compliance with safety and health requirements.

.7 Check for proper operation of water hammer arrestors. Run one outlet for 10 seconds, then shut of water immediately. If water hammer occurs, replace water hammer arrestor or re-charge air chambers. Repeat for outlets and flush valves.

.8 Confirm water quality consistent with supply standards, and ensure no residuals remain as result of flushing or cleaning.

.3 Reports:

.1 In accordance with Section 01 91 13 - General Commissioning (Cx) Requirements: Reports, using report forms as specified in Section 01 91 13 - General Commissioning (Cx) Requirements: Report Forms and Schematics.

.2 Include certificate of water flow and pressure tests conducted on incoming water service, demonstrating adequacy of flow and pressure.

3.10 OPERATION REQUIREMENTS

.1 Co-ordinate operation and maintenance requirements including, cleaning and maintenance of specified materials and products with Section 23 05 05 - Installation of Pipework.

3.11 CLEANING

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

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

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 ASTM International Inc.

.1 ASTM B32- 08 , Standard Specification for Solder Metal.

.2 ASTM B306- 02 , Standard Specification for Copper Drainage Tube (DWV).

.3 ASTM C564- 03a , Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings.

.2 Canadian Standards Association (CSA International).

.1 CSA B67- 1972(R1996) , Lead Service Pipe, Waste Pipe, Traps, Bends and Accessories.

.2 CAN/CSA-B70- 06 , Cast Iron Soil Pipe, Fittings and Means of Joining.

.3 CAN/CSA-B125.3- 05 , Plumbing Fittings.

.3 Green Seal Environmental Standards (GSES)

.1 Standard GS-36- 00 , Commercial Adhesives.

.4 South Coast Air Quality Management District (SCAQMD), California State

.1 SCAQMD Rule 1168- A2005 , Adhesive and Sealant Applications.

1.2 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 datasheets for adhesives, and include product characteristics, performance criteria, physical size, finish and limitations.

1.3 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.

.2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

.3 Packaging Waste Management: remove for return of pallets crates padding packaging materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

Part 2 Products

2.1 COPPER TUBE AND FITTINGS

.1 Above ground sanitary storm and vent Type DWV to: ASTM B306.

.1 Fittings.

.1 Cast brass: to CAN/CSA-B125.3.

.2 Wrought copper: to CAN/CSA-B125.3.

.2 Solder: lead free 95:5, type TA, to ASTM B32.

2.2 CAST IRON PIPING AND FITTINGS

.1 Buried sanitary storm and vent minimum NPS 3, to: CAN/CSA-B70, with one layer of protective coating.

.1 Joints:

.1 Mechanical joints:

.1 Neoprene or butyl rubber compression gaskets: to CAN/CSA-B70.

.2 Above ground sanitary storm and vent: to CAN/CSA-B70.

.1 Joints:

.1 Mechanical joints:

.1 Neoprene or butyl rubber compression gaskets with stainless steel clamps.

Part 3 Execution

3.1 APPLICATION

.1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 INSTALLATION

.1 In accordance with Section 23 05 05 - Installation of Pipework.

.2 Install in accordance with National Plumbing Code.

3.3 TESTING

.1 Pressure test buried systems before backfilling.

.2 Hydraulically test to verify grades and freedom from obstructions.

3.4 PERFORMANCE VERIFICATION

.1 Cleanouts:

.1 Ensure accessible and that access doors are correctly located.

.2 Open, cover with linseed oil and re-seal.

.3 Verify that cleanout rods can probe as far as the next cleanout, at least.

.2 Test to ensure traps are fully and permanently primed.

.3 Storm water drainage:

.1 Verify domes are secure.

.2 Ensure weirs are correctly sized and installed correctly.

.3 Verify provisions for movement of roof system.

.4 Ensure that fixtures are properly anchored, connected to system and effectively vented.

.5 Affix applicable label (storm, sanitary, vent, pump discharge etc.) c/w directional arrows every floor or 4.5 m (whichever is less).

3.5 CLEANING

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

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

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 American Society of Mechanical Engineers (ASME)

.1 ASME Boiler and Pressure Vessel Code Section VIII Pressure Vessels.

.1 BPVC-VIII B - 2004 , BPVC Section VIII - Rules for Construction of Pressure Vessels Division 1.

.2 BPVC-VIII-2 B - 2004 , BPVC Section VIII - Rules for Construction of Pressure Vessels Division 2 - Alternative Rules.

.3 BPVC-VIII-3 B - 2004 , BPVC Section VIII - Rules for Construction of Pressure Vessels Division 3 - Alternative Rules High Press Vessels.

.2 ASME B16.5- 03 , Pipe Flanges and Flanged Fittings.

.3 ASME B16.11- 01 , Forged Fittings, Socket-Welding and Threaded.

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

.1 ASTM A53/A53M- 04 , Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.

.2 ASTM A181/A181M- 01 , Standard Specification for Carbon Steel Forgings for General Purpose Piping.

.3 Canadian Standards Association (CSA International)

.1 CSA B51- 03 , Boiler, Pressure Vessel, and Pressure Piping Code.

.4 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet for piping, fittings and equipment.

.2 Submit WHMIS MSDS in accordance with Section 02 81 01 - Hazardous Materials. Indicate VOC's for adhesive and solvents during application and curing.

.3 Shop Drawings:

.1 Submit shop drawings to indicate project layout including layout, dimensions and extent of piping system.

.1 Vertical and horizontal piping locations and elevations and connections details.

.2 Test Reports: submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.

.3 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.4 Instructions: submit manufacturer's installation instructions.

.5 Closeout Submittals: submit maintenance and engineering data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals include data as follows:

1.3 QUALITY ASSURANCE

.1 Pre-Installation Meeting:

.1 Convene pre-installation meeting one week prior to beginning work of this Section.

.1 Verify project requirements.

.2 Review installation and substrate conditions.

.3 Co-ordination with other building subtrades.

.4 Review manufacturer's installation instructions and warranty requirements.

.2 Health and Safety:

.1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Waste Management and Disposal:

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

.2 Remove from site and dispose of packaging materials at appropriate recycling facilities.

.3 Collect and separate for disposal paper plastic polystyrene corrugated cardboard packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan (WMP).

.4 Separate for recycling and place in designated containers Steel Metal Plastic waste in accordance with Waste Management Plan (WMP).

.5 Handle and dispose of hazardous materials in accordance with CEPA, TDGA, Regional and Municipal, regulations.

.6 Divert unused metal materials from landfill to metal recycling facility as approved by NRC Departmental Representative.

Part 2 Products

2.1 AIR COMPRESSOR

.1 General: Two stage, air-cooled, reciprocating, horizontal, tank-mounted, V-belt driven.

.2 Motor: standard protected.

.3 Control:

.1 Manual control with H-0-A starter switch.

.2 Pressure switch to cut out at 688 kPa and with minimum differential pressure.

.4 Accessories: belt guard and pressure gauges. Complete with discharge check valve.

.5 Air intakes: complete with bird screen, replaceable cartridge type intake filter and silencer.

.6 Capacity: 11L/s of free air. 688 kPa at 1750 r/min. 2hp, 600V/3PH

.7 Vibration isolation: 95% minimum efficiency.

2.2 AIR RECEIVER

.1 76 Liter, ASME stamped tank

.2 Accessories: adjustable pressure regulator, safety valve, 125 mm diameter gauge with pressure range of 0 to 1500 kPa, drain cock and automatic condensate trap.

.3 Provincial inspector's certificate and label.

.4 Finish: shop primed, ready for field painting.

2.3 REFRIGERATED AIR DRYER

.1 Self-contained, hermetically sealed, complete with air cooled heat exchanger, compressor, automatic controls, moisture removal trap, wiring, piping and refrigerant charge.

.2 Inlet and outlet connections to be factory insulated.

.3 Capacity:

.1 13 L/s at compressor air saturated at 38°C and 688kPa and operating in a 38°C ambient environment.

.2 Size to operate at 40% of time at design capacity.

.4 Electrical supply: 120V, 1 phase, 60cycle.

2.4 COMBINATION FILTER-REGULATOR

.1 Factory assembled, heavy-duty with mounting bracket and low pressure side relief valve.

.2 Maximum inlet pressure: 800 kPa.

.3 Operating temperature: minus 18 degrees C to plus 52 degrees C.

.4 Filter element: 40 micron. Bowls: polycarbonate.

.5 Pressure range in regulator: 34 kPa to 800 kPa.

.6 Gauge range: 0 kpa to 1100 kPa.

2.5 PIPING

.1 Piping: to ASTM A53/A53M, schedule 80 seamless black steel.

.2 Fittings:

.1 NPS2 and smaller: to ASME B16.11, schedule 80 steel, socket welded.

.2 NPS2 1/2 and larger: to ASME B16.11, schedule 80 steel, butt or socket welded.

.3 Couplings: to ASME B16.11, socket welded or threaded half coupling type.

.4 Unions: 1000 kPa malleable iron with brass-to-iron ground seat.

.5 Dissimilar metal junctions: use dielectric unions.

.6 Flanges:

.1 NPS2 and smaller: to ASME B16.5, forged steel, raised face and socket welded.

.2 NPS2 1/2 and larger: to ASME B16.5, forged steel, raised face and slip-on or weld neck.

.7 Joints:

.1 NPS2 and smaller: socket welded.

.2 NPS2 1/2 and larger: butt welded.

2.6 BALL VALVES

.1 Three piece design or top entry for ease of in-line maintenance.

.1 To ASTM A181/A181M, Class 70, carbon steel body screwed ends, carbon steel ball and associated trim suitable for compressed air application.

.2 To withstand 1034 kPa maximum pressure.

2.7 COUPLERS/CONNECTORS

.1 Industrial interchange series, full-bore.

.2 Maximum inlet pressure: 1700 kPa.

.3 Valve seat: moulded nylon.

.4 Body: zinc plated steel.

.5 Threads: NPT.

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 COMPRESSOR STATION

.1 Install on vibration isolators on housekeeping pad as indicated.

3.3 REFRIGERATED AIR DRYER

.1 Install on three-valve bypass.

.2 Install tee connection after dryer for emergency connection to instrument control air system.

3.4 COMPRESSED AIR LINE FILTER

.1 Install on discharge line from refrigerated air dryer.

3.5 MAIN AIR PRESSURE REGULATORS

.1 Install at air compressor station.

.2 Install additional regulators on connections to equipment.

3.6 COMPRESSED AIR PIPING CONNECTIONS AND INSTALLATION

.1 Install flexible connection in accordance with Section 23 05 16 - Expansion Fittings and Loops for HVAC Piping.

.2 Install shut-off valves at outlets, major branch lines and in locations as indicated.

.3 Install quick-coupler chucks and pressure gauges on drop pipes.

.4 Install unions to permit removal or replacement of equipment.

.5 Install tees in lieu of elbows at changes in direction of piping. Install plug in open ends of tees.

.6 Grade piping at 1% slope minimum.

.7 Install compressed air trap and pressure equalizing pipe at moisture collecting points. Drain pipe to nearest floor drain.

.8 Make branch connections from top of main.

.9 Install compressed air trap at bottom of risers and at low points in mains, piped to nearest drain. Distance between drain points to be 30 m maximum.

.10 Provide drain from refrigerated air dryer.

.11 Weld steel piping in accordance with Section 23 05 17 - Pipe Welding and;

.1 To ASME code and requirements of authority having jurisdiction.

.2 Weld concealed and inaccessible piping regardless of size.

3.7 FIELD QUALITY CONTROL

.1 Site Tests/Inspection:

.1 Testing: pressure test in accordance with requirements of Section 21 05 01 - Common Work Results for Mechanical, for 4 h minimum, to 1100 kPa, with outlets closed and with compressor isolated from system. Pressure drop not to exceed 10 kPa.

.2 Manufacturer's Field Services:

.1 Have manufacturer of products supplied under this Section review work involved in handling, installation/application, protection and cleaning of its product s , and submit written reports, in acceptable format, to verify compliance of work with Contract.

.2 Provide manufacturer's field services, consisting of product use recommendations and periodic site visits for inspection of product installation, in accordance with manufacturer's instructions.

.3 Schedule site visits to review work at stages listed:

.1 After delivery and storage of products, and when preparatory work on which work of this Section depends is complete, but before installation begins.

.2 Twice during progress of work at 25% and 60% complete.

.3 Upon completion of Work, after cleaning is carried out.

.3 Obtain reports within 3 days of review and submit immediately to NRC Departmental Representative.

3.8 CLEANING

.1 Refer to Section 23 08 01 - Performance Verification of Mechanical Piping Systems.

.2 Cleaning: blow out piping to clean interior thoroughly of oil and foreign matter.

.3 Check entire installation is approved by authority having jurisdiction.

.4 Perform cleaning operations in accordance with manufacturer's recommendations.

.5 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CSA B51- 03(R2007) , Boiler, Pressure Vessel, and Pressure Piping Code.

.2 CAN/CSA C22.2 No.110- 94(R2004) , Construction and Test of Electric Storage Tank Water Heaters.

.3 CAN/CSA-C191- 04 , Performance of Electric Storage Tank Water Heaters for Household Service.

.4 CAN/CSA-C309- M90(R2003) , Performance Requirements for Glass-Lined Storage Tanks for Household Hot Water Service.

1.2 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 datasheets for domestic water heater, and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:

.1 Indicate:

.1 Equipment, including connections, fittings, control assemblies and ancillaries, identifying factory and field assembled.

1.3 CLOSEOUT SUBMITTALS

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

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.

.2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

.3 Packaging Waste Management: remove for return of pallets crates padding packaging materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

1.5 WARRANTY

.1 For the Work of this Section 22 30 05 - Domestic Water Heaters, 12 months warranty period prescribed in subsection GC 32.1 of General Conditions "C" is extended to number of years specified for each product.

.2 Contractor hereby warrants domestic water heaters in accordance with CCDC2, but for number of years specified for each product.

Part 2 Products

2.1 COMPONENTS

.1 Sustainable Requirements:

.1 Materials and products in accordance with Section 01 47 15 - Sustainable Requirements: Construction.

2.2 ELECTRIC WATER HEATER

.1 To CAN/CSA C22.2 No.110, CAN/CSA-C191 and CAN/CSA-C309. UL listed. To NSF Standard 5.

.2 With 3 immersion type elements each controlled by an individual thermostat and high temperature cut off switch. All internal circuits fused.

.3 Tank: 305 L, foam insulation, glass-lined, steel with extruded high density anode, 3 year warranty certificate.

.4 Factory-installed and wired control panel

.5 Factory-installed electrical junction box with heavy duty terminal block.

.6 Drain valve

.7 ASME rated temperature and pressure relief

2.3 TRIM AND INSTRUMENTATION

.1 Drain valve: NPS 1 with hose end.

.2 Thermometer: 100 mm dial type with red pointer and thermowell filled with conductive paste.

.3 Pressure gauge: 75 mm dial type with red pointer, and shut-off cock.

.4 Thermowell filled with conductive paste for control valve temperature sensor.

.5 ASME rated temperature and pressure relief valve sized for full capacity of heater, having discharge terminating over floor drain and visible to operators.

.6 Magnesium anodes adequate for 20 years of operation and located for easy replacement.

2.4 ANCHOR BOLTS AND TEMPLATES

.1 Supply anchor bolts and templates for installation in concrete support pad in accordance with Section 03 30 00 - Cast-in-Place Concrete.

.2 Size anchor bolts to withstand seismic zone 4 acceleration and velocity forces.

Part 3 Execution

3.1 APPLICATION

.1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 INSTALLATION

.1 Install in accordance with manufacturer's recommendations and authority having jurisdiction.

.2 Provide insulation between tank and supports.

3.3 FIELD QUALITY CONTROL

.1 Manufacturer's factory trained, certified Engineer to start up and commission DHW heaters.

3.4 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 recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 ASTM International

.1 ASTM A126- 04(2009) , Standard Specification for Gray Iron Castings for Valves, Flanges and Pipe Fittings.

.2 ASTM B62- 09 , Standard Specification for Composition Bronze or Ounce Metal Castings.

.2 American Water Works Association (AWWA)

.1 ANSI/AWWA C700- 09 , Standard for Cold Water Meters-Displacement Type, Bronze Main Case.

.2 ANSI/AWWA C701- 12 , Standard for Cold Water Meters-Turbine Type for Customer Service.

.3 ANSI/AWWA C702- 10 , Standard for Cold Water Meters-Compound Type.

.3 CSA International

.1 CSA-B64 Series- 11 , Backflow Preventers and Vacuum Breakers.

.2 CSA B79- 08 , Commercial and Residential Drains and Cleanouts.

.3 CAN/CSA-B356- 10 , Water Pressure Reducing Valves for Domestic Water Supply Systems.

.4 Efficiency Valuation Organization (EVO)

.1 International Performance Measurement and Verification Protocol (IPMVP).

.1 IPMVP 2007 Version.

.5 Plumbing and Drainage Institute (PDI)

.1 PDI-G101- R2010 , Testing and Rating Procedure for Grease Interceptors with Appendix of Installation and Maintenance.

.2 PDI-WH201- R2010 , Water Hammer Arresters Standard.

1.2 ADMINISTRATIVE REQUIREMENTS

.1 Pre-installation Meetings:

.1 Convene pre-installation meeting 1 week prior to on-site installation, with contractor's representative NRC Departmental Representative to:

.1 Verify project requirements.

.2 Review installation and substrate conditions.

.3 Co-ordination with other building construction subtrades.

.4 Review manufacturer's written installation instructions and warranty requirements.

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 plumbing products and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Submit 2 copies of WHMIS MSDS in accordance with Section 01 35 29.06 - Health and Safety Requirements. Indicate VOC's:

.3 Shop Drawings:

.1 Indicate on drawings to indicate materials, finishes, method of anchorage, number of anchors, dimensions construction and assembly details accessories.

.4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.5 Instructions: submit manufacturer's installation instructions.

.6 Manufacturers' Field Reports: manufacturers' field reports specified.

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 plumbing specialties and accessories for incorporation into manual.

.1 Description of plumbing specialties and accessories, giving manufacturers name, type, model, year and capacity.

.2 Details of operation, servicing and maintenance.

.3 Recommended spare parts list.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.

.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 plumbing materials from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

.4 Packaging Waste Management: in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

Part 2 Products

2.1 FLOOR DRAINS

.1 Floor Drains and Trench Drains: to ASME A112.6.3-2001.

.2 Type FD1: foot traffic areas; cast iron body round, adjustable head, nickel bronze strainer, integral seepage pan, and flashing collar, trip seal primer tapping, no hub outlet.

.1 Equivalent to Jay R. Smith 2005Y

.3 Type FD2: wheel traffic areas (mechanical rooms, basement corridor, workshops); cast iron body round, adjustable head, heavy duty nickel bronze strainer, integral seepage pan, and flashing collar, trip seal primer tapping, no hub outlet.

.1 Equivalent to Jay R. Smith 2005AHD

.4 Type FFD: funnel floor drain (mechanical rooms); cast iron body round, adjustable head, heavy duty nickel bronze strainer with integral oval funnel, integral seepage pan, and flashing collar, trip seal primer tapping, no hub outlet.

.1 Equivalent to Jay R. Smith 2005AHD-F19

2.2 ROOF DRAINS

.1 Type 1: cast iron body, under deck clamp and sump receiver to suit roof construction, flashing clamp ring with integral gravel stop, bearing pan, polyethylene dome.

.1 Equivalent to Jay R Smith 1010

2.3 CLEANOUTS

.1 Cleanout Plugs: heavy cast iron male ferrule with brass screws and threaded brass or bronze plug. Sealing-caulked lead seat or neoprene gasket.

.2 Access Covers:

.1 Wall Access: face or wall type, stainless steel square cover with flush head securing screws, bevelled edge frame complete with anchoring lugs.

.2 Floor Access: round cast iron body and frame with adjustable secured nickel bronze top and:

.1 Plugs: bolted bronze with neoprene gasket.

.2 Cover for Unfinished Concrete Floors: cast iron round, gasket, vandal-proof screws.

.1 Equivalent to Jay R. Smith 4220

.3 Cover for Terrazzo Finish: polished nickel bronze with recessed cover for filling with terrazzo, vandal-proof locking screws.

.1 Equivalent to Jay R. Smith 4180-CAN

.4 Cover for Tile and Linoleum Floors: polished nickel bronze with recessed cover for linoleum or tile infill, complete with vandal-proof locking screws.

.5 Cover for Carpeted Floors: polished nickel bronze with deep flange cover for carpet infill, complete with carpet retainer vandal-proof locking screws.

.1 Equivalent to Jay R. Smith 4021S-Y

2.4 NON-FREEZE WALL HYDRANTS

.1 Recessed type with integral vacuum breaker-backflow preventor, NPS 3/4 hose outlet, removable operating key. Chrome plated brassfinish.

.2 To ASSE 1019

.1 Equivalent to Watts series HY42

2.5 WATER HAMMER ARRESTORS

.1 Hard drawn copper body with machined lead-free brass piston, NPT solid hex brass, air chamber precharged to 422 kPa.

.2 PDI WH201 approved

.3 ANSI A112.26.1M approved

.1 Equivalent to Watts Series LF15

2.6 BACK FLOW PREVENTERS

.1 Preventers: to CSA-B64 Series, application as indicated,

.2 reduced pressure principle type, complete with strainer, isolation ball valves, differential pressure relief valve between two positively seated check valves – Watts Series 909

.3 double check valve assembly

.4 Dual check valve with intermediate atmospheric vent, complete with union connections, stainless steel internals, rubber seated checks, ASSE approved – Watts 9D.

2.7 VACUUM BREAKERS

.1 Breakers: to CSA-B64 Series, vacuum breaker.

2.8 HOSE BIBBS AND SEDIMENT FAUCETS

.1 Bronze construction complete with integral back flow preventer, hose thread spout, replaceable composition disc, and chrome plated in finished areas.

2.9 WATER MAKE-UP ASSEMBLY

.1 Complete with backflow preventer pressure gauge on inlet and outlet, pressure reducing valve to CAN/CSA-B356, pressure relief valve on low pressure side and gate valves on inlet and outlet.

2.10 WATER METERS

.1 Compound type to ANSI/AWWA C702.

.2 Accessories: remote readout device.

2.11 TRAP SEAL PRIMERS

.1 Brass, with integral vacuum breaker, NPS 1/2 solder ends, NPS 1/2 drip line connection.

.1 Equivalent to P.P.P Inc Model P0-500

2.12 STRAINERS

.1 860 kPa, Y type with 20 mesh, monel, bronze or stainless steel removable screen.

.2 NPS 2 and under, bronze body, screwed ends, with brass cap.

.3 NPS 2 1/2 and over, cast iron body, flanged ends, with bolted cap.

2.13 VACUUM PUMP TANK

.1 Vacuum tank:

- .1 300 gallon – 6mm (1/4") A36 Grade Carbon Steel
- .2 Single Compartment, 914mm (36") diameter x 1829mm (6') long
- .3 Offset construction
- .4 Two flanged & Dished tank heads
- .5 Exterior seams submerged arc welded (SAW)

.2 The Vacuum Tank shall be furnished will all of the following accessories:

- .1 Rails – standard style, 25mm A36 Carbon Steel
- .2 Discharge port – 100mm threaded nipple, male NPT
- .3 Valve – Brass Lever – 75mm Female NPT x Female NPT with 75mm Male Camlock NPT & Female Camlock Dust Cap.
- .4 Valve – Brass Level – 100mm Female NPT x Female NPT with 100mm Male Camlock NPT & Female Camlock Dust Cap.
- .5 Manway – 914mm (36") with 305mm (12") Neck, 8 Wingnut, 6mm (1/4") A36 Carbon Steel, Rear Mounted
- .6 Accessory Package – Conde – For Super & SDS Pump Models, includes Oil Catch Muffler, Primary & Secondary Shutoffs, Pre-Filters
- .7 Hose Hangers – 150mm (6") Driver's Side
- .8 Sight Eyes (2) – 125mm (5") Glass with Carbon Steel Weldment
- .9 Vacuum/Pressure Gauge – 115mm (4.5") Standard with Guard
- .10 Pressure Relief Valve – 38mm (1.5") Brass (109 L/S) with Guard.
- .11 Vacuum Relief Valve – 38mm (1.5") Brass (175 L/S)
- .12 SDS-12 Conde 85 L/S (Vacuum/Pressure) pump belt driven with 10 HP three phase electric motor platform.
- .13 Pump Platform – Standard (LMT)
- .14 Paint Preparation – Wash, Phosphatization, Primer (< 3785 L or < 1000 Gal)
- .15 Paint – Standard – 1890 L – 3591 L (500 – 950 Gal) Tank, Bright White.
- .16 3m long 75mm diameter reinforced flexible drain hose with threaded coupling for connecting to tank discharge and plain end for discharge into sanitary.
- .17 Recessed floor box with hinged cover for access to capped sanitary wye in floor to drain tank.

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 plumbing specialities and accessories installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate in presence of NRC Departmental Representative.

.2 Inform NRC 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 NRC Departmental Representative.

3.2 MANUFACTURER'S INSTRUCTIONS

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

3.3 INSTALLATION

.1 Install in accordance with National Plumbing Code of Canada.

.2 Install in accordance with manufacturer's instructions and as specified.

3.4 CLEANOUTS

.1 Install cleanouts at base of soil and waste stacks, and rainwater leaders, at locations required code, and as indicated.

.2 Bring cleanouts to wall or finished floor unless serviceable from below floor.

.3 Building drain cleanout and stack base cleanouts: line size to maximum NPS 4.

3.5 NON-FREEZE WALL HYDRANTS

.1 Install 600 mm above finished grade and as indicated.

3.6 WATER HAMMER ARRESTORS

.1 Install on branch supplies to fixtures or group of fixtures.

3.7 BACK FLOW PREVENTERS

.1 Install in accordance with CSA-B64 Series, where indicated and elsewhere as required by code.

.1 Drains.

.2 Backwater Valves.

.3 Water Make-up Assembly.

.4 Grease Interceptors.

.2 Pipe discharge to terminate over nearest funnel floor drain.

3.8 HOSE BIBBS AND SEDIMENT FAUCETS

.1 Install at bottom of risers, at low points to drain systems, and as indicated.

3.9 TRAP SEAL PRIMERS

.1 Install for floor drains and elsewhere, as indicated.

.2 Install on cold water supply to nearest frequently used plumbing fixture, in concealed space, to approval of NRC Departmental Representative.

.3 Install soft copper tubing to floor drain.

3.10 STRAINERS

.1 Install with sufficient room to remove basket for maintenance.

3.11 WATER METERS

.1 Install water meter provided by local water authority.

.2 Install water meter as indicated.

3.12 WATER MAKE-UP ASSEMBLY

.1 Install on valved bypass.

.2 Pipe discharge from relief valve to nearest floor drain.

3.13 START-UP

.1 General:

.1 In accordance with Section 01 91 13 - General Commissioning (Cx) Requirements: General Requirements, supplemented as specified herein.

.2 Timing: start-up only after:

.1 Pressure tests have been completed.

.2 Disinfection procedures have been completed.

.3 Certificate of static completion has been issued.

.4 Water treatment systems operational.

.3 Provide continuous supervision during start-up.

3.14 TESTING AND ADJUSTING

.1 General:

.1 Test and adjust plumbing specialties and accessories in accordance with Section 01 91 13- General Commissioning (Cx) Requirements : General Requirements, supplemented as specified.

.2 Timing:

.1 After start-up deficiencies rectified.

.2 After certificate of completion has been issued by authority having jurisdiction.

.3 Application tolerances:

.1 Pressure at fixtures: +/- 70 kPa.

.2 Flow rate at fixtures: +/- 20%.

.4 Adjustments:

.1 Verify that flow rate and pressure meet design criteria.

.2 Make adjustments while flow rate or withdrawal is (1) maximum and (2) 25% of maximum and while pressure is (1) maximum and (2) minimum.

.5 Floor drains:

.1 Verify operation of trap seal primer.

.2 Prime, using trap primer. Adjust flow rate to suit site conditions.

.3 Check operations of flushing features.

.4 Check security, accessibility, removability of strainer.

.5 Clean out baskets.

.6 Vacuum breakers, backflow preventers, backwater valves:

.1 Test tightness, accessibility for O M of cover and of valve.

.2 Simulate reverse flow and back-pressure conditions to test operation of vacuum breakers, backflow preventers.

.3 Verify visibility of discharge from open ports.

.7 Roof drains:

.1 Check location at low points in roof.

.2 Check security, removability of dome.

.3 Adjust weirs to suit actual roof slopes, meet requirements of design.

.4 Clean out sumps.

.5 Verify provisions for movement of roof systems.

.8 Access doors:

.1 Verify size and location relative to items to be accessed.

.9 Cleanouts:

.1 Verify covers are gas-tight, secure, yet readily removable.

.10 Water hammer arrestors:

.1 Verify proper installation of correct type of water hammer arrester.

.11 Wall, ground hydrants:

.1 Verify complete drainage, freeze protection.

.2 Verify operation of vacuum breakers.

.12 Pressure regulators, PRV assemblies:

.1 Adjust settings to suit locations, flow rates, pressure conditions.

.13 Strainers:

.1 Clean out repeatedly until clear.

.2 Verify accessibility of cleanout plug and basket.

.3 Verify that cleanout plug does not leak.

.14 Grease interceptors:

.1 Activate, using manufacturer's recommended procedures and materials.

.15 Hose bibbs, sediment faucets:

.1 Verify that flow and pressure meet design criteria.

.2 Check for leaks, replace compression washer if required.

.16 Hydronic system water Make-up Assembly:

.1 Verify flow, pressure, and connection.

.17 Water meters:

.1 Verify location and accessibility.

.2 Test meter reading accuracy.

3.15 CLOSEOUT ACTIVITIES

.1 Commissioning Reports: in accordance with Section 01 91 13 - General Commissioning (Cx) Requirements: reports, supplemented as specified.

.2 Training: provide training in accordance with Section 01 91 13 - General Commissioning (Cx) Requirements: Training of O M Personnel, supplemented as specified.

3.16 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: in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.17 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by plumbing specialties and accessories installation.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CAN/CSA-B45 Series- 02(R2008) , Plumbing Fixtures.

.2 CAN/CSA-B125.3- 05 , Plumbing Fittings.

.3 CAN/CSA-B651- 04 , Accessible Design for the Built Environment.

.2 Green Seal Environmental Standards (GSES)

.1 Standard GS-36- 00 , Commercial Adhesives.

.3 South Coast Air Quality Management District (SCAQMD), California State

.1 SCAQMD Rule 1168- A2005 , Adhesive and Sealant Applications.

1.2 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 datasheets for washroom fixtures, and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Indicate fixtures and trim:

.1 Dimensions, construction details, roughing-in dimensions.

.2 Factory-set water consumption per flush at recommended pressure.

.3 For water closets, urinals: minimum pressure required for flushing.

1.3 CLOSEOUT SUBMITTALS

.1 Provide operation and maintenance data for washroom fixtures, for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

.2 Include:

.1 Description of fixtures and trim, giving manufacturer's name, type, model, year, capacity.

.2 Details of operation, servicing, maintenance.

.3 List of recommended spare parts.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.

.2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

.3 Packaging Waste Management: in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

Part 2 Products

2.1 MANUFACTURED UNITS

.1 Fixtures: manufacture in accordance with CAN/CSA-B45 series.

.2 Trim, fittings: manufacture in accordance with CAN/CSA-B125.3.

.3 Exposed plumbing brass to be chrome plated.

.4 Number, locations: as indicated.

.5 Fixtures in any one location to be product of one manufacturer and of same type.

.6 Trim in any one location to be product of one manufacturer and of same type.

.7 Water closets:

.1 WC-1 : wall-mounted, exposed flush valve, top spud ultra-low flush, maximum 6 litres/flush.

.1 Bowl: vitreous china, syphon jet, elongated rim. Fully glazed trapway.

.2 MaP score: 1000g of miso @ 1.6 gpf

.3 Equivalent to American Standard Afwall 1.6gpm

.2 WC-2 : As above and barrier free

.8 Electronic Water Closet Flush Valves:

.1 Barrier free, stainless steel, electronic, sensor proximity type, activated by infra-red.

.2 Sensor: waterproof, with impact-resistant, anti scratch coated plastic lens, sensitivity adjustable from 100 mm to 450 mm.

.3 Water conservation: 30 second maximum run time.

.4 Controls: interchangeable receptacles for stainless steel sheathed sensor and modular plug-type solenoid connections, single 6 VDC, slow-closing commercial solenoid for 860 kPa, 85 degrees C.

.5 Transformer: 120VAC/6 VDC , Class 2, UL and CSA listed, hardwire type, sized for up to 8 solenoids.

.6 Equipped with manual override button.

.9 Water Closet Seats.

.1 Seat: white, elongated, open front, moulded solid plastic, less cover, stainless steel check hinges, stainless steel insert post.

.10 Urinals:

.1 U-1 : wall mounted, ultra-low flush, exposed flush valve, top spud.

.1 Urinal: vitreous china, washout type, integral flushing rim, extended shields, integral trap, removable stainless steel strainer, back outlet.

.11 Urinal Electronic Flush Valves:

.1 Surface mounted, controlled by infra-red occupancy detector.

.1 Complete with removable filter, 9 second time delay, flush time adjustable from 0-8 seconds, factory set at 4.5 seconds, 4.5 L flush/cycle maximum.

.2 Sensor adjustable from 50-1220 mm, factory set to 860 mm.

.3 Solenoid valve: 6 VDC slow-closing type for 60 kPa (minimum), 1000 kPa (maximum), 85 degrees C with manual over-ride, adjustable flow control.

.4 Transformer: 120/ VAC Class 2, 6 VDC UL and CSA listed, hardwire type.

.5 Manual mechanical override.

.12 Washroom Lavatories:

.1 L-1 : counter-top:

.1 Porcelain-on-steel, self-rimming, with front overflow, soap depressions, gasket, swivel clamps, semi-oval or rectangular bowl, supply openings on 200 mm centres. Sizes: 475 x 400 mm outside, 400 x 250 mm nominal inside.

.2 L-2: wall-hung, for handicapped.

.1 Vitreous china, low shelf, with integral back, contoured front, shallow front basin, front overflow, soap depressions, supply openings on 299 mm centres, concealed supports. Sizes: 686 x 508 mm.

.13 Washroom Lavatory Electronic Trim:

.1 Barrier-free electronic faucet:

.1 Infra-red motion sensor activated by hand motion in lavatory.

.2 Sensor: waterproof, incorporated in body of unit, with impact-resistant plastic lens and anti-scratch coating, inside spout, sensitivity adjustable from 100 mm to 450 mm.

.3 Water conservation: 30 second maximum run time.

.4 Controls: vandal-proof, interchangeable receptacles for stainless steel sheathed sensor and modular plug-type solenoid connections, single 12 VDC slow-closing commercial solenoid for 860 kPa, 85 degrees C.

.5 Transformer: 120/12 VDC Class 2, UL and CSA listed, hard wire type, sized for up to 8 solenoids.

.6 Spout: Chrome plated, with integral flow control aerator rated at 8.35 l/minute at 413 kPa maximum.

.7 Under-counter temperatures mixing controls.

.14 Fixture piping:

.1 Hot and cold water supplies to fixtures:

.1 flexible supply pipes with screwdriver stop, reducers, escutcheon.

.2 Waste:

.1 Brass P trap with clean out on fixtures not having integral trap.

.2 Chrome plated in exposed places.

.15 Chair carriers:

.1 Factory manufactured floor-mounted carrier systems for wall-mounted fixtures.

Part 3 Execution

3.1 APPLICATION

.1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 INSTALLATION

.1 Mounting heights:

.1 Standard: to manufacturer's recommendations, measured from finished floor.

.2 Barrier free: to most stringent of NBCC and CAN/CSA B651.

3.3 ADJUSTING

.1 Conform to water conservation requirements specified this section.

.2 Adjustments:

.1 Adjust water flow rate to design flow rates.

.2 Adjust pressure to fixtures to ensure no splashing at maximum pressures.

.3 Adjust flush valves to suit actual site conditions.

.4 Adjust urinal flush timing mechanisms.

.5 Set controls of automatic flush valves for WCs and urinals to prevent unnecessary flush cycles.

.3 Checks:

.1 Water closets, urinals: flushing action.

.2 Aerators: operation, cleanliness.

.3 Vacuum breakers, backflow preventers: operation under all conditions.

.4 Thermostatic controls:

.1 Verify temperature settings, operation of control, limit and safety controls.

3.4 CLEANING

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

.1 Remove surplus materials, excess materials, rubbish, tools and equipment.

.2 Waste Management: in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-1.181-99, Ready-Mixed Organic Zinc-Rich Coating.

.2 Canadian Standards Association (CSA International)

.1 CSA B139-04, Installation Code for Oil Burning Equipment.

.3 Green Seal Environmental Standards (GSES)

.1 Standard GS-11-2008, 2nd Edition, Environmental Standard for Paints and Coatings.

.4 National Fire Code of Canada (NFCC 2005)

.5 South Coast Air Quality Management District (SCAQMD), California State, Regulation XI. Source Specific Standards

.1 SCAQMD Rule 1113-A2007, Architectural Coatings.

.2 SCAQMD Rule 1168-A2005, Adhesive and Sealant Applications.

1.2 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 datasheets for piping and equipment and include product characteristics, performance criteria, physical size, finish and limitations.

1.3 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.

.2 Delivery and Acceptance Requirements:

.1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

.3 Packaging Waste Management: remove for return by manufacturer of pallets crates padding packaging materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

Part 2 Products

2.1 MATERIAL

.1 Paint: zinc-rich to CAN/CGSB-1.181.

.1 Primers Paints Coating: in accordance with manufacturer's recommendations for surface conditions.

.2 Sealants: in accordance with Section 07 92 00 - Joint Sealants.

.3 Fire Stopping: in accordance with Section 07 84 00 - Fire Stopping.

Part 3 Execution

3.1 APPLICATION

.1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 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 subject to movement.

3.3 CLEARANCES

.1 Provide clearance around systems, equipment and components for observation of operation, inspection, servicing, maintenance and as recommended by manufacturer and National Fire Code of Canada.

.2 Provide space for disassembly, removal of equipment and components as recommended by manufacturer without interrupting operation of other system, equipment, components.

3.4 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.

.1 Discharge to be visible.

.4 Drain valves: NPS 3/4 gate or globe valves unless indicated otherwise, with hose end male thread, cap and chain.

3.5 AIR VENTS

.1 Install manual air vents to CSA B139 at high points in piping systems.

.2 Install isolating valve at each automatic air valve.

.3 Install drain piping to approved location and terminate where discharge is visible.

3.6 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.

3.7 PIPEWORK INSTALLATION

.1 Install pipework to CSA B139.

.2 Screwed fittings jointed with Teflon tape.

.3 Protect openings against entry of foreign material.

.4 Install to isolate equipment and allow removal without interrupting operation of other equipment or systems.

.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 size of main.

.1 Hole saw (or drill) and ream main to maintain full inside diameter of branch line prior to welding saddle.

.7 Install exposed piping, equipment, rectangular cleanouts and similar items parallel or perpendicular to building lines.

.8 Install concealed pipework to minimize furring space, maximize headroom, conserve space.

.9 Slope piping, except where indicated, in direction of flow for positive drainage and venting.

.10 Install, except where indicated, to permit separate thermal insulation of each pipe.

.11 Group piping wherever possible and as indicated.

.12 Ream pipes, remove scale and other foreign material before assembly.

.13 Use eccentric reducers at pipe size changes to ensure positive drainage and venting.

.14 Provide for thermal expansion as indicated.

.15 Valves:

.1 Install in accessible locations.

.2 Remove interior parts before soldering.

.3 Install with stems above horizontal position unless indicated.

.4 Valves accessible for maintenance without removing adjacent piping.

.5 Install globe valves in bypass around control valves.

.6 Use ball valves at branch take-offs for isolating purposes except where specified.

.7 Install butterfly valves on chilled water and related condenser water systems only.

.8 Install butterfly valves between weld neck flanges to ensure full compression of liner.

.9 Install ball valves for glycol service.

.10 Use chain operators on valves NPS 2 1/2 and larger where installed more than 2400 mm above floor in Mechanical Rooms.

.16 Check Valves:

.1 Install silent check valves on discharge of pumps in vertical pipes with downward flow and as indicated.

.2 Install swing check valves in horizontal lines on discharge of pumps and as indicated.

3.8 SLEEVES

.1 General: install where pipes pass through masonry, concrete structures, fire rated assemblies, and as indicated.

.2 Material: schedule 40 black steel pipe.

.3 Construction: use annular fins continuously welded at mid-point at foundation walls and where sleeves extend above finished floors.

.4 Sizes: 6 mm minimum clearance between sleeve and uninsulated pipe or between sleeve and insulation.

.5 Installation:

.1 Concrete, masonry walls, concrete floors on grade: terminate flush with finished surface.

.2 Other floors: terminate 25 mm above finished floor.

.3 Before installation, paint exposed exterior surfaces with heavy application of zinc-rich paint to CAN/CGSB-1.181.

.6 Sealing:

.1 Foundation walls and below grade floors: fire retardant, waterproof non-hardening mastic.

.2 Elsewhere:

.1 Provide space for firestopping.

.2 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.

3.9 ESCUTCHEONS

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

.2 Construction: one piece type with set screws.

.1 Chrome or nickel plated brass or type 302 stainless steel..

.3 Sizes: outside diameter to cover opening or sleeve.

.1 Inside diameter to fit around pipe or outside of insulation if so provided.

3.10 PREPARATION FOR FIRE STOPPING

.1 Install firestopping within annular space between pipes, ducts, insulation and adjacent fire separation in accordance with Section 07 84 00 - Fire Stopping.

.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 fires topping material or installation.

.4 Insulated pipes and ducts: ensure integrity of insulation and vapour barriers.

3.11 FLUSHING OUT OF PIPING SYSTEMS

.1 Flush system 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 mechanical sections.

.3 Preparatory to acceptance, clean and refurbish equipment and leave in operating condition, including replacement of filters in piping systems.

3.12 PRESSURE TESTING OF EQUIPMENT AND PIPEWORK

.1 Advise NRC Departmental Representative 48 hours minimum prior to performance of pressure tests.

.2 Pipework: test as specified in relevant sections of heating, ventilating and air conditioning work.

.3 Maintain specified test pressure without loss for 4 hours minimum unless specified for longer period of time in relevant mechanical sections.

.4 Prior to tests, isolate equipment and other parts which are not designed to withstand test pressure or media.

.5 Conduct tests in presence of NRC Departmental Representative.

.6 Pay costs for repairs or replacement, retesting, and making good. NRC Departmental Representative to determine whether repair or replacement is appropriate.

.7 Insulate or conceal work only after approval and certification of tests by NRC Departmental Representative.

3.13 EXISTING SYSTEMS

.1 Connect into existing piping systems at times approved by NRC Departmental Representative.

.2 Request written approval by NRC Departmental Representative 10 days minimum, prior to commencement of work.

.3 Be responsible for damage to existing plant by this work.

3.14 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 in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

END OF SECTION

Part 1 General

1.1. QUALITY ASSURANCE

.1 The Variable Frequency Drive (VFD) manufacturing facility shall be ISO 9001 certified. The VFD shall be UL listed, Canadian UL listed and CSA listed.

.2 Provide a minimum 100,000 hours mean time before failure (MTBF).

.3 The term Variable Frequency Drive (VFD) shall be synonymous with Variable Speed Drives (VSD) and Adjustable Frequency Drives (AFD).

.4 All Variable Frequency Drives for this project shall be of a single manufacturer for all fan and pump systems, including all components that require VFDs for air handling equipment, cooling towers, fluid coolers, pumps, etc.

1.2. RELATED WORK

.1 For motors connected to variable frequency drives, refer to requirements of Section 21 05 13.00 – ELECTRIC MOTORS.

Part 2 Products

2.1. GENERAL REQUIREMENTS

.1 Variable frequency drives (VFD) shall be Danfoss/Graham Company VLT6000, Allan-Bradley PowerFlex 700, and ABB ACH550 as specified herein for the fans, pumps, heat recovery wheels, and cooling tower fans designated on the schedules or in the respective specification sections to be variable speed.

.2 All standard and optional features shall be included within the VFD enclosure, unless otherwise specified. The VFD's UL listing shall allow it to be mounted in a plenum or other air handling compartments.

.3 The VFD shall be housed in a UL Type 1 ventilated enclosure

.4 The VFD shall be a digitally controlled drive, using, the Pulse Width Modulation (PWM) technology with sensorless vector control. It shall utilize IGBTs in its inverter section.

.5 The VFD shall allow the motor to produce full rated power at rated amps, RMS fundamental volts, and speed without using the motor's service factor when the motors rated voltage is applied to the VFD input.

.6 The VFD including all specified options shall be assembled by the ANSI/UL Standard 508 certified manufacturer for the building and assembly of option panels and the complete unit shall be tested to ANSI/UL Standard 508. Assembly of the option panels by a third-party panel shop shall not be acceptable. Where the components are separate, the appropriate CSA or C-UL stickers shall be applied to both the VFD and option panel. Both the VFD and option panel shall be manufactured in ISO 9001 certified facilities.

.7 The VFD shall have a 5% THD input current harmonic filter, designed such that no individual current harmonic will be greater than 4% at full load operation. The supply of line reactors (such as 3% DC reactors or 5% AC reactors), without filters, is NOT acceptable. Filters shall be by Matrix or Mirus (The Lineator) or similar.

.8 The VFD's full load amp rating shall meet or exceed NEC Table 430-150. The VFD shall be able to provide full rated output current continuously, 110% of rated current for 60 seconds and 160% of rated current for up to 0.5 second while starting.

.9 The VFD shall be able to provide full torque at any selected frequency from 28 Hz to base speed to allow driving direct drive fans without derating.

.10 Input and output power circuit switching shall be able to be accomplished without interlocks or damage to the VFD. Switching rate may be up to 1 time per minute on the input and unlimited on the output. Disconnects located between the drive and the motor shall be interlocked into the VFD's safety circuitry.

.11 An automatic motor adaptation test algorithm shall measure motor stator resistance and reactance to optimize performance and efficiency. It shall not be necessary to run the motor or de-couple the motor from the load to run the test.

.12 VFD power components shall be designed for 600VAC where intended for 575V/600V service. Components designed for 480VAC installed on 575V/600V service shall not be acceptable.

.13 VFD shall minimize the audible motor noise through the use of an adjustable carrier frequency. The carrier frequency shall be automatically adjusted to optimize motor and VFD efficiencies while reducing motor noise.

.14 VFD's output switching shall be maintained within the requirements of NEMA standard MG1 part 30, VFD's with output exceeding 1000V shall employ DVDT output filters.

2.2. PROTECTIVE FEATURES

.1 A minimum of Class 20 I^2t electronic motor overload protection for single motor applications and thermal-mechanical overloads for multiple motor applications shall be provided.

.2 Protection against input transients, loss of AC line phase, output short circuit, output ground fault, over-voltage, under-voltage, VFD over-temperature and motor over-temperature. The VFD shall display all faults in plain English. Codes shall not be acceptable.

.3 Protect the VFD from sustained power or phase loss. The VFD shall provide full rated output with an input voltage as low as 90% of the nominal.

.4 The VFD assembly including all required options shall be rated for 100,000amp interrupting capacity (AIC).

.5 The VFD shall have built-in or externally mounted EMI electromagnetic filters to limit the EMI and RFI output from the VFD, designed to meet standard EN61800-3.

.6 The VFD shall have a wide operating supply power range and shall continue to operate without faulting or tripping until the input voltage reaches at least 701 VAC on 600 volt systems and 300 VAC on 208/230 volt systems and 539 VAC on 460 volt systems.

2.3. INTERFACE FEATURES

.1 Each VFD shall have the same operator's keypad, including digital display with Hand/Start, Off/Stop and Auto/Start, Help selector switches or buttons shall be provided to start and stop the VFD and determine the speed reference. The keypad shall be removable, capable of remote mounting and allow for uploading and downloading of parameter settings. The keypad shall include a built-in real time clock with date function. Speed Transfer between Hand and Auto shall be "bumpless."

.2 Each VFD shall include an open system communication protocol interface, either BACnet as defined by ANSI/ASHRAE standard 135-2001 or LONWorks as defined by ANSI/CEA standard 709.1 for seamless integration with Section 23 09 00.00 - BUILDING AUTOMATION SYSTEM (BAS).

.3 Run permissive circuit shall be provided to accept a "system ready" signal to ensure that the VFD does not start until dampers or other auxiliary equipment are in the proper state for VFD operation. The run permissive circuit shall also be capable of sending an output signal as a start command to actuate external equipment before allowing the VFD to start.

.4 The VFD shall be able to be programmed to sense the loss of load and signal a no load/broken belt warning or fault.

.5 If the temperature of the VFD's heat sink rises to 80 Deg. C. (176 Deg. C.), the VFD shall automatically reduce its carrier frequency to reduce the heat sink temperature. If the temperature of the heat sink continues to rise the VFD shall automatically reduce its output frequency to the motor. As the VFD's heat sink temperature returns to normal, the VFD shall automatically increase the output frequency to the motor and return the carrier frequency to its normal switching speed.

.6 At least six programmable digital inputs shall be provided for interfacing with the systems control and safety interlock circuitry.

.7 As a minimum, the following hardware points shall be available for direct connection to BAS:

.1 VFD Start/Stop

.2 VFD Speed Control

.3 VFD Speed Feedback

.8 Under smoke control or special fire mode conditions, the VFD shall be able to be programmed to automatically default to a preset speed or bypass.

2.4. SERVICE CONDITIONS

.1 Ambient temperature, -10 Deg. C. to 40 Deg. C. (14 Deg. F. to 104 Deg. F.) without derating.

.2 0 to 95% relative humidity, non-condensing.

.3 Elevation to 1005 m (3300 ft.) without derating.

.4 AC line voltage variation, -10 to +10% of nominal with full output.

.5 No side clearance shall be required for cooling of any units. All power and control wiring shall be done from the bottom.

2.5. BYPASS

.1 Supply either a manual 3 contactor bypass as per Article .2 or supply an electronic bypass system as per Article .4 and all respective Sub-Articles.

.2 Provide a manual 3-contactor bypass, consisting of a door interlocked main fused disconnect padlockable in the off position, a built-in motor starter and a four position DRIVE/OFF/BYPASS/TEST switch controlling three contactors. In the DRIVE position, the motor is operated at an adjustable speed from the VFD. In the OFF position, the motor and VFD are disconnected. In the BYPASS position, the motor is operated at full speed from the AC power line and power is disconnected from the VFD so that service can be performed. In the TEST position, the motor is operated at full speed from the AC line power while power is applied to the input of the VFD. This allows the VFD to be given an operational test while continuing to run the motor at full speed in bypass. In case of an external safety fault, a customer supplied normally closed dry contact shall be able to stop the motor whether in DRIVE or BYPASS mode. Supply VFD specific only fuses

.3 Service personnel shall be able to defeat the main power disconnect and open the bypass enclosure without disconnecting power. This shall be accomplished through the use of a specially designed tool and mechanism while meeting all local and national code requirements for safety.

.4 Include a door interlocked, padlockable circuit breaker or disconnect switch to disconnect all input power to the drive and bypass system.

.5 Supply fast acting fuses exclusive to and in front of the VFD only.

.6 The electronic bypass shall have its own keypad with, Drive, Bypass, Hand, Off, Auto, Reset operator keys.

.7 The keypad shall also have the following LED indication, Ready, Enable, Drive running, Bypass running, Drive fault, Bypass fault, Bypass H-O-A mode, Auto transfer to bypass selected, Drive selected, Bypass selected.

.8 All external safety interlocks shall remain fully functional whether the system is in Hand, Auto or Bypass modes.

3. Execution

3.1. INSTALLATION

.1 Comply with manufacturer's installation instructions.

.2 Provide a disconnect switch at the motor where required by the authorities having jurisdiction. Where such a switch is installed, provide an auxiliary contact or switch at the disconnect, mounted to open when the disconnect switch is opened and wired to a terminal strip in the VFD such that opening the disconnect switch initiates a drive shut down and prevents the drive from starting in either Line or Drive positions.

.3 Locate and mount VFD panels in Mechanical Rooms and/or where shown on the Drawings.

.4 Arrange for manufacturer's technical representative or local qualified representative to:

.1 Inspect the installation of the drives and to start-up

.2 Test and commission the drives. The VFD shall operate a dynamometer at full load and speed and shall be cycled during the test.

.3 Be present during testing and commissioning performed under Section 25 05 01 – BUILDING AUTOMATION SYSTEM (BAS).

.5 Measure the distortion of each phase at the load terminals of the branch breaker and report the results to the Engineer’s Representative. Any deficiency shall be corrected and re-evaluated.

.6 Implement a communication protocol for remote interface to match the communication protocol under Section 23 09 00.00 – BUILDING AUTOMATION SYSTEM (BAS).

.7 BAS connection to drives provided under Section 23 09 00.00 – BUILDING AUTOMATION SYSTEM (BAS).

3.2. WARRANTY

.1 Warranty shall be 24 months from the date of Substantial Performance of the work. Warranty shall be on-site parts and labour inclusive.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 ASTM International Inc.

.1 ASTM A53/A53M-[07], Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.

.2 ASTM A105/A105M-[05], Standard Specification for Carbon Steel Forgings, for Piping Applications.

1.2 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 datasheets for fixtures, and include product characteristics, performance criteria, physical size, finish and limitations.

.1 Manufacturer, model number, line contents, pressure and temperature rating.

.2 Movement handled, axial, lateral, angular and the amounts of each.

.3 Nominal size and dimensions including details of construction and assembly.

1.3 CLOSEOUT SUBMITTALS

.1 Provide maintenance and operation data in accordance with Section 01 78 00 - Closeout Submittals.

.1 Data to include:

.1 Servicing requirements, including special requirements, stuffing box packing, lubrication and recommended procedures.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.

.2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

.3 Packaging Waste Management: in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

Part 2 Products

2.1 SLIP TYPE EXPANSION JOINTS

.1 Application: for axial pipe movement, as indicated.

.2 Repacking: under full line pressure.

.3 Body and packing housings: Class 150, 1MPa carbon steel pipe to ASTM A53/A53M, Grade B. Wall thickness to match pipe with raised face flanges to match pipe.

.4 Slip or traverse sleeves: carbon steel pipe to ASTM A53/A53M, Grade B, hard chrome plated.

.5 Anchor base: construction steel, welded to body.

.6 Guides (internal and external): embody into packing housing with concentric alignment of slip or traverse sleeve with packing housing.

.7 Extension limit stop: stainless steel, to prevent over-extension with accessible and removable pins.

.8 Packing rings: 6 minimum, graphite impregnated non-asbestos.

.9 Thermal plastic packing: graphite impregnated non-asbestos slug supplied loose.

.10 Lubricating fittings: pet cocks with grease nipple.

.11 Plunger body and plunger:

.1 Plunger body: heavy wall carbon steel welded to body.

.2 Plunger: carbon steel with hex head for use with socket wrench.

.12 Lubricant: to manufacturer's recommendations.

.13 Lubricant gun: complete with hose assembly.

.14 Drip connection: 20 MPa forged steel to ASTM A105/A105M. Include half coupling with drain plug.

2.2 BELLOWS TYPE EXPANSION JOINTS

.1 For axial, lateral or angular movements, as indicated.

.2 Maximum operating pressure: 1030 kPa.

.3 Maximum operating temperature: 150 degrees C.

.4 Type A: free flexing, factory tested to 1 times maximum working pressure. Provide test certificates.

.5 Type B: externally pressurized, constant volume, pressure balanced, designed to eliminate pressure thrust, factory tested to 1 times maximum working pressure. Provide test certificates.

.6 Bellows:

.1 Multiple bellows, hydraulically formed, two ply, austenitic stainless steel for specified fluid, pressure and temperature, water treatment and pipeline cleaning procedures.

.7 Reinforcing or control rings:

.1 2 piece nickel iron.

.8 Ends:

.1 Raised face flanges to match pipe.

.9 Liner:

.1 Austenitic stainless steel in direction of flow.

.10 Shroud:

.1 Carbon steel, painted.

2.3 GROOVED END EXPANSION JOINTS

.1 Packless, Gasketted, Slip, Expansion Joints:

.1 2413 kPa maximum working pressure.

.2 Steel pipe fitting consisting of telescoping body and slip-pipe sections.

.3 PTFE modified polyphenylene sulfide coated slide section.

.4 Suitable for axial end movement to 75 mm.

.2 Expansion joint consisting of series of grooved end pipe nipples joined in tandem with flexible couplings. Total joint movement dependent on number of couplings and nipples used.

2.4 FLEXIBLE CONNECTION

.1 Application: to suit motion as indicated.

.2 Minimum length in accordance with manufacturer's recommendations to suit offset as indicated.

.3 Inner hose: stainless steel corrugated.

.4 Braided wire mesh stainless steel outer jacket.

.5 Diameter and type of end connection: as indicated.

.6 Operating conditions:

.1 Working pressure: 1034 kPa.

.2 Working temperature: 150 degrees C.

.3 To match system requirements.

.7 Three flexible grooved couplings placed in close proximity to vibration source for vibration attenuation and stress relief.

2.5 ANCHORS AND GUIDES

.1 Anchors:

.1 Provide as indicated.

.2 Concrete: to Section 03 30 00 - Cast-in-Place Concrete.

.3 Reinforcement: to Section 03 20 00 - Concrete Reinforcing.

.2 Alignment guides:

.1 By conduit manufacturer.

.2 To accommodate specified thickness of insulation.

.3 Vapour barriers, jackets to remain uninterrupted.

Part 3 Execution

3.1 APPLICATION

.1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 INSTALLATION

.1 Install expansion joints with cold setting, as instructed by NRC Departmental Representative. Make record of cold settings.

.2 Install expansion joints and flexible connections in accordance with manufacturer's instructions.

.3 Install pipe anchors and guides as indicated. Anchors to withstand 150 % of axial thrust.

3.3 PIPE CLEANING AND START-UP

.1 In accordance with Section 23 08 02 - Cleaning and Start-up of Mechanical Piping Systems.

3.4 PERFORMANCE VERIFICATION

.1 In accordance with Section 23 08 01 - Performance Verification: Mechanical Piping Systems.

3.5 CLEANING

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

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

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 American National Standards Institute/American Society of Mechanical Engineers (ANSI/ASME)

.1 ANSI/ASME B31.1- 2007 , Power Piping.

.2 ANSI/ASME B31.3- 2006 , Process Piping.

.3 ANSI/ASME Boiler and Pressure Vessel Code- 2007 :

.1 BPVC 2007 Section I: Power Boilers.

.2 BPVC 2007 Section V: Nondestructive Examination.

.3 BPVC 2007 Section IX: Welding and Brazing Qualifications.

.2 American National Standards Institute/American Water Works Association (ANSI/AWWA)

.1 ANSI/AWWA C206- 03 , Field Welding of Steel Water Pipe.

.3 American Welding Society (AWS)

.1 AWS C1.1M/C1.1- 2000(R2006) , Recommended Practices for Resistance Welding.

.2 AWS Z49.1- 2005 , Safety in Welding, Cutting and Allied Process.

.3 AWS W1- 2000 , Welding Inspection Handbook..

.4 Canadian Standards Association (CSA International)

.1 CSA W47.2- M1987(R2008) , Certification of Companies for Fusion Welding of Aluminum.

.2 CSA W48- 06 , Filler Metals and Allied Materials for Metal Arc Welding.

.3 CSA B51- 03(R2007) , Boiler, Pressure Vessel and Pressure Piping Code.

.4 CSA-W117.2- 2006 , Safety in Welding, Cutting and Allied Processes.

.5 CSA W178.1- 2008 , Certification of Welding Inspection Organizations.

.6 CSA W178.2- 2008 , Certification of Welding Inspectors.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

1.3 QUALITY ASSURANCE

.1 Qualifications:

.1 Welders:

.1 Welding qualifications in accordance with CSA B51.

.2 Use qualified and licensed welders possessing certificate for each procedure performed from authority having jurisdiction.

.3 Submit welder's qualifications to NRC Departmental Representative.

.4 Each welder to possess identification symbol issued by authority having jurisdiction.

.5 Certification of companies for fusion welding of aluminum in accordance with CSA W47.2.

.2 Inspectors:

.1 Inspectors qualified to CSA W178.2.

.3 Certifications:

.1 Registration of welding procedures in accordance with CSA B51.

.2 Copy of welding procedures available for inspection.

.3 Safety in welding, cutting and allied processes in accordance with CSA-W117.2.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.

.2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

.3 Packaging Waste Management: in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

Part 2 Products

2.1 ELECTRODES

.1 Electrodes: in accordance with CSA W48 Series.

Part 3 Execution

3.1 APPLICATION

.1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 QUALITY OF WORK

.1 Welding: in accordance with ANSI/ASME B31.3, ANSI/ASME Boiler and Pressure Vessel Code, Sections I and IX and ANSI/AWWA C206, using procedures conforming to AWS B3.0, AWS C1.1, and applicable requirements of provincial authority having jurisdiction.

3.3 INSTALLATION REQUIREMENTS

.1 Identify each weld with welder's identification symbol.

.2 Backing rings:

.1 Where used, fit to minimize gaps between ring and pipe bore.

.2 Do not install at orifice flanges.

.3 Fittings:

.1 NPS 2 and smaller: install welding type sockets.

.2 Branch connections: install welding tees or forged branch outlet fittings.

3.4 INSPECTION AND TESTS - GENERAL REQUIREMENTS

.1 Review weld quality requirements and defect limits of applicable codes and standards with NRC Departmental Representative before work is started.

.2 Formulate "Inspection and Test Plan" in co-operation with NRC Departmental Representative.

.3 Do not conceal welds until they have been inspected, tested and approved by inspector.

.4 Provide for inspector to visually inspect welds during early stages of welding procedures in accordance with Welding Inspection Handbook. Repair or replace defects as required by codes and as specified.

3.5 SPECIALIST EXAMINATIONS AND TESTS

.1 General:

.1 Perform examinations and tests by specialist qualified to CSA W178.1 and CSA W178.2 and approved by NRC Departmental Representative.

.2 To ANSI/ASME Boiler and Pressure Vessels Code, Section V, CSA B51 and requirements of authority having jurisdiction.

.3 Inspect and test 10 % of welds in accordance with "Inspection and Test Plan" by non-destructive visual examination spot gamma ray radiographic (hereinafter referred to as "radiography") tests.

.2 Hydrostatically test welds to ANSI/ASME B31.1.

.3 Visual examinations: include entire circumference of weld externally and wherever possible internally.

.4 Failure of visual examinations:

.1 Upon failure of welds by visual examination, perform additional testing as directed by NRC Departmental Representative of total of up to 10.

.5 Full radiographic tests for steam piping systems.

.1 Spot radiography:

.1 Conduct spot radiographic tests of up to 10% of welds, selected at random by NRC Departmental Representative from welds which would be most difficult to repair in event of failure after system is operational.

.2 Radiographic film:

.1 Identify each radiographic film with date, location, name of welder, and submit to NRC Departmental Representative. Replace film if rejected because of poor quality.

.3 Interpretation of radiographic films:

.1 By qualified radiographer.

.4 Failure of radiographic tests:

.1 Extend tests to welds by welder responsible when those welds fails tests.

3.6 DEFECTS CAUSING REJECTION

.1 As described in ANSI/ASME B31.1 and ANSI/ASME Boiler and Pressure Vessels Code.

.2 In addition, chilled water systems:

.1 Undercutting greater than 0.8 mm adjacent to cover bead on outside of pipe.

.2 Undercutting greater than 0.8 mm adjacent to root bead on inside of pipe.

.3 Undercutting greater than 0.8 mm at combination of internal surface and external surface.

.4 Incomplete penetration and incomplete fusion greater than total length of 38 mm in 1500 mm length of weld depth of such defects being greater than 0.8 mm.

.5 Repair cracks and defects in excess of 0.8 mm in depth.

.6 Repair defects whose depth cannot be determined accurately on basis of visual examination or radiographic tests.

3.7 REPAIR OF WELDS WHICH FAILED TESTS

.1 Re-inspect and re-test repaired or re-worked welds at Contractor's expense.

3.8 CLEANING

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

.2 Waste Management:in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 American National Standards Institute (ANSI)/American Society of Mechanical Engineers (ASME)

.1 ANSI/ASME B1.20.1- 1983(R2006) , Pipe Threads, General Purpose (Inch).

.2 ANSI/ASME B16.18- 2001 , Cast Copper Alloy Solder Joint Pressure Fittings.

.2 ASTM International

.1 ASTM A276- 08 , Standard Specification for Stainless Steel Bars and Shapes.

.2 ASTM B62- 02 , Standard Specification for Composition Bronze or Ounce Metal Castings.

.3 ASTM B283- 08a , Standard Specification for Copper and Copper Alloy Die Forgings (Hot-Pressed).

.4 ASTM B505/B505M- 08a , Standard Specification for Copper-Base Alloy Continuous Castings.

.3 Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS)

.1 MSS-SP-25- 1998 , Standard Marking System for Valves, Fittings, Flanges and Unions.

.2 MSS-SP-80- 2008 , Bronze Gate Globe, Angle and Check Valves.

.3 MSS-SP-110- 1996 , Ball Valves, Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.

1.2 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 for equipment and systems and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Submit WHMIS MSDS - Material Safety Data Sheets in accordance with Section 02 81 01 - Hazardous Materials .

.3 Shop Drawings:

.1 Submit drawings stamped and signed by professional engineer registered or licensed in Province Territory of Canada.

.2 Submit data for valves specified in this Section.

1.3 CLOSEOUT SUBMITTALS

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

1.4 MAINTENANCE MATERIAL SUBMITTALS

.1 Extra Materials/Spare Parts:

.1 Furnish following spare parts:

.1 Valve seats: one for every 10 valves each size, minimum 1 .

.2 Discs: one for every 10 valves, each size. Minimum 1 .

.3 Stem packing: one for every 10 valves, each size. Minimum 1 .

.4 Valve handles: 2 of each size.

.5 Gaskets for flanges: one for every 10 flanged joints.

.2 Tools:

.1 Furnish special tools for maintenance of systems and equipment.

.2 Include following:

.1 Lubricant gun for expansion joints.

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:

.1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

.3 Packaging Waste Management: remove for reuse of pallets, crates, padding, packaging materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal .

Part 2 Products

2.1 MATERIALS

.1 Valves:

.1 Except for specialty valves, to be single manufacturer.

.2 Products to have CRN registration numbers.

.2 End Connections:

.1 Connection into adjacent piping/tubing:

.1 Steel pipe systems: screwed ends to ANSI/ASME B1.20.1.

.2 Copper tube systems: solder ends to ANSI/ASME B16.18.

.3 Lockshield Keys:

.1 Where lockshield valves are specified, provide 10 keys of each size: malleable iron cadmium plated.

.4 Gate Valves:

.1 Requirements common to gate valves, unless specified otherwise:

.1 Standard specification: MSS SP-80.

.2 Bonnet: union with hexagonal shoulders.

.3 Connections: screwed with hexagonal shoulders.

.4 Inspection and pressure testing: to MSS SP-80. Tests to be hydrostatic.

.5 Packing: non-asbestos.

.6 Handwheel: non-ferrous.

.7 Handwheel Nut: bronze to ASTM B62.

.2 NPS 2 and under, non-rising stem, solid wedge disc, Class 125

.1 Body: with long disc guides, screwed bonnet with stem retaining nut.

.2 Operator: Handwheel .

.3 NPS 2 and under, non-rising stem, solid wedge disc, Class 150:

.1 Body: with long disc guides, screwed bonnet with stem retaining nut.

.2 Operator: handwheel .

.4 NPS 2 and under, rising stem, split wedge disc, Class 125:

.1 Body: with long disc guides, screwed bonnet.

.2 Disc: split wedge, bronze to ASTM B283, loosely secured to stem.

.3 Operator: handwheel .

.5 NPS 2 and under, rising stem, solid wedge disc, Class 125:

.1 Body: with long disc guides, screwed bonnet.

.2 Operator: handwheel .

.6 NPS 2 and under, rising stem, solid wedge disc, Class 150:

.1 Body: with long disc guides, screwed bonnet.

.2 Operator: handwheel .

.5 Globe Valves:

.1 Requirements common to globe valves, unless specified otherwise:

.1 Standard specification: MSS SP-80.

.2 Bonnet: union with hexagonal shoulders.

.3 Connections: screwed with hexagonal shoulders.

.4 Pressure testing: to MSS SP-80. Tests to be hydrostatic.

.5 Stuffing box: threaded to bonnet with gland follower, packing nut, high grade non-asbestos packing.

.6 Handwheel: non-ferrous.

.7 Handwheel Nut: bronze to ASTM B62.

.2 NPS 2 and under, composition disc, Class 125:

.1 Body and bonnet: screwed bonnet.

.2 Disc and seat: renewable rotating PTFE disc , regrindable bronze seat, loosely secured to bronze stem to ASTM B505.

.3 Operator: handwheel .

.3 NPS 2 and under, composition disc, Class 150:

.1 Body and bonnet: union bonnet.

.2 Disc and seat: renewable rotating PTFE disc in easily removable disc holder, regrindable bronze seat, loosely secured to bronze stem to ASTM B505.

.3 Operator: handwheel .

.4 NPS 2 and under, plug disc, Class 150, screwed ends:

.1 Body and bonnet: union bonnet.

.2 Disc and seat ring: tapered plug type with disc stem ring of AISI S420 stainless steel to ASTM A276, loosely secured to stem.

.3 Operator: handwheel .

.5 Angle valve, NPS 2 and under, composition disc, Class 150:

.1 Body and bonnet: union bonnet.

.2 Disc and seat: renewable rotating PTFE disc in slip-on easily removable disc holder having integral guides, regrindable bronze seat, loosely secured to stem.

.3 Operator: handwheel .

.6 Self Balancing and Control Valves (13mm TO 32mm)

.1 Class 125 bronze body, maximum actuator close off pressure is 620 kPa, 120℃ max. temperature rating, Dezinc resistant brass body, EPDM O-Ring and seat, stainless steel spring, cone and screws, Wrought copper plug, Die forged brass seat.

.2 Danfoss AM-QM. Fig AB-QM 1/2 - 1 1/4 Globe style or equivalent.

.3 Acceptable alternate product shall include BELIMO P2 Series Proportional/MFT pressure independent characterized control valves.

.4 Actuators to be AME-110NL unless specified otherwise

.5 All hydronic control valves to be self balancing type unless specified otherwise.

.7 Check Valves:

.1 Requirements common to check valves, unless specified otherwise:

.1 Standard specification: MSS SP-80.

.2 Connections: screwed with hexagonal shoulders.

.2 NPS 2 and under, swing type, bronze disc, Class 125:

.1 Body: Y-pattern with integral seat at 45 degrees, screw-in cap with hex head.

.2 Disc and seat: renewable rotating disc, two-piece hinge disc construction; seat: regrindable.

.3 NPS 2 and under, swing type, bronze disc:

.1 Body: Y-pattern with integral seat at 45 degrees, screw-in cap with hex head.

.2 Disc and seat: renewable rotating disc, two-piece hinge disc construction; seat: regrindable.

.4 NPS 2 and under, swing type, composition disc, Class 200:

.1 Body: Y-pattern with integral seat at 45 degrees, screw-in cap with hex head.

.2 Disc: renewable rotating disc of number 6 composition to suit service conditions, bronze two-piece hinge disc construction.

.5 NPS 2 and under, horizontal lift type, composition disc, Class 150:

.1 Body: with integral seat, union bonnet ring with hex shoulders, cap.

.2 Disc: renewable PTFE rotating disc in disc holder having guides top and bottom, of bronze to ASTM B62.

.6 NPS 2 and under, vertical lift type, bronze disc, Class 125:

.1 Disc: rotating disc having guides top and bottom, disc guides, retaining rings.

.8 Silent Check Valves:

.1 NPS 2 and under:

.1 Body: cast high tensile bronze to ASTM B62 with integral seat.

.2 Pressure rating: Class 125 .

.3 Connections: screwed ends to ANSI B1.20.1 and with hex. shoulders.

.4 Disc and seat: renewable rotating disc.

.5 Stainless steel spring, heavy duty.

.6 Seat: regrindable.

.9 Ball Valves:

.1 NPS 2 and under:

.1 Body and cap: cast high tensile bronze to ASTM B62.

.2 Pressure rating: Class125 , 860 kPa steam.

.3 Connections: screwed ends to ANSI B1.20.1 and with hexagonal shoulders solder ends to ANSI .

.4 Stem: tamperproof ball drive.

.5 Stem packing nut: external to body.

.6 Ball and seat: replaceable stainless steel solid ball and Teflon seats.

.7 Stem seal: TFE with external packing nut.

.8 Operator: removable lever handle.

.10 Butterfly Valves:

.1 NPS 2 1/2 through NPS 6, 2068 kPa with grooved ends.

.1 Body: cast bronze, with copper-tube dimensioned grooved ends.

.2 Disc: elastomer coated ductile iron with integrally cast stem.

.3 Operator: lever .

Part 3 Execution

3.1 INSTALLATION

.1 Install rising stem valves in upright position with stem above horizontal.

.2 Remove internal parts before soldering.

.3 Install valves with unions at each piece of equipment arranged to allow servicing, maintenance, and equipment removal.

3.2 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 recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal .

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 American Society of Mechanical Engineers (ASME)

.1 ASME B16.1- 05 , Cast Iron Pipe Flanges and Flanged Fittings.

.2 ASTM International Inc.

.1 ASTM A49- 01(2006) , Standard Specification for Heat-Treated Carbon Steel Joint Bars.

.2 ASTM A126- 04 , Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.

.3 ASTM A536- 84(2004)e1 , Standard Specification for Ductile Iron Castings.

.4 ASTM B61- 08 , Standard Specification for Steam or Valve Bronze Castings.

.5 ASTM B62- 02 , Standard Specification for Composition Bronze or Ounce Metal Castings.

.6 ASTM B85/B85M- 08 , Standard Specification for Aluminum-Alloy Die Castings.

.7 ASTM B209- 07 , Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.

.3 Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS)

.1 MSS SP-61- 03 , Pressure Testing of Steel Valves.

.2 MSS SP-70- 06 , Grey Iron Gate Valves, Flanged and Threaded Ends.

.3 MSS SP-71- 05 , Grey Iron Swing Check Valves, Flanged and Threaded Ends.

.4 MSS SP-82- 1992 , Valve Pressure Testing Methods.

.5 MSS SP-85- 2002 , Cast Iron Globe and Angle Valves, Flanged and Threaded Ends.

1.2 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 datasheets for valves and include product characteristics, performance criteria, physical size, finish and limitations.

1.3 CLOSEOUT SUBMITTALS

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

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements .

.2 Delivery and Acceptance Requirements:

.1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

.3 Packaging Waste Management: remove for reuse of pallets crates padding packaging materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal .

1.5 MAINTENANCE MATERIAL SUBMITTALS

.1 Extra Materials/Spare Parts:

.2 Furnish following spare parts:

.1 Valve seats: one for every 10 valves each size, minimum 1 .

.2 Discs: one for every 10 valves, each size, minimum 1 .

.3 Stem packing: one for every 10 valves, each size, minimum 1 .

.4 Valve handles: 2 of each size.

.5 Gaskets for flanges: one for every 10 flanged joints.

.3 Tools:

.1 Furnish special tools for maintenance of systems and equipment.

.2 Include following:

.1 Lubricant gun for expansion joints.

Part 2 Products

2.1 MATERIAL

.1 Valves:

.1 Except for specialty valves, to be of single manufacturer.

.2 Standard specifications:

.1 Gate valves: MSS SP-70.

.2 Globe valves: MSS SP-85.

.3 Check valves: MSS SP-71.

.3 Requirements common to valves, unless specified otherwise:

.1 Body, bonnet: cast iron to ASTM B209 Class B .

.2 Connections: flanged ends to ANSI B16.1.

.3 Inspection and pressure testing: to MSS SP-82.

.4 Bonnet gasket: non-asbestos.

.5 Stem: to have precision-machined Acme or 60 degrees V threads, top screwed for handwheel nut.

.6 Stuffing box: non-galling two-piece ball-jointed packing gland, gland bolts and nuts.

.7 Gland packing: non-asbestos.

.8 Handwheel: die-cast aluminum alloy to ASTM B85/B85M or malleable iron to ASTM A49. Nut of bronze to ASTM B62.

.9 Identification tag: with catalogue number, size, other pertinent data.

.4 All products to have CRN registration numbers.

2.2 GATE VALVES

.1 NPS 2 1/2 - 8, non rising stem, inside screw, bronze trim, solid wedge disc:

.1 Body and multiple-bolted bonnet: with, full length disc guides designed to ensure correct re-assembly, Class 125.

.2 Disc: solid offset taper wedge, bronze to ASTM B62.

.3 Seat rings: renewable bronze to ASTM B62, screwed into body.

.4 Stem: bronze to ASTM B62.

.5 Disc: solid offset taper wedge, cast iron to ASTM A126 Class B, secured to wrought steel stem.

.6 Seat: integral with body.

.7 Stem: wrought steel.

.8 Operator: handwheel .

.9 Bypass: complete with union and NPS gate valve as Section 23 05 23.01 - Valves - Bronze .

.2 NPS 10 - 24, non rising stem, inside crew, bronze trim, solid wedge disc:

.1 Body and multiple-bolted bonnet: cast iron to ASTM A126 Class B for sizes up to NPS 14, Class C for sizes NPS 16 and over, with bosses in body and bonnet for taps and drains, full length disc guides designed to ensure correct re-assembly, body tie ribs between bonnet and end flanges.

.2 Pressure ratings: Class 125.

.3 Disc: solid offset taper wedge, with bronze rings to ASTM B62 rolled into cast iron disc, secured to stem.

.4 Seat rings: renewable bronze to ASTM B62 screwed into body.

.5 Stem: bronze to ASTM B62.

.6 Disc: solid offset taper wedge, cast iron secured to stem.

.7 Seat: integral with body up to NPS 14, renewable nodular iron on other sizes.

.8 Stem: wrought steel.

.9 Operator: handwheel .

.10 Bypass: complete with union and NPS gate valve as Section 23 05 05 - Installation of Pipework .

.3 NPS 2 1/2-8, outside screw and yoke (OS Y), bronze trim, solid wedge disc:

.1 Body and multiple-bolted bonnet: with bosses in body and bonnet for taps and drains, full length disc guides designed to ensure correct re-assembly, yoke, yoke hub, yoke sleeve and nut. Class 125.

.2 Disc: solid offset taper wedge, bronze to ASTM B62 up to NPS 3, cast iron with bronze disc rings on other sizes, secured to stem through integral forged T-head disc-stem connection.

.3 Seat rings: renewable bronze screwed into body.

.4 Stem: nickel-plated steel .

.5 Disc: solid offset taper all-cast iron, secured to stem through integral forged T-head disc-stem connection.

.6 Seat rings: integral with body.

.7 Stem: nickel-plated steel.

.8 Pressure-lubricated operating mechanism.

.9 Operator: handwheel .

.10 Bypass: complete with union and NPS gate globe valve as Section 23 05 05 - Installation of Pipework .

.4 NPS 10 - 24, outside screw and yoke (OS Y), bronze trim, solid wedge disc:

.1 Body and multiple-bolted bonnet: NPS 10 - 14: cast iron to ASTM A126 Class B. With bosses in body and bonnet for taps and drains, full length disc guides designed to ensure correct re-assembly, body tie ribs between bonnet and end flanges, yoke, yoke hub, yoke sleeve and nut.

.2 Pressure ratings: Class 125.

.1 NPS 10-12: WP = 1.4 Mpa CWP.

.2 NPS 14-24: WP = 1.03 Mpa CWP.

.3 Disc: solid offset taper wedge, bronze disc rings to ASTM B62 rolled into cast iron disc, secured to stem through integral forged T-head disc-stem connection.

.4 Seat rings: renewable bronze to ASTM B62 screwed into body.

.5 Stem: nickel-plated steel .

.6 Disc: solid offset taper all-cast iron, secured to stem through integral forged T-head disc-stem connection.

.7 Seat: integral with body up to NPS 14, renewable nodular iron on other sizes.

.8 Stem: nickel-plated steel.

.9 Pressure-lubricated operating mechanism.

.10 Operator: handwheel .

.11 Bypass: complete with union and NPS gate valve as Section 23 05 23.01 - Valves - Bronze.

2.3 UNDERWRITERS APPROVED GATE VALVE

.1 NPS 2 1/2 - 14, OS Y:

.1 Approvals: UL and FM approved for fire service.

.2 UL and FM Label: on valve yoke.

.3 Body, Bonnet: cast iron to ASTM A126 Class B.

.4 Bonnet bushing, yoke sleeve: bronze, to FM requirements.

.5 Packing gland: bronze.

.6 Stem: manganese bronze. Diameter to ULC C-262 (B). .

.7 Stuffing box dimensions, gland bolt diameter: to ULC C-262 (B).

.8 Bosses for bypass valve, drain: on NPS 4 and over.

.9 Disc: solid taper wedge. Up to NPS 3: bronze. NPS 4 and over: EPDM coated cast iron with bronze disc rings.

.10 Disc seat ring: self-aligning, Milwood undercut on NPS 3 - 12.

.11 Pressure rating:

.1 NPS 2-1/2 - 12: 1.7 Mpa CWP.

.2 NPS 14-1.2: 1.2 MPa CWP.

.12 Operator: handwheel.

.13 Bypass: complete with union and NPS gate valve as Section 23 05 23.01 - Valves - Bronze .

2.4 GLOBE VALVES

.1 NPS 2 1/2 - 10, OSY:

.1 Body: with multiple-bolted bonnet.

.2 WP: 860 kPa steam, 1.4 MPa CWP.

.3 Bonnet-yoke gasket: non-asbestos.

.4 Disc: bronze to ASTM B62, fully guided from bottom, securely yet freely connected to stem for swivel action and accurate engagement with disc.

.5 Seat ring: renewable, regrindable, screwed into body.

.6 Stem: bronze to ASTM B62.

.7 Operator: handwheel .

.8 Bypass: complete with union and NPS gate valve as Section 23 05 23.01 - Valves - Bronze .

2.5 SELF BALANCING AND CONTROL VALVES (38MM TO 50MM)

.1 Class 250 Ductile iron body, maximum actuator close off pressure is 620 kPa, 120℃ max. temperature rating, EPDM O-Ring and membrane, stainless steel spring, seat, cone(Pc) and screws, Wrought copper cone (Cv).

.2 Danfoss AB-QM. Fig AB-QM 11/ 2- 2 Globe style

.3 Actuators to be AME-15QM unless specified otherwise

.4 All hydronic control valves to be self balancing type unless specified otherwise.

2.6 SELF BALANCING AND CONTROL VALVES (65MM TO 100MM)

.1 Class 250 ductile iron body, maximum actuator close off pressure is 620 kPa, 120℃ max. temperature rating, EPDM O-Ring and membrane,

stainless steel spring, seat, cone(Pc) and screws, Wrought copper cone (Cv).

.2 Danfoss AB-QM. Fig AME 55QM Globe style

.3 Actuators to be AME-15QM unless specified otherwise

.4 All hydronic control valves to be self balancing type unless specified otherwise.

2.7

2.8 BYPASSES FOR GATE AND GLOBE VALVES

.1 Locations: on valves as indicated.

.2 Size of bypass valve:

.1 Main valve up to NPS 8: NPS 3/4.

.2 Main valve NPS 10 and over: NPS 1.

.3 Type of bypass valves:

.1 On gate valve: globe, with bronze disc, bronze trim, to Section 23 05 23.01 - Valves - Bronze . Pressure rating to match main valve.

.2 On globe valve: globe, with bronze disc, bronze trim, to Section 23 05 23.01 - Valves - Bronze . Pressure rating to match main valve.

2.9 VALVE OPERATORS

.1 Install valve operators as follows:

.1 Handwheel: on valves except as specified.

.2 Handwheel with chain operators: on valves installed more than 2400 mm above floor in mechanical equipment rooms .

2.10 CHECK VALVES

.1 Swing check valves, Class 125:

.1 Body and bolted cover: with tapped and plugged opening on each side for hinge pin. Grooved or flanged ends: plain faced with smooth finish.

.1 Up to NPS 16: cast iron to ASTM A126 Class B ductile iron ASTM A536 Grade 65-45-12 .

.2 Ratings:

.1 NPS 2 1/2 - 12: 860 kPa steam; 1.4 MPa CWP.

.2 NPS 14 - 16: 860 kPa steam; 1.03 MPa CWP.

.3 NPS 18 and over: 1.03 MPa CWP.

.3 Disc: rotating for extended life.

.1 Up to NPS 6: bronze to ASTM B62 .

.2 NPS 8 and over: bronze-faced cast iron.

.4 Seat rings: renewable bronze to ASTM B62 screwed into body.

.5 Hinge pin, bushings: renewable bronze to ASTM B62 .

.6 Disc: A126 Class B, secured to stem, rotating for extended life.

.7 Seat: cast iron, integral with body.

.8 Hinge pin: exelloy; bushings: malleable iron.

.9 Identification tag: fastened to cover.

.10 Hinge: stainless steel .

.2 Swing check valves, NPS 2 1/2 - 8 Class 250:

.1 Body and bolted cover: cast iron to ASTM A126 Class B with tapped and plugged opening on each side for hinge pin.

.2 Flanged ends: 2 mm raised face with serrated finish.

.3 Rating: 250 psi steam; 500 psi CWP.

.4 Disc: rotating for extended life.

.1 Up to NPS 3: bronze to ASTM B61.

.2 NPS 4 - 8: iron faced with ASTM B61 bronze.

.5 Seat rings: renewable bronze to ASTM B61, screwed into body.

.6 Hinge pin, bushings: renewable, bronze to ASTM B61.

.7 Hinge: galvanized malleable iron.

.8 Identification tag: fastened to cover.

2.11 SILENT CHECK VALVES

.1 Construction:

.1 Body: malleable with integral seat.

.2 Pressure rating: Class 125, WP = 860 kPa.

.3 Connections: grooved ends.

.4 Disc: bronze renewable rotating disc.

.5 Seat: renewable, EPDM.

.6 Stainless steel spring, heavy duty.

Part 3 Execution

3.1 INSTALLATION

.1 Install rising stem valves in upright position with stem above horizontal.

3.2 CLEANING

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

.2 Clean installed products in accordance to manufacturer's recommendation.

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

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 American National Standards Institute (ANSI)/American Society of Mechanical Engineers (ASME)

.1 ASME B16, Fittings and Valves Package.

.2 ASME B16.5-2009, Pipe Flanges and Flanged Fittings: NPS through NPS 24 Metric/Inch Standard.

.3 ANSI/ASME B16.10-2009, Face-to-Face and End-to-End Dimensions Valves.

.4 ANSI/ASME B16.25- 2007 , Buttwelding Ends.

.5 ANSI/ASME B16.34- 2009 , Valves Flanged, Threaded and Welding End. Includes Supplement (2010).

.2 American Petroleum Institute (API)

.1 API STD 598- 2009 , Valve Inspection and Testing.

.3 ASTM International

.1 ASTM A49- 12 , Standard Specification for Heat-Treated Carbon Steel Joint Bars, Micro Alloyed Joint Bars, and Forged Carbon Steel Comprise Joint Bars.

.2 ASTM A182/A182M- 11a , Standard Specification for Specification for Forged or Rolled Alloy and Stainless Steel Pipe Flanges, Forged Fittings, and Valve Parts for High Temperature Service.

.3 ASTM A193/A193M- 12 , Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature or High Pressure Service and Other Special Purpose Applications.

.4 ASTM A194/A194M- 2011 , Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High-Pressure and High-Temperature Service, or Both.

.5 ASTM A216/A216M- 08 , Standard Specification for Steel Castings, Carbon Suitable for Fusion Welding for High-Temperature Service.

.6 ASTM B85/B85M- 10 , Standard Specification for Aluminum-Alloy Die Castings.

.4 Efficiency Valuation Organization (EVO)

.1 International Performance Measurement and Verification Protocol (IPMVP)

.1 IPMVP 2007 Version.

.5 Green Seal Environmental Standards (GS)

.1 GS-11- 11 , Standard for Paints and Coatings.

.2 GS-36- 11 , Standard for Commercial Adhesives.

.6 Manufacturers Standardization Society of the Valve and Fittings Industry (MSS)

.1 MSS SP-25- 2008 , Standard Marking System for Valves, Fittings, Flanges and Unions.

.2 MSS SP-61- 2009 , Pressure Testing of Valves.

1.2 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 each valve and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

1.3 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 00 - Closeout Submittals .

.2 Operation and Maintenance Data: submit operation and maintenance data for valves for incorporation into manual.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements .

.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 in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect valves from nicks, scratches, and blemishes .

.3 Replace defective or damaged materials with new.

.4 Develop Construction Waste Management Plan related to Work of this Section .

.5 Packaging Waste Management: remove for reuse by manufacturer of pallets, crates, padding, packaging materials as specified in Construction Waste Management Plan .

1.5 MAINTENANCE MATERIAL SUBMITTALS

.1 Submit in accordance with Section 01 78 00 - Closeout Submittals .

.2 Extra Stock Materials:

.3 Furnish following spare parts:

.1 Valve seats: one for every 10 valves each size, minimum 1 .

.2 Discs: one for every 10 valves, each size, minimum 1 .

.3 Stem packing: one for every 10 valves, each size. Minimum 1 .

.4 Valve handles: 2 of each size.

.5 Gaskets for flanges: one for every 10 flanged joints.

Part 2 Products

2.1 MATERIAL

.1 Valves:

.1 To be of single manufacturer.

.2 Test valves individually.

.2 Requirements common to valves, unless specified otherwise:

.1 Pressure-temperature ratings: to ANSI B16.34.

.2 Inspections and tests: to API 598.

.3 Pressure testing: to MSS SP-61.

.4 Flanged valves:

.1 Face-to-face dimensions: to ANSI B16.10.

.2 Flange dimensions: to ANSI B16.5 with 1.6 mm raised face.

.5 Butt-weld valves:

.1 End-to-end dimensions: to ANSI B16.10.

.2 End dimensions: to ANSI B16.25 bored for standard pipe schedule .

.6 Handwheel: non-heating type with raised rim of die-cast aluminum alloy to ASTM B85 or malleable iron to ASTM A49.

.7 Markings: to MSS SP-25.

.8 Identification:

.1 Plate showing catalogue number, size, material of body disc, stem seat, fluid, pressure-temperature rating.

.2 Body markings: manufacturer, size, primary service rating, material symbol.

.9 CRN registration number required for all products.

2.2 GATE VALVES

.1 NPS 2 1/2 - 12, rising stem, OS Y, solid wedge disc, flanged ends, Class 150 :

.1 Body and multiple-bolted integral yoke and bonnet: cast steel to ASTM A216/A216M WCB, with full length disc guides designed to ensure correct re-assembly.

.2 Body/bonnet joint: flat face with corrugated metallic gasket.

.3 Bonnet studs: to ASTM A193/A193M Type B7.

.4 Bonnet nuts: to ASTM A194/A194M Type 2H.

.5 Stuffing box: including non-galling two-piece ball jointed packing gland, with swing-type eye bolts and nuts.

.6 Gland packing: containing corrosion inhibitor to prevent stem pitting.

.7 Yoke sleeve: Ni-Resist, minimum melting point above 954 degrees C.

.8 Hydraulic grease fitting: for lubrication of yoke sleeve bearing surfaces.

.9 Disc: with disc stem ring to connect to stem, guided throughout its travel.

.1 NPS 2 1/2 - 6: solid corrosion and heat resistant 13% chromium steel with minimum hardness of 350 HB.

.2 NPS 8 and larger: carbon steel faced with corrosion and heat resistant 13 chromium steel with minimum hardness of 350 HB.

.10 Seat ring: seamless carbon steel with hard-faced cobalt-chromium-tungsten alloy seating surface, slipped in, seal welded, ground to match disc.

.11 Stem: heat treated corrosion and heat resistant 13% chromium steel with accurately-cut precision-machined Acme or 60 degrees V threads, top screwed for handwheel nut, T-head disc-stem connection.

.12 Operator: see elsewhere in this Section.

2.3 GLOBE VALVES

.1 NPS 2 1/2 - 12, rising stem, OS Y, flanged ends, Class 150 :

.1 Body and multiple-bolted integral yoke and bonnet: cast steel to ASTM A216/A216M WCB.

.2 Body/bonnet joint: flat face with corrugated metallic gasket.

.3 Bonnet studs: to ASTM A193/A193M Type B7.

.4 Bonnet nuts: to ASTM A194/A194M Type 2H.

.5 Stuffing box: including non-galling two-piece ball-jointed packing gland, with swing-type eye bolts and nuts.

.6 Gland packing: containing corrosion inhibitor to prevent stem pitting.

.7 Yoke bushing: Ni-Resist, minimum melting point above 954 degrees C.

.8 Hydraulic grease fitting: for lubrication of yoke sleeve bearing surfaces.

.9 Disc: plug type with 15 degrees taper seat and bottom guide .

.10 Seat rings: with 1.6 mm thick cobalt-chromium-tungsten alloy facings with minimum hardness of 375 HB (cold), slipped in, seal welded, ground to match disc.

.11 Stem: heat treated corrosion and heat resistant 13% chromium steel with bonnet bushing, long engagement with yoke bushing for accurate seating, accurately-cut precision-machined Acme or 60 degrees V threads, top screwed for handwheel nut.

.12 Operator: see elsewhere in this Section.

2.4 VALVE OPERATORS

.1 Handwheel: on all valves.

.2 Handwheel with chain operators: on valves installed more than 2400 mm above floor in mechanical equipment rooms .

2.5 BYPASSES FOR GATE AND GLOBE VALVES

.1 Locations: on valves as indicated.

.2 Size of bypass valve:

.1 Main valve up to NPS 8: NPS 3/4.

.3 Type of bypass valves:

.1 On gate valve: globe, with bronze disc, bronze trim, to Section 23 05 23.01 - Valves - Bronze .

.2 On globe valve: globe, with bronze disc, bronze trim, to Section 23 05 23.01 - Valves - Bronze .

2.6 CHECK VALVES

.1 NPS 2 1/2 and over, flanged ends, Class 150 : swing check.

.1 Body and multiple-bolted cap: cast steel to ASTM A216/A216M WCB.

.2 Cap studs: to ASTM A193/A193M Type B7.

.3 Cap nuts: to ASTM A194/A194M Type 2H.

.4 Body/cap joint: male-female face with corrugated metallic gasket.

.5 Disc: heat treated corrosion and heat resistant 13% chromium steel.

.6 Seat rings: heat treated corrosion and heat resistant 13% chromium steel, slipped in, seal welded, ground to match disc.

.7 Hinge: ASTM A182/A182M .

.8 Hinge pin: ASTM A182/A182M .

.9 Hinge pin plugs: ASTM A182/A182M .

2.7 SILENT CHECK VALVES

.1 Construction:

.1 Body: cast steel with integral seat.

.2 Pressure rating: Class 125 .

.3 Connections: flanged ends.

.4 Double bronze disc with SS seat and stem. Renewable disc, seat, stem and spring. Spring rating must match system design for silent operation and installation.

.5 Stainless steel spring, heavy duty.

.6 Seat: regrindable.

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 NRC Departmental Representative .

.2 Inform NRC 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 NRC Departmental Representative .

3.2 INSTALLATION

.1 Install in accordance with manufacturer's recommendations in upright position with stem above horizontal.

3.3 COMMISSIONING

.1 As part of commissioning activities, develop schedule of valves and record thereon identifier, location, service, purchase order number and date, manufacturer, identification data specified above.

3.4 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 recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal .

.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.5 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by cast steel valve installation.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 American Society of Mechanical Engineers (ASME)

.1 ASME B31.1- 07 , Power Piping.

.2 ASTM International

.1 ASTM A125- 1996(2007) , Standard Specification for Steel Springs, Helical, Heat-Treated.

.2 ASTM A307- 07b , Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.

.3 ASTM A563- 07a , Standard Specification for Carbon and Alloy Steel Nuts.

.3 Factory Mutual (FM)

.4 Manufacturer's Standardization Society of the Valves and Fittings Industry (MSS)

.1 MSS SP58- 2002 , Pipe Hangers and Supports - Materials, Design and Manufacture.

.2 MSS SP69- 2003 , Pipe Hangers and Supports - Selection and Application.

.3 MSS SP89- 2003 , Pipe Hangers and Supports - Fabrication and Installation Practices.

.5 Underwriter's Laboratories of Canada (ULC)

1.2 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 for hangers and supports and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:

.1 Submit shop drawings for:

.1 Bases, hangers and supports.

.2 Connections to equipment and structure.

.3 Structural assemblies.

.4 Certificates:

.1 Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.5 Manufacturers' Instructions:

.1 Provide manufacturer's installation instructions.

.1 NRC Departmental Representative will make available 1 copy of systems supplier's installation instructions.

1.3 CLOSEOUT SUBMITTALS

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

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.

.2 Delivery and Acceptance Requirements:

.1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

.3 Packaging Waste Management: in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

Part 2 Products

2.1 SYSTEM DESCRIPTION

.1 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 B31.1 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 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 in accordance with MSS SP58.

2.2 GENERAL

.1 Fabricate hangers, supports and sway braces in accordance with MSS SP58.

2.3 PIPE HANGERS

.1 Finishes:

.1 Pipe hangers and supports: galvanized.

.2 Use electro-plating galvanizing process.

.3 Ensure steel hangers in contact with copper piping are 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 carbon steel retaining clip.

.1 Rod: 9 mm UL listed.

.2 Cold piping NPS 2 1/2 or greater, hot piping: malleable iron beam clamp, eye rod, jaws and extension with carbon steel retaining clip, tie rod, nuts and washers, UL listed to MSS-SP58.

.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, UL listed to MSS SP69.

.2 Cold piping NPS 2 1/2 or greater, hot piping: malleable iron top-of-beam jaw-clamp with hooked rod, spring washer, plain washer and nut UL 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 UL listed to MSS SP69.

.5 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 Do not use 22 mm or 28 mm rod.

.6 Pipe attachments: material to MSS SP58:

.1 Attachments for steel piping: carbon steel.

.2 Attachments for copper piping: copper plated black steel.

.3 Use insulation shields for hot pipework.

.4 Oversize pipe hangers and supports.

.7 Adjustable clevis: material to MSS SP69 UL listed, clevis bolt with nipple spacer and vertical adjustment nuts above and below clevis.

.1 Ensure "U" has hole in bottom for rivetting to insulation shields.

.8 Yoke style pipe roll: carbon steel yoke, rod and nuts with cast iron roll, to MSS SP69.

.9 U-bolts: carbon steel to MSS SP69 with 2 nuts at each end to ASTM A563.

.1 Finishes for steel pipework: black.

.2 Finishes for copper, glass, brass or aluminum pipework: epoxy coated.

.10 Pipe rollers: cast iron roll and roll stand with carbon steel rod to MSS SP69.

2.4 RISER CLAMPS

.1 Steel or cast iron pipe: galvanized carbon steel to MSS SP58, type 42, UL 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^3 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 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 Section 05 12 23 - Structural Steel for Buildings. 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 Section 05 50 00 - Metal Fabrications.

2.11 HOUSE-KEEPING PADS

.1 Provide 100 mm high concrete housekeeping pads for base-mounted equipment; size pads 50 mm larger than equipment; chamfer pad edges.

.2 Concrete: to Section 03 30 00 - Cast-in-Place Concrete.

2.12 OTHER EQUIPMENT SUPPORTS

.1 Fabricate equipment supports from structural grade steel meeting requirements of Section 05 12 23 - Structural Steel for Buildings .

.2 Submit structural calculations with shop drawings.

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 in accordance with:

.1 Manufacturer's instructions and recommendations.

.2 Vibration Control Devices:

.1 Install on piping systems at pumps, boilers, chillers, cooling towers, and 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 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 Provide supplementary structural steelwork where structural bearings do not exist or where concrete inserts are not in correct locations.

.6 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.

.7 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.

3.3 HANGER SPACING

.1 Plumbing piping: to Canadian Plumbing Code.

.2 Fire protection: to applicable fire code.

.3 Gas and fuel oil piping: up to NPS 1/2: every 1.8 m.

.4 Copper piping: up to NPS 1/2: every 1.5 m.

.5 Flexible joint roll groove pipe: in accordance with table below for steel, but not less than one hanger at joints. Table listings for straight runs without concentrated loads and where full linear movement is not required.

.6 Within 300 mm of each elbow.

Maximum Pipe Size : NPS	Maximum Spacing Steel	Maximum Spacing Copper
up to 1-1/4	2.4 m	1.8 m
1-1/2	3.0 m	2.4 m
2	3.0 m	2.4 m
2-1/2	3.7 m	3.0 m
3	3.7 m	3.0 m
3-1/2	3.7 m	3.3 m
4	3.7 m	3.6 m
5	4.3 m	
6	4.3 m	
8	4.3 m	
10	4.9 m	
12	4.9 m	

.7 Pipework greater than NPS 12: to MSS SP69.

3.4 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.

3.5 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.

3.6 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.

3.7 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 - ACTION AND INFORMATIONAL SUBMITTALS.

.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.

3.8 CLEANING

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

.1 Remove surplus materials, excess materials, rubbish, tools and equipment.

.2 Waste Management: in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

.2 National Fire Protection Association (NFPA)

.1 NFPA 13-2002, Standard for the Installation of Sprinkler Systems.

.3 National Building Code of Canada (NBC) - 1995

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.

.1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.

.2 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.

.1 Provide system shop drawings complete with performance and product data.

.2 Provide detailed drawings of seismic control measures for equipment and piping.

.3 Shop drawings to be prepared by a professional engineer licensed in the Province of Ontario.

.3 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.

.1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.2 Instructions: submit manufacturer's installation instructions.

.3 Manufacturer's Field Reports: manufacturer's field reports specified.

.4 Closeout:

.1 Provide review letter signed and sealed by engineer licensed in the Province of Ontario verifying review of seismic installation is complete and in compliance with engineered seismic design.

.5 Seismic Design Requirements.

.1 Sa(0.2) = 0.633

.2 Fa = 1.14

.3 I = 1.0

1.3 QUALITY ASSURANCE

.1 Health and Safety:

.1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

1.4 DELIVERY, STORAGE, AND HANDLING

.1 Packing, shipping, handling and unloading:

.1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.

.2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.2 Waste Management and Disposal:

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

Part 2 Products

2.1 GENERAL

.1 Size and shape of bases type and performance of vibration isolation as indicated.

2.2 ELASTOMERIC PADS

.1 Type EP1 - neoprene waffle or ribbed; 9 mm minimum thick; 50 durometer; maximum loading 350 kPa.

.2 Type EP2 - rubber waffle or ribbed; 9 mm minimum thick; 30 durometer natural rubber; maximum loading 415 kPa.

.3 Type EP3 - neoprene-steel-neoprene; 9 mm minimum thick neoprene bonded to 1.71 mm steel plate; 50 durometer neoprene, waffle or ribbed; holes sleeved with isolation washers; maximum loading 350 kPa.

.4 Type EP4 - rubber-steel-rubber; 9 mm minimum thick rubber bonded to 1.71 mm steel plate; 30 durometer natural rubber, waffle or ribbed; holes sleeved with isolation washers; maximum loading 415 kPa.

2.3 ELASTOMERIC MOUNTS

.1 Type M1 - colour coded; neoprene in shear; maximum durometer of 60; threaded insert and two bolt-down holes; ribbed top and bottom surfaces.

2.4 SPRINGS

.1 Design stable springs: ratio of lateral to axial stiffness is equal to or greater than 1.2 times ratio of static deflection to working height. Select for 50% travel beyond rated load. Units complete with levelling devices.

.2 Ratio of height when loaded to diameter of spring between 0.8 to 1.0.

.3 Cadmium plate for 100% relative humidity installations.

.4 Colour code springs.

2.5 SPRING MOUNT

.1 Zinc or cadmium plated hardware; housings coated with rust resistant paint.

.2 Type M2 - stable open spring: support on bonded 6 mm minimum thick ribbed neoprene or rubber friction and acoustic pad.

.3 Type M3 - stable open spring: 6 mm minimum thick ribbed neoprene or rubber friction and acoustic pad, bonded under isolator and on isolator top plate; levelling bolt for rigidly mounting to equipment.

.4 Type M4 - restrained stable open spring: supported on bonded 6 mm minimum thick ribbed neoprene or rubber friction and acoustic pad; built-in resilient limit stops, removable spacer plates.

.5 Type M5 - enclosed spring mounts with snubbers for isolation up to 950 kg maximum.

2.6 HANGERS

.1 Colour coded springs, rust resistant, painted box type hangers. Arrange to permit hanger box or rod to move through a 30 degrees arc without metal to metal contact.

.2 Type H1 - neoprene - in-shear, moulded with rod isolation bushing which passes through hanger box.

.3 Type H2 - stable spring, elastomeric washer, cup with moulded isolation bushing which passes through hanger box.

.4 Type H3 - stable spring, elastomeric element, cup with moulded isolation bushing which passes through hanger box.

.5 Type H4 - stable spring, elastomeric element with precompression washer and nut [with deflection indicator].

2.7 ACOUSTIC BARRIERS FOR ANCHORS AND GUIDES

.1 Acoustic barriers: between pipe and support, consisting of 25 mm minimum thick heavy duty duck and neoprene isolation material.

2.8 HORIZONTAL THRUST RESTRAINT

.1 Spring and elastomeric element housed in box frame; assembly complete with rods and angle brackets for equipment and ductwork attachment; provision for adjustment to limit maximum start and stop movement to 9 mm.

.2 Arrange restraints symmetrically on either side of unit and attach at centerline of thrust.

2.9 STRUCTURAL BASES

.1 Type B1 - Prefabricated steel base: integrally welded on sizes up to 2400 mm on smallest dimension, split for field welding on sizes over 2400 mm on smallest dimension and reinforced for alignment of drive and driven equipment; without supplementary hold down devices; complete with isolation element attached to base brackets arranged to

minimize height; pre-drilled holes to receive equipment anchor bolts; and complete with adjustable built-in motor slide rail where indicated.

.2 Type B2 - Steel rail base: structural steel, positioned for alignment of drive and driven equipment; without supplementary hold down devices; complete with isolation element attached to base brackets arranged to minimize height; and pre-drilled holes to receive equipment anchor bolts.

.3 Bases to clear housekeeping pads by 25 mm minimum.

2.10 INERTIA BASE

.1 Type B3 - Full depth perimeter structural or formed channels, frames: welded in place reinforcing rods running in both directions; spring mounted, carried by gussetted height-saving brackets welded to frame; and clear housekeeping pads by 50 mm minimum.

.2 Pump bases: "T" shaped, where applicable, to provide support for elbows.

.3 Concrete: to Section 03 30 00 - Cast-in-Place Concrete.

2.11 ROOF CURB ISOLATION RAILS

.1 General: complete factory assembled without need for sub-base.

.2 Lower member: continuous extruded aluminum channel.

.3 Upper member: continuous extruded aluminum channel to provide continuous support for equipment, complete with all-directional neoprene snubber bushings 6 mm thick to resist wind and seismic forces.

.4 Springs: steel, adjustable, removable, selected for 25 mm maximum static deflection plus 50% additional travel to solid, cadmium plated, sized and positioned to ensure uniform deflection.

.5 High frequency isolation: 6 mm minimum thick continuous gasket on top and bottom of complete assembly. Material: closed cell neoprene.

.6 Weatherproofing: continuous flexible counterflashing to curb and providing access to springs. Material: aluminum.

.7 Hardware: cadmium plated or galvanized.

2.12 SEISMIC CONTROL MEASURES

.1 General:

.1 Following systems and/or equipment to remain operational during and after earthquakes:

.1 Steam.

.2 Chillers

.3 Refrigerant-containing devices

.2 Seismic control systems to work in every direction.

.3 Fasteners and attachment points to resist same maximum load as seismic restraint.

.4 Drilled or power driven anchors and fasteners not permitted.

.5 No equipment, equipment supports or mounts to fail before failure of structure.

.6 Supports of cast iron or threaded pipe not permitted.

.7 Seismic control measures not to interfere with integrity of firestopping.

.2 Static equipment:

.1 Anchor equipment to equipment supports. Anchor equipment supports to structure.

.2 Suspended equipment:

.1 Use one or more of following methods depending upon site conditions:

.1 Install tight to structure.

.2 Cross brace in every direction.

.3 Brace back to structure.

.4 Cable restraint system.

.3 Seismic restraints:

.1 Cushioning action gentle and steady.

.2 Never reach metal-like stiffness.

.3 Vibration isolated equipment:

.1 Seismic control measures not to jeopardize noise and vibration isolation systems. Provide 6 to 9 mm clearance during normal operation of equipment and systems between seismic restraint and equipment.

.2 Incorporate seismic restraints into vibration isolation system to resist complete isolator unloading.

.4 Piping systems:

.1 Fire protection systems: to NFPA 13.

.2 Piping systems: hangers longer than 300 mm; brace at each hanger.

.3 Compatible with requirements for anchoring and guiding of piping systems.

.5 Bracing methods:

.1 Approved by NRC Departmental Representative.

.2 Structural angles or channels.

.3 Cable restraint system incorporating grommets, shackles and other hardware to ensure alignment of restraints and to avoid bending of cables at connection points. Incorporate neoprene into cable connections to reduce shock loads.

.6 Service and utilities entrance into building: anchor services to structure.

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 Seismic control measures to meet requirements of NBC.

.2 Install vibration isolation equipment in accordance with manufacturers instructions and adjust mountings to level equipment.

.3 Ensure piping, ducting and electrical connections to isolated equipment do not reduce system flexibility and that piping, conduit and ducting passage through walls and floors do not transmit vibrations.

.4 Unless indicated otherwise, support piping connected to isolated equipment with spring mounts or spring hangers with 25 mm minimum static deflection as follows:

.1 Up to NPS4: first 3 points of support. NPS5 to NPS8: first 4 points of support. NPS10 and Over: first 6 points of support.

.2 First point of support: static deflection of twice deflection of isolated equipment, but not more than 50 mm.

.5 Where isolation is bolted to floor use vibration isolation rubber washers.

.6 Block and shim level bases so that ductwork and piping connections can be made to rigid system at operating level, before isolator adjustment is made. Ensure that there is no physical contact between isolated equipment and building structure.

3.3 FIELD QUALITY CONTROL

.1 Manufacturer's Field Services:

.1 Arrange with manufacturer's representative to review work of this Section and submit written reports to verify compliance with Contract Documents.

.2 Manufacturer's Field Services: consisting of product use recommendations and periodic site visits to review installation, scheduled as follows:

.1 After delivery and storage of Products.

.2 After preparatory work is complete but before installation commences.

.3 Twice during the installation, at 25% and 60% completion stages.

.4 Upon completion of installation.

.3 Submit manufacturer's reports to NRC Departmental Representative within 3 days of manufacturer representative's review.

.4 Make adjustments and corrections in accordance with written report.

.2 Inspection and Certification:

.1 Experienced and competent sound and vibration testing professional engineer to take vibration measurement for HVAC systems after start up and TAB of systems to Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.

.2 Take vibration measurements for equipment listed below.

.1 All motor-driven equipment

.2 All compressors

.3 All fans

.3 Provide NRC Departmental Representative with notice 24 h in advance of commencement of tests.

.4 Establish adequacy of equipment isolation and acceptability of noise levels in occupied areas and where appropriate, remedial recommendations (including sound curves).

.5 Submit complete report of test results including sound curves.

3.4 CLEANING

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

.2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Materials and requirements for the identification of piping systems, duct work, valves and controllers, including the installation and location of identification systems.

1.2 REFERENCES

.1 The most recent version of the following codes are to be followed

.2 Canadian Gas Association (CGA)

.1 CSA/CGA B149.1, Natural Gas and Propane Installation Code.

.3 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-1.60, Interior Alkyd Gloss Enamel.

.2 CAN/CGSB-24.3, Identification of Piping Systems.

.4 National Fire Protection Association (NFPA)

.1 NFPA 13, Standard for the Installation of Sprinkler Systems.

.2 NFPA 14, Standard for the Installation of Standpipe and Hose Systems.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Product Data:

.2 Submittals: in accordance with Section 01 33 00 - Submittal Procedures .

.3 Product data to include paint colour chips, other products specified in this section.

.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.

1.4 QUALITY ASSURANCE

.1 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures .

.2 Health and Safety:

.1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements .

1.5 DELIVERY, STORAGE, AND HANDLING

.1 Packing, shipping, handling and unloading:

.1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements .

.2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.2 Waste Management and Disposal:

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

.2 Dispose of unused paint coating material at official hazardous material collections site approved by NRC Departmental Representative .

.3 Do not dispose of unused paint coating material into sewer system, into streams, lakes, onto ground or in locations where it will pose health or environmental hazard.

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 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 , 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 .

.5 Identification for PWGSC Preventive Maintenance Support System (PMSS):

.1 Use arrangement of Main identifier, Source identifier, Destination identifier.

.2 Equipment in Mechanical Room:

.1 Main identifier: size #9.

.2 Source and Destination identifiers: size #6.

.3 Terminal cabinets, control panels: size #5.

.3 Equipment elsewhere: sizes as appropriate.

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 NRC Departmental Representative .

2.4 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: 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 Other pipes: pressure sensitive vinyl with protective overcoating, waterproof contact adhesive undercoating, suitable for ambient of 100% RH and continuous operating temperature of 150 degrees C and intermittent temperature of 200 degrees C.

.7 Colours and Legends:

.1 Where not listed, obtain direction from NRC Departmental Representative .

.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
Condenser water supply	Green	COND. WTR. SUPPLY
Condenser water return	Green	COND. WTR. RETURN
Chilled water supply	Green	CH. WTR. SUPPLY
Chilled water return	Green	CH. WTR. RETURN
Hot water heating supply	Yellow	HEATING SUPPLY
Hot water heating return	Yellow	HEATING RETURN
Steam _____ kPa	Yellow	_____ kPa STEAM
Steam condensate (gravity)	Yellow	ST.COND.RET (GRAVITY)
Steam condensate (pumped)	Yellow	ST.COND.RET (PUMPED)
Safety valve vent	Yellow	STEAM VENT
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
Refrigeration hot gas	Yellow	REF. HOT GAS
Compressed air (	Green	COMP. AIR _____ kPa
Compressed air (700kPa)	Yellow	COMP. AIR _____ kPa
Vacuum	Green	VACUUM
Instrument air	Green	INSTRUMENT AIR

2.5 IDENTIFICATION DUCTWORK SYSTEMS

.1 50 mm high stencilled letters and directional arrows 150 mm long x 50 mm high.

.2 Colours: back, or co-ordinated with base colour to ensure strong contrast.

2.6 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.

2.7 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.

2.8 LANGUAGE

.1 Identification in English and French .

.2 Use one nameplate and label for each language both languages .

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 TIMING

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

3.3 INSTALLATION

.1 Perform work in accordance with CAN/CGSB-24.3 except as specified otherwise.

.2 Provide CSA registration plates as required by respective agency.

.3 Identify systems, equipment to conform to PWGSC PMSS.

3.4 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.

3.5 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, and dampers. Where this is not possible, place identification as close as possible, preferably on upstream side.

.9 Identification easily and accurately readable from usual operating areas and from access points.

.1 Position of identification 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.

3.6 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 NRC Departmental Representative . Provide one copy (reduced in size if required) in each operating and maintenance manual.

.3 Number valves in each system consecutively.

3.7 CLEANING

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

.2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 TAB is used throughout this Section to describe the process, methods and requirements of testing, adjusting and balancing for HVAC.

.2 TAB means to test, adjust and balance to perform in accordance with requirements of Contract Documents and to do other work as specified in this section.

1.2 QUALIFICATIONS OF TAB PERSONNEL

.1 Submit names of personnel to perform TAB to NRC Representative within 90 days of award of contract.

.2 Provide documentation confirming qualifications, successful experience.

.3 TAB: performed in accordance with the requirements of standard under which TAB Firm's qualifications are approved:

.1 Associated Air Balance Council, (AABC) National Standards for Total System Balance, MN-1-2002.

.2 National Environmental Balancing Bureau (NEBB) TABES, Procedural Standards for Testing, Adjusting, Balancing of Environmental Systems-1998.

.3 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA), HVAC TAB HVAC Systems - Testing, Adjusting and Balancing-2002.

.4 Recommendations and suggested practices contained in the TAB Standard: mandatory.

.5 Use TAB Standard provisions, including checklists, and report forms to satisfy Contract requirements.

.6 Use TAB Standard for TAB, including qualifications for TAB Firm and Specialist and calibration of TAB instruments.

.7 Where instrument manufacturer calibration recommendations are more stringent than those listed in TAB Standard, use manufacturer's recommendations.

.8 TAB Standard quality assurance provisions such as performance guarantees form part of this contract.

.1 For systems or system components not covered in TAB Standard, use TAB procedures developed by TAB Specialist.

.2 Where new procedures, and requirements, are applicable to Contract requirements have been published or adopted by body responsible for TAB Standard used (AABC, NEBB, or TABB), requirements and recommendations contained in these procedures and requirements are mandatory.

1.3 PURPOSE OF TAB

.1 Test to verify proper and safe operation, determine actual point of performance, 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 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.

1.4 EXCEPTIONS

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

1.5 CO-ORDINATION

.1 Schedule time required for TAB (including repairs, re-testing) into project construction and completion schedule to ensure completion before acceptance of project.

.2 Do TAB of each system independently and subsequently, where interlocked with other systems, in unison with those systems.

1.6 PRE-TAB REVIEW

.1 Review contract documents before project construction is started confirm in writing to NRC Representative adequacy of provisions for TAB and other aspects of design and installation pertinent to success of TAB.

.2 Review specified standards and report to NRC Representative in writing proposed procedures which vary from standard.

.3 During construction, co-ordinate location and installation of TAB devices, equipment, accessories, measurement ports and fittings.

1.7 START-UP

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

.2 Follow special start-up procedures specified elsewhere in Division 23.

1.8 OPERATION OF SYSTEMS DURING TAB

.1 Operate systems for length of time required for TAB and as required by NRC Representative for verification of TAB reports.

1.9 START OF TAB

.1 Notify NRC Representative 7 days prior to start of TAB.

.2 Start TAB when building is essentially completed, including:

.3 Installation of ceilings, doors, windows, other construction affecting TAB.

.4 Application of weatherstripping, sealing, and caulking.

.5 Pressure, leakage, other tests specified elsewhere Division 23.

.6 Provisions for TAB installed and operational.

.7 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 Filters in place, clean.

.2 Duct systems 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 Outlets 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.

1.10 APPLICATION TOLERANCES

.1 Do TAB to following tolerances of design values:

.1 Laboratory HVAC systems: plus 10 %, minus 0 %.

.2 Other HVAC systems: plus 5 %, minus 5 %.

.3 Hydronic systems: plus or minus 10 %.

1.11 ACCURACY TOLERANCES

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

1.12 INSTRUMENTS

.1 Prior to TAB, submit to NRC Representative list of instruments 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 NRC Representative.

1.13 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit, prior to commencement of TAB:

.2 Proposed methodology and procedures for performing TAB if different from referenced standard.

1.14 TAB REPORT

.1 Format in accordance with referenced standard.

.2 TAB report to show results in SI units and to include:

.1 Project record drawings.

.2 System schematics.

.3 Submit TAB Report in PDF format to NRC Representative for verification and approval, in English in D-ring binders, complete with index tabs.

1.15 VERIFICATION

.1 Reported results subject to verification by NRC Representative.

.2 Provide personnel and instrumentation to verify up to 30 % of reported results.

.3 Number and location of verified results as directed by NRC Representative.

.4 Pay costs to repeat TAB as required to satisfaction of NRC Representative.

1.16 SETTINGS

.1 After TAB is completed to satisfaction of NRC Representative, replace drive guards, close access doors, lock devices in set positions, ensure sensors are at required settings.

.2 Permanently mark settings to allow restoration at any time during life of facility. Do not eradicate or cover markings.

1.17 COMPLETION OF TAB

.1 TAB considered complete when final TAB Report received and approved by NRC Representative.

1.18 AIR SYSTEMS

.1 Standard: TAB to most stringent of TAB standards of AABC NEBB SMACNA ASHRAE.

.2 Do TAB of systems, equipment, components, controls specified Division 23 following systems, equipment, components, controls:

.1 All schedule equipment

.2 Air handlers and all associated terminal boxes, valves, and supply and return outlets

.3 All pumps and associated CBV’s

.3 Qualifications: personnel performing TAB qualified to standards of AABC NEBB.

.4 Measurements: to include as appropriate for systems, equipment, components, controls: air velocity, static pressure, flow rate, pressure drop (or loss), temperatures (dry bulb, wet bulb, dewpoint), duct cross-sectional area, RPM, electrical power, voltage, noise, vibration.

.5 Locations of equipment measurements: to include as appropriate:

.1 Inlet and outlet of dampers, filter, coil, humidifier, fan, other equipment causing changes in conditions.

.2 At controllers, controlled device.

.6 Locations of systems measurements to include as appropriate: main ducts, main branch, sub-branch, run-out (or grille, register or diffuser).

1.19 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 during winter summer design conditions.

.3 Zone pressure differences:

.1 Adjust HVAC systems, equipment, controls to establish specified air pressure differentials, with systems in every possible combinations of normal operating modes. Record minimum and maximum differential pressure achieved.

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 Materials and methods for pressure testing ducts over 5 m in length, forming part of a supply, return or exhaust ductwork system directly or indirectly connected to air handling equipment.

.2 Testing requirements for air valve and branch duct assemblies.

1.2 REFERENCES

.1 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

.2 Sheet Metal and Air Conditioning Contractor's National Association (SMACNA)

.1 SMACNA HVAC Air Duct Leakage Test Manual, [1985].

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Test Reports: submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties. Include pressure test information and results as follows:

.1 Submit proposed report form and test report format to NRC Departmental Representative for approval at least three months before proposed date of first series of tests. Do not start tests until approval received in writing from NRC Departmental Representative.

.2 Prepare report of results and submit to NRC Departmental Representative within 24 hours of completion of tests. Include:

.1 Schematic of entire system.

.2 Schematic of section under test showing test site.

.3 Required and achieved static pressures.

.4 Orifice differential pressure at test sites.

.5 Permissible and actual leakage flow rate (L/s) for test sites.

.6 Witnessed certification of results.

.3 Include test reports in final TAB report.

.4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.5 Instructions: submit manufacturer's installation instructions.

.6 Manufacturer's field reports specified.

1.4 QUALITY ASSURANCE

.1 Pre-Installation Meetings:

.1 Convene pre-installation meeting one week prior to beginning on-site installations.

.1 Verify project requirements.

.2 Review installation and substrate conditions.

.3 Co-ordination with other building subtrades.

.4 Review manufacturer's installation instructions and warranty requirements.

.2 Health and Safety:

.1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

Part 2 Products

2.1 TEST INSTRUMENTS

.1 Test apparatus to include:

.1 Fan capable of producing required static pressure.

.2 Duct section with calibrated orifice plate mounted and accurately located pressure taps.

.3 Flow measuring instrument compatible with the orifice plate.

.4 Calibration curves for orifice plates used.

.5 Flexible duct for connecting to ductwork under test.

.6 Smoke bombs for visual inspections.

.2 Test apparatus: accurate to within +/- 3 % of flow rate and pressure.

.3 Submit details of test instruments to be used to NRC Departmental Representative at least three months before anticipated start date.

.4 Test instruments: calibrated and certificate of calibration deposited with NRC Departmental Representative no more than 28 days before start of tests.

.5 Re-calibrated every six months thereafter.

2.2 EQUIPMENT LEAKAGE TOLERANCES

.1 General building equipment and system components such as VAV boxes, duct heating leakage: 5 %.

.2 Laboratory equipment and system components such as air valves, ducts: 0%.

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 TEST PROCEDURES

.1 Maximum lengths of ducts to be tested consistent with capacity of test equipment.

.2 Section of duct to be tested to include:

.1 Fittings, branch ducts, tap-ins.

.3 Repeat tests until specified pressures are attained. Bear costs for repairs and repetition to tests.

.4 Base partial system leakage calculations on SMACNA HVAC Air Duct Leakage Test Manual.

.5 Seal leaks that can be heard or felt, regardless of their contribution to total leakage.

3.3 SITE TOLERANCES

.1 System leakage tolerances specified are stated as percentage of total flow rate handled by system. Pro-rate specified system leakage tolerances. Leakage for sections of duct systems: not to exceed total allowable leakage.

.2 Leakage tests on following systems not to exceed specified leakage rates.

.1 Small duct systems up to 250 Pa: leakage 2%.

.2 VAV box and duct on downstream side of VAV box: leakage 2%.

.3 Large low pressure duct systems up to 500 Pa: leakage 2%.

.4 HP duct systems up to 1000 Pa pressure classification, including upstream side of VAV boxes: leakage 1.

.3 Evaluation of test results to use surface area of duct and pressure in duct as basic parameters.

3.4 TESTING

.1 Test ducts before installation of insulation or other forms of concealment.

.2 Test after seals have cured.

.3 Test when ambient temperature will not affect effectiveness of seals, and gaskets.

.4 Flexible connections to VAV boxes.

3.5 FIELD QUALITY CONTROL

.1 Manufacturer's Field Services.

.1 Have manufacturer of products, supplied under this Section, review Work involved in the handling, installation/application, protection and cleaning, of its product[s] and submit written reports, in acceptable format, to verify compliance of Work with Contract.

.2 Manufacturer's Field Services: provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

.3 Schedule site visits, to review Work, at stages listed:

.1 After delivery and storage of products, and when preparatory Work, or other Work, on which the Work of this Section depends, is complete but before installation begins.

.2 Twice during progress of Work at 25% and 60% complete.

.3 Upon completion of the Work, after cleaning is carried out.

.4 Obtain reports, within 3 days of review, and submit, immediately, to NRC Departmental Representative.

.2 Performance Verification:

.1 NRC Departmental Representative to witness tests and to verify reported results.

.2 To be certified by same TAB agency approved by NRC Departmental Representative to undertake TAB on this project.

3.6 CLEANING

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

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 Definitions:

.1 For purposes of this section:

.1 "CONCEALED" - insulated mechanical services and equipment in suspended ceilings and non-accessible chases and furred-in spaces.

.2 "EXPOSED" - means "not concealed" as previously defined.

.3 Insulation systems - insulation material, fasteners, jackets, and other accessories.

.2 TIAC Codes:

.1 CRD: Code Round Ductwork,

.2 CRF: Code Rectangular Finish.

.2 Reference Standards:

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

.1 ANSI/ASHRAE/IESNA 90.1-04, SI; Energy Standard for Buildings Except Low-Rise Residential Buildings.

.2 ASTM International Inc.

.1 ASTM B209M-07, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric).

.2 ASTM C335-05ae1, Standard Test Method for Steady State Heat Transfer Properties of Pipe Insulation.

.3 ASTM C411-05, Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.

.4 ASTM C449/C449M-00, Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.

.5 ASTM C547-07e1, Standard Specification for Mineral Fiber Pipe Insulation.

.6 ASTM C553-02e1, Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.

.7 ASTM C612-04e1, Standard Specification for Mineral Fiber Block and Board Thermal Insulation.

.8 ASTM C795-03, Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.

.9 ASTM C921-03a, Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.

.3 Canadian General Standards Board (CGSB)

.1 CGSB 51-GP-52Ma-89, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.

.4 Green Seal Environmental Standards (GSES)

.1 Standard GS-36-00, Commercial Adhesives.

.5 South Coast Air Quality Management District (SCAQMD), California State

.1 SCAQMD Rule 1168-A2005, Adhesive and Sealant Applications.

.6 Thermal Insulation Association of Canada (TIAC): National Insulation Standards (2005).

.7 Underwriters Laboratories of Canada (ULC)

.1 CAN/ULC-S102-03, Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.

.2 CAN/ULC-S701-05, Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering.

1.2 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 datasheets for duct insulation, and include product characteristics, performance criteria, physical size, finish and limitations.

.1 Description of equipment giving manufacturer's name, type, model, year and capacity.

.2 Details of operation, servicing and maintenance.

.3 Recommended spare parts list.

.3 Manufacturers' Instructions:

.1 Provide manufacture's written duct insulation jointing recommendations. and special handling criteria, installation sequence, cleaning procedures.

1.3 QUALITY ASSURANCE

.1 Qualifications:

.1 Installer: 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.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.

.2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

.3 Packaging Waste Management: remove for reuse and return of pallets crates padding packaging materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

Part 2 Products

2.1 FIRE AND SMOKE RATING

.1 To CAN/ULC-S102:

.1 Maximum flame spread rating: 25.

.2 Maximum smoke developed rating: 50.

2.2 INSULATION

.1 Mineral fibre: as specified includes glass fibre, rock wool, slag wool.

.2 Thermal conductivity ("k" factor) not to exceed specified values at 24 degrees C mean temperature when tested in accordance with ASTM C335.

.3 TIAC Code C-1: Rigid mineral fibre board to ASTM C612, with factory applied vapour retarder jacket to CGSB 51-GP-52Ma (as scheduled in PART 3 of this Section).

.4 TIAC Code C-2: Mineral fibre blanket to ASTM C553 faced with factory applied vapour retarder jacket to CGSB 51-GP-52Ma (as scheduled in PART 3 of this section).

.1 Mineral fibre: to ASTM C553.

.2 Jacket: to CGSB 51-GP-52Ma.

.3 Maximum "k" factor: to ASTM C553.

2.3 JACKETS

.1 Canvas:

.1 220 gm/m^2 cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C921.

.2 Lagging adhesive: compatible with insulation.

.1 Maximum VOC limit 250 g/L to SCAQMD Rule 1168.

.3 Aluminum:

.1 To ASTM B209 with moisture barrier as scheduled in PART 3 of this section.

.2 Thickness: 0.50 mm sheet.

.3 Finish: Stucco embossed.

.4 Jacket banding and mechanical seals: 12 mm wide, 0.5 mm thick stainless steel.

.1 Stainless steel:

.5 Type: 316.

.6 Thickness: 0.50 mm sheet.

.7 Finish: Smooth.

.8 Jacket banding and mechanical seals: 12 mm wide, 0.5 mm thick stainless steel.

2.4 ACCESSORIES

.1 Vapour retarder lap adhesive:

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

.1 Maximum VOC limit 50 170 200 g/L to SCAQMD Rule 1168 GSES GS-36.

.2 Indoor Vapour Retarder Finish:

.1 Vinyl emulsion type acrylic, compatible with insulation.

.3 Insulating Cement: hydraulic setting on mineral wool, to ASTM C449.

.4 ULC Listed Canvas Jacket:

.1 220 gm/m^2 cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C921.

.5 Outdoor Vapour Retarder Mastic:

.1 Vinyl emulsion type acrylic, compatible with insulation.

.2 Reinforcing fabric: Fibrous glass, untreated 305 g/m^2.

.6 Tape: self-adhesive, aluminum, reinforced, 50 mm wide minimum.

.7 Contact adhesive: quick-setting

.1 Maximum VOC limit 250 g/L to SCAQMD Rule 1168.

.8 Canvas adhesive: washable.

.1 Maximum VOC limit 250 g/L to SCAQMD Rule 1168.

.9 Tie wire: 1.5 mm stainless steel.

.10 Banding: 12 mm wide, 0.5 mm thick stainless steel.

.11 Facing: 25 mm stainless steel hexagonal wire mesh stitched on one face of insulation with expanded metal lath on other face of insulation.

.12 Fasteners: 4 mm diameter pins with 35 mm diameter clips, length to suit thickness of insulation.

Part 3 Execution

3.1 APPLICATION

.1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 PRE-INSTALLATION REQUIREMENTS

.1 Pressure test ductwork systems complete, witness and certify.

.2 Ensure surfaces are clean, dry, free from foreign material.

3.3 INSTALLATION

.1 Install in accordance with TIAC National Standards.

.2 Apply materials in accordance with manufacturer’s instructions and as indicated.

.3 Use 2 layers with staggered joints when required nominal thickness exceeds 75 mm.

.4 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.

.1 Ensure hangers, and supports are outside vapour retarder jacket.

.5 Hangers and supports in accordance with Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.

.1 Apply high compressive strength insulation where insulation may be compressed by weight of ductwork.

.6 Fasteners: install at 300 mm on centre in horizontal and vertical directions, minimum 2 rows each side.

3.4 DUCTWORK INSULATION SCHEDULE

.1 Insulation types and thicknesses: conform to following table:

TIAC Code	Vapour Retarder	Thickness (mm)	
Rectangular cold and dual temperature supply air ducts	C-1	yes	50
Round cold and dual temperatire supply air ducts	C-2	yes	50
Rectangular warm air ducts	C-1	no	25
Round warm air ducts	C-1	no	25
Outside air ducts to mixing plenum	C-1	yes	25
Mixing plenums	C-1	yes	25
Exhaust duct between dampers and louvres	C-1	no	25
Rectangular ducts outside	C-1	special	50
Round ducts outside	C-1	special	50
Acoustically lined ducts	none		

.2 Exposed round ducts 600 mm and larger, smaller sizes where subject to abuse:

.1 Use TIAC code C-1 insulation, scored to suit diameter of duct.

.1 Finishes: conform to following table:

TIAC Code		
	Rectangular	Round
Indoor, concealed	none	none
Indoor, exposed within mechanical room	Canvas	Canvas
Indoor, exposed elsewhere	Canvas	Canvas
Outdoor, exposed to precipitation	Aluminum	Aluminum
Outdoor, elsewhere	Aluminum	Aluminum

3.5 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 in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

END OF SECTION

Part 1 General

1.1 REFERENCES

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

.1 ANSI/ASHRAE 90.1- 04 -SI Edition, Energy Standard for Buildings Except Low-Rise Residential Buildings.

.2 ASTM International Inc.

.1 ASTM C335- 05ae1 , Standard Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.

.2 ASTM C449/C449M- 07 , Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.

.3 ASTM C533- 07 , Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation.

.4 ASTM C547- 07 , Standard Specification for Mineral Fiber Pipe Insulation.

.5 ASTM C553- 02 , Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.

.6 ASTM C612- 04e1 , Standard Specification for Mineral Fiber Block and Board Thermal Insulation.

.7 ASTM C795- 03 , Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.

.8 ASTM C921- 03a , Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.

.3 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

.4 South Coast Air Quality Management District (SCAQMD), California State

.1 SCAQMD Rule 1168- A2005 , Adhesive and Sealant Applications.

.5 Thermal Insulation Association of Canada (TIAC)

.1 National Insulation Standards 2005 .

.6 Underwriters Laboratories of Canada (ULC)

.1 CAN/ULC-S102- 07 , Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.

1.2 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 datasheets for insulation and adhesives, include product characteristics, performance criteria, physical size, finish and limitations.

.3 Manufacturer's Instructions:

.1 Include procedures to be used and installation standards to be achieved.

.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.

1.3 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements .

.2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

.3 Store at temperatures and conditions recommended by manufacturer.

.4 Packaging Waste Management: remove for reuse by manufacturer of pallets crates padding packaging materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal .

Part 2 Products

2.1 FIRE AND SMOKE RATING

.1 Fire and smoke ratings to CAN/ULC-S102:

.1 Maximum flame spread rating: 25 .

.2 Maximum smoke developed rating: 50 .

2.2 INSULATION

.1 Mineral fibre: includes glass fibre, rock wool, slag wool.

.2 Thermal conductivity ("k" factor) not to exceed specified values at 24 degrees C mean temperature when tested in accordance with ASTM C335.

.3 TIAC Code A-1: rigid moulded mineral fibre without factory applied vapour retarder jacket.

.1 Mineral fibre: ASTM C547.

.2 Maximum "k" factor: ASTM C547.

.4 TIAC Code A-3: rigid moulded mineral fibre with factory applied vapour retarder jacket.

.1 Mineral fibre: ASTM C547.

.2 Jacket: to CGSB 51-GP-52MA.

.3 Maximum "k" factor: ASTM C547.

.5 TIAC Code C-2: mineral fibre blanket unfaced or faced with factory applied vapour retarder jacket (as scheduled in PART 3 of this section).

.1 Mineral fibre: ASTM C553.

.2 Jacket: to CGSB 51-GP-52MA.

.3 Maximum "k" factor: ASTM C553.

.6 TIAC Code A.6: flexible unicellular tubular elastomer.

.1 Insulation: with vapour retarder jacket .

.2 Jacket: to CGSB 51-GP-52MA.

.3 Maximum "k" factor.

.4 Certified by manufacturer free of potential stress corrosion cracking corrodents.

.7 TIAC Code A-2: rigid moulded calcium silicate in sections and blocks, and with special shapes to suit project requirements.

.1 Insulation: ASTM C533.

.2 Maximum "k" factor: ASTM C533.

.3 Design to permit periodic removal and re-installation.

2.3 CEMENT

.1 Thermal insulating and finish

.1 To: ASTM C449/C449M.

.2 Hydraulic setting Air drying on mineral wool, to ASTM C449.

2.4 JACKETS

.1 Canvas:

.1 120 gm/m^2 cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C921.

.2 Lagging adhesive: compatible with insulation.

.2 Aluminum:

.1 To ASTM B209.

.2 Thickness: 0.50 mm sheet.

.3 Finish: smooth .

.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.

2.5 INSULATION SECUREMENTS

.1 Tape: self-adhesive, aluminum, reinforced , 50 mm wide minimum.

.2 Contact adhesive: quick setting.

.3 Canvas adhesive: washable.

.4 Tie wire: 1.5 mm diameter stainless steel.

.5 Bands: Stainless steel, 19 mm wide, 0.5 mm thick.

.6 Facing: 25 mm galvanized steel hexagonal wire mesh on on one face of insulation with expanded metal lath on other face of insulation .

.7 Fasteners: 4 mm diameter pins with 35 mm diameter clips. Length of pin to suit thickness of insulation.

2.6 VAPOUR RETARDER LAP ADHESIVE

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

2.7 INDOOR VAPOUR RETARDER FINISH

.1 Vinyl emulsion type acrylic, compatible with insulation.

2.8 OUTDOOR VAPOUR RETARDER MASTIC

.1 Vinyl emulsion type acrylic, compatible with insulation.

.2 Reinforcing fabric: Fibrous glass, untreated 305 g/m^2.

Part 3 Execution

3.1 APPLICATION

.1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 PRE- INSTALLATION REQUIREMENTS

.1 Pressure testing of equipment and adjacent piping systems complete, witnessed and certified.

.2 Surfaces clean, dry, free from foreign material.

3.3 INSTALLATION

.1 Install in accordance with TIAC National Standards

.1 Hot equipment: To TIAC code 1503-H.

.2 Cold equipment: to TIAC code 1503-C.

.2 Elastomeric Insulation:to remain dry. Overlaps to manufacturer's instructions. Joints tight and sealed properly.

.3 Provide vapour retarder as recommended by manufacturer.

.4 Apply materials in accordance with insulation and equipment manufacturer's instructions and this specification.

.5 Use two layers with staggered joints when required nominal wall thickness exceeds 75 mm.

.6 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.

.1 Hangers, supports outside vapour retarder jacket.

.7 Supports, Hangers:

.1 Apply high compressive strength insulation, suitable for service, at oversized saddles and shoes where insulation saddles have not been provided.

3.4 REMOVABLE, PRE-FABRICATED, INSULATION AND ENCLOSURES

.1 Application: At expansion joints , valves , primary flow measuring elements flanges and unions at equipment .

.2 Installation to permit movement of expansion joint and to permit periodic removal and replacement without damage to adjacent insulation.

3.5 FIRE SUPPRESSION EQUIPMENT INSULATION SCHEDULES

.1 Includes valves, valve bonnets, strainers, flanges and fittings unless otherwise specified.

.2 Hot Equipment:

.1 TIAC code A-1 with mechanical fastenings wire bands and 13 mm cement reinforced with one layer of reinforcing mesh.

.2 TIAC code C-2 unfaced with wire bands and 13 mm cement precede by one layer of reinforcing mesh.

.3 Thicknesses:

Domestic hot water storage tanks 25 mm
Heat exchangers 50 mm
Steam condensate receivers 50 mm
Deaerator-feedwater heaters 50 mm

.3 Steam relief vents:

.1 TIAC code A-2 with 25 mm air gap, mechanical fastenings and 13 mm cement reinforced with one layer of reinforcing mesh.

.4 Cold equipment:

.1 TIAC A-3 with mechanical fastenings and 13 mm cement reinforced with one layer of reinforcing mesh.

.2 TIAC C-2 faced with vapour retardant jacket and with wire bands and 13 mm cement preceded by one layer of reinforcing mesh.

.3 Thicknesses: chillers (except factory insulated) 50 mm.

.5 Finishes:

.1 Equipment in mechanical rooms: TIAC code CEF/1 with canvas jacket.

.2 Equipment elsewhere: TIAC code CEF/2 with canvas jacket.

3.6 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 recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal

END OF SECTION

Part 1 General

1.1 REFERENCES

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

.1 ASHRAE Standard 90.1-[01], Energy Standard for Buildings Except Low-Rise Residential Buildings (IESNA co-sponsored; ANSI approved; Continuous Maintenance Standard).

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

.1 ASTM B209M-[04], Standard Specification for Aluminum and Aluminum Alloy Sheet and Plate [Metric].

.2 ASTM C335-[04], Standard Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.

.3 ASTM C411-[04], Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.

.4 ASTM C449/C449M-[00], Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.

.5 ASTM C533-[2004], Calcium Silicate Block and Pipe Thermal Insulation.

.6 ASTM C547-[2003], Mineral Fiber Pipe Insulation.

.7 ASTM C795-[03], Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.

.8 ASTM C921-[03a], Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.

.3 Canadian General Standards Board (CGSB)

.1 CGSB 51-GP-52Ma-[89], Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.

.2 CAN/CGSB-51.53-[95], Poly (Vinyl Chloride) Jacketting Sheet, for Insulated Pipes, Vessels and Round Ducts

.4 Department of Justice Canada (Jus)

.1 Canadian Environmental Assessment Act (CEAA), 1995, c. 37.

.2 Canadian Environmental Protection Act (CEPA), 1999, c. 33.

.3 Transportation of Dangerous Goods Act (TDGA), 1992, c. 34.

.5 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

.6 Manufacturer's Trade Associations

.1 Thermal Insulation Association of Canada (TIAC): National Insulation Standards (Revised 2004).

.7 Underwriters' Laboratories of Canada (ULC)

.1 CAN/ULC-S102-[03], Surface Burning Characteristics of Building Materials and Assemblies.

.2 CAN/ULC-S701-[01], Thermal Insulation, Polystyrene, Boards and Pipe Covering.

.3 CAN/ULC-S702-[1997], Thermal Insulation, Mineral Fibre, for Buildings

.4 CAN/ULC-S702.2-[03], Thermal Insulation, Mineral Fibre, for Buildings, Part 2: Application Guidelines.

1.2 DEFINITIONS

.1 For purposes of this section:

.1 "CONCEALED" - insulated mechanical services in suspended ceilings and non-accessible chases and furred-in spaces.

.2 "EXPOSED" - will mean "not concealed" as specified.

.2 TIAC ss:

.1 CRF: Code Rectangular Finish.

.2 CPF: Code Piping Finish.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.

.2 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.

.1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00 - Submittal Procedures.

.3 Shop Drawings:

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

.4 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.

.1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.2 Instructions: submit manufacturer's installation instructions.

.1 NRC Departmental Representative will make available 1 copy of systems supplier's installation instructions.

1.4 QUALITY ASSURANCE

.1 Qualifications:

.2 Installer: 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.

.3 Health and Safety:

.1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Packing, shipping, handling and unloading:

.1 Deliver, store and handle in accordance with manufacturer's written instructions and Section 01 61 00 - Common Product Requirements.

.2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.3 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

.2 Storage and Protection:

.1 Protect from weather, construction traffic.

.2 Protect against damage.

.3 Store at temperatures and conditions required by manufacturer.

.3 Waste Management and Disposal:

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

.2 Place excess or unused insulation and insulation accessory materials in designated containers.

.3 Divert unused metal materials from landfill to metal recycling facility approved by NRC Departmental Representative.

.4 Dispose of unused adhesive material at official hazardous material collections site approved by NRC Departmental Representative.

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 Thermal conductivity ("k" factor) not to exceed specified values at 24 degrees C mean temperature when tested in accordance with ASTM E 84.

.2 TIAC Code A-1: rigid moulded inorganic glass fibre without factory applied vapour retarder jacket.

.1 Mineral fibre: to CAN/ULC-S102-M88.

.2 Maximum "k" factor: to CAN/ULC-S102-M88.

.3 Equivalent to Knauf 1000°

.3 TIAC Code A-3: rigid moulded inorganic glass fibre without factory applied vapour retarder jacket.

.1 Mineral fibre: to CAN/ULC-S102-M88.

.2 Maximum "k" factor: to CAN/ULC-S102-M88.

.3 Equivalent to Knauf 1000°

.4 TIAC Code C-2: rigid moulded inorganic glass fibre with factory applied vapour retarder jacket.

.1 Mineral fibre: to CAN/ULC-S102-M88.

.2 Maximum "k" factor: to CAN/ULC-S102-M88.

.3 Equivalent to Knauf 1000°

.5 TIAC Code A-6: flexible closed cell fiber-free tubular elastomeric foam.

.1 Insulation: shall conform to minimum requirements in ASTM C534

.2 Maximum "k" factor: 0.04 W/mK., to ASTM C 177 or C518

.3 All locations, PVC jacketing.

.4 Certified by manufacturer: free of potential stress corrosion cracking corrodants.

.5 Equivalent to AP Armaflex or nOMACO Flex Therm

.6 Produce application to conform to: “NOMACO THERMAL INSULATION SPECIFICATION GUIDE FOR REFRIGERATION SYSTEMS”

.6 TIAC Code A-2: rigid moulded calcium silicate in sections and blocks, and with special shapes to suit project requirements.

.1 Insulation: to ASTM C533.

.2 Maximum "k" factor: 0.059 W/mK to ASTM C 177.

.3 Design to permit periodic removal and re-installation.

.4 Equivalent to Industrial Insulation Group Thermo 12 Gold

2.3 INSULATION SECUREMENT

.1 Tape: self-adhesive, aluminum, plain, 50 mm wide minimum.

.2 Contact adhesive: quick setting.

.3 Canvas adhesive: washable.

.4 Tie wire: 1.5 mm diameter stainless steel.

.5 Bands: stainless steel, 19mm wide, 0.5 mm thick.

2.4 CEMENT

.1 Thermal insulating and finishing cement:

.1 Hydraulic setting on mineral wool, to ASTM C449/C449M.

2.5 VAPOUR RETARDER LAP ADHESIVE

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

2.6 INDOOR VAPOUR RETARDER FINISH

.1 Vinyl emulsion type acrylic, compatible with insulation.

2.7 OUTDOOR VAPOUR RETARDER FINISH

.1 Vinyl emulsion type acrylic, compatible with insulation.

.2 Reinforcing fabric: fibrous glass, untreated 305 g/m^2.

2.8 JACKETS

.1 Polyvinyl Chloride (PVC):

.1 One-piece moulded type [and sheet] to CAN/CGSB-51.53 with pre-formed shapes as required.

.2 Colours: NRC Departmental Representative.

.3 Minimum service temperatures: -20 degrees C.

.4 Maximum service temperature: 65 degrees C.

.5 Moisture vapour transmission: 0.02 perm.

.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.

.7 Special requirements:

.1 Outdoor: UV rated material at least 0.5 mm thick.

.2 Aluminum:

.1 To ASTM B209.

.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, 0.5mm thick at 300 mm spacing.

2.9 WEATHERPROOF CAULKING FOR JACKETS INSTALLED OUTDOORS

.1 Caulking to: Section 07 92 00 - Joint Sealants.

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 PRE-INSTALLATION REQUIREMENT

.1 Pressure testing of piping systems and adjacent equipment to be complete, witnessed and certified.

.2 Type 6 Flex Cell insulation to be operationally tested and inspected prior to installing jacketing.

.3 Surfaces clean, dry, free from foreign material.

3.3 INSTALLATION

.1 Install in accordance with TIAC National Standards.

.2 Apply materials in accordance with manufacturers instructions and this specification.

.3 Use two layers with staggered joints when required nominal wall thickness exceeds 75 mm.

.4 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.

.1 Install hangers, supports outside vapour retarder jacket.

.5 Supports, Hangers:

.1 Apply high compressive strength insulation, suitable for service, at oversized saddles and shoes where insulation saddles have not been provided.

3.4 REMOVABLE, PRE-FABRICATED, INSULATION AND ENCLOSURES

.1 Application: at expansion joints, valves, primary flow measuring elements flanges and unions at equipment.

.2 Design: to permit movement of expansion joint to permit periodic removal and replacement without damage to adjacent insulation.

.3 Insulation:

.1 Insulation, fastenings and finishes: same as system.

.2 Jacket: PVC.

3.5 INSTALLATION OF ELASTOMERIC INSULATION

.1 Insulation to remain dry. Overlaps to manufacturers instructions. Ensure tight joints.

.2 Provide vapour retarder as recommended by manufacturer.

3.6 PIPING INSULATION SCHEDULES

.1 Includes valves, valve bonnets, strainers, flanges and fittings unless otherwise specified.

.2 TIAC Code: A-1.

.1 Securements: Tape at 300 mm on centre.

.2 Seals: lap seal adhesive, lagging adhesive.

.3 Installation: TIAC Code 1501-H.

.3 TIAC Code: A-3.

.1 Securements: Tape at 300 mm on centre.

.2 Seals: VR lap seal adhesive, VR lagging adhesive.

.3 Installation: TIAC Code: 1501-C.

.4 TIAC Code: A-6.

.1 Continuous formed (not Self-Seal)

.2 Seals: lap seal adhesive, lagging adhesive.

.5 TIAC Code: C-2 with vapour retarder jacket.

.1 Seals: lap seal adhesive, lagging adhesive.

.2 Installation: TIAC Code: 1501-C.

.6 TIAC Code: A-2.

.1 Seals: lap seal adhesive, lagging adhesive.

.2 Installation: TIAC Code: 1501-H.

.7 Thickness of insulation as listed in following table.

.1 Run-outs to individual units and equipment not exceeding 4000 mm long.

.2 Do not insulate exposed runouts to plumbing fixtures, chrome plated piping, valves, fittings.

Applica-tion	Temp degrees C	TIAC code	Pipe sizes (NPS) and insulation thickness (mm)										
Run out	to 1	1 1/4 to 2	2 1/2 to 4	5 to 6	8	up to 175	[A-1]	38	50	65	75	90	90
Steam, Saturated and Super heated	over 175	[A-1]	38	65	65	75	90	90					
Condensate Return	60 - 94	[A-1]	25	38	38	38	38	38					
Pumped Condensate return	up to 94	[A-1]	25	38	38	38	38	38					
Boiler Feed Water	[A-1]	25	25	25	25	25	25						
Hot Water Heating	60 - 94	[A-1]	25	38	38	38	38	38					
Hot Water Heating	up to 59	[A-1]	25	25	25	25	38	38					
Glycol Heating	60 - 94	[A-1]	25	38	38	38	38	38					
Glycol Heating	up to 59	[A-1]	25	25	25	25	38	38					

Domestic HWS	[A-1]	25	25	25	38	38	38						
Chilled Water	4 - 13	[A-3]	25	25	25	25	25	25					
Chilled Water or Glycol	below 4	[A-6] 38	38	38	38	38	38	38					
Dual Temp. Heating	[A-3]	[_____]	[_____]	[_____]	[_____]	[_____]	[_____]						
Dual Temp. Cooling	[A-3]	[_____]	[_____]	[_____]	[_____]	[_____]	[_____]						
Chilled Water Pump Casing	[A-3]	25	25	25	25	25	25						
Condenser Water Outdoors	[_____]	[_____]	[_____]	[_____]	[_____]	[_____]							
Condenser Water Indoors	[_____]	[_____]	[_____]	[_____]	[_____]	[_____]							
Refrigerated Drinking Water	[A-3]	25	25	25	25	25	25						
Domestic CWS	[A-3]	25	25	25	25	25	25						
Domestic CWS with vapour retarder	[C-2]	25	25	25	25	25	25						
Refrigerant[hot gas] [liquid] [suction]	4 - 13	[A-6]	25	25	25	25	25	25					
Refrigerant[hot gas] [liquid] [suction]	below 4	[A-6]	25	25	38	38	38	38					
RWL and RWP	[C-2]	25	25	25	25	25	25						
Cooling Coil cond. drain	[C-2]	25	25	25	25	25	25						
Diesel generator exhaust system	[A-2]	38	65	65	75	90	90						

.8 Finishes:

.1 Exposed indoors: PVC jacket.

.2 Exposed in mechanical rooms: PVC jacket.

.3 Concealed, indoors: canvas on valves, fittings. No further finish.

.4 Use vapour retarder jacket on TIAC code A-3 insulation compatible with insulation.

.5 Outdoors: water-proof aluminum jacket.

.6 Finish attachments: SS bands, at 150 mm on centre. Seals: wing.

.7 Installation: to appropriate TIAC code CRF/1 through CPF/5.

3.7 CLEANING

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

.2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General

1.1 REFERENCES

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

.1 ASTM E202-00, Standard Test Methods for Analysis of Ethylene Glycols and Propylene Glycols.

.2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.

.2 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.

.1 Instructions: submit manufacturer's installation instructions.

.1 NRC Representative will make available 1 copy of systems supplier's installation instructions.

1.3 QUALITY ASSURANCE

.1 Health and Safety:

.1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

1.4 DELIVERY, STORAGE, AND HANDLING

.1 Packing, shipping, handling and unloading:

.1 Deliver, store and handle in accordance with manufacturer's written instructions and Section 01 61 00 - Common Product Requirements.

.2 Waste Management and Disposal:

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

Part 2 Products

2.1 CLEANING SOLUTIONS

.1 Tri-sodium phosphate: 0.40 kg per 100 L water in system.

.2 Sodium carbonate: 0.40 kg per 100 L water in system.

.3 Low-foaming detergent: 0.01 kg per 100 L water in 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 CLEANING HYDRONIC AND STEAM SYSTEMS

.1 Timing: systems operational, hydrostatically tested and with safety devices functional, before cleaning is carried out.

.2 Cleaning Agency:

.1 Retain qualified water treatment specialist to perform system cleaning.

.3 Install instrumentation such as flow meters, orifice plates, pitot tubes, flow metering valves only after cleaning is certified as complete by water treatment specialist.

.4 Cleaning procedures:

.1 Provide detailed report outlining proposed cleaning procedures at least 4 weeks prior to proposed starting date. Report to include:

.1 Cleaning procedures, flow rates, elapsed time.

.2 Chemicals and concentrations used.

.3 Inhibitors and concentrations.

.4 Specific requirements for completion of work.

.5 Special precautions for protecting piping system materials and components.

.6 Complete analysis of water used to ensure water will not damage systems or equipment.

.5 Conditions at time of cleaning of systems:

.1 Systems: free from construction debris, dirt and other foreign material.

.2 Control valves: operational, fully open to ensure that terminal units can be cleaned properly.

.3 Strainers: clean prior to initial fill.

.4 Install temporary filters on pumps not equipped with permanent filters.

.5 Install pressure gauges on strainers to detect plugging.

.6 Report on Completion of Cleaning:

.1 When cleaning is completed, submit report, complete with certificate of compliance with specifications of cleaning component supplier.

.7 Hydronic Systems:

.1 Fill system with water, ensure air is vented from system.

.2 Fill expansion tanks 1/3 to 1/2 full, charge system with compressed air to at least 35 kPa (does not apply to diaphragm type expansion tanks).

.3 Use water metre to record volume of water in system to +/- 0.5%.

.4 Add chemicals under direct supervision of chemical treatment supplier.

.5 Closed loop systems: circulate system cleaner at 60 degrees C for at least 36 h. Drain as quickly as possible. Refill with water and inhibitors. Test concentrations and adjust to recommended levels.

.6 Flush velocity in system mains and branches to ensure removal of debris. System pumps may be used for circulating cleaning solution provided that velocities are adequate.

.7 Add chemical solution to system.

.8 Establish circulation, raise temperature slowly to maximum design. Circulate for 12 h, ensuring flow in all circuits. Remove heat, continue to circulate until temperature is below 38 degrees C. Drain as quickly as possible. Refill with clean water. Circulate for 6 h at design temperature. Drain and repeat procedures specified above. Flush through low point drains in system. Refill with clean water adding to sodium sulphite (test for residual sulphite).

.8 Glycol Systems:

.1 In addition to procedures specified above perform specified procedures.

.2 Test to prove concentration will prevent freezing to minus 40 degrees C. Test inhibitor strength and include in procedural report. Refer to ASTM E202.

.9 Steam Systems: in addition to general requirements as specified above, perform following:

.1 Remove internal components of steam traps until flushing and warm-up have been completed.

.2 Open drip points to atmosphere. If needed for protection of personnel or environment, install flexible hose and direct discharge to safe location.

.3 Starting at drip point closest to source, verify removal of condensate, then re-install steam trap internal parts. Repeat sequence down the line.

.4 Water hammer: determine source and eliminate cause.

3.3 START-UP OF HYDRONIC SYSTEMS

.1 After cleaning is completed and system is filled:

.1 Establish circulation and expansion tank level, set pressure controls.

.2 Ensure air is removed.

.3 Check pumps to be free from air, debris, possibility of cavitation when system is at design temperature.

.4 Dismantle system pumps used for cleaning, inspect, replace worn parts, install new gaskets and new set of seals.

.5 Clean out strainers repeatedly until system is clean.

.6 Commission water treatment systems as specified in Section 23 25 00 - HVAC Water Treatment Systems.

.7 Check water level in expansion tank with cold water with circulating pumps OFF and again with pumps ON.

.8 Repeat with water at design temperature.

.9 Check pressurization to ensure proper operation and to prevent water hammer, flashing, cavitation. Eliminate water hammer and other noises.

.10 Bring system up to design temperature and pressure slowly over a 48 hour period.

.11 Perform TAB as specified in Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.

.12 Adjust pipe supports, hangers, springs as necessary.

.13 Monitor pipe movement, performance of expansion joints, loops, guides, anchors.

.14 If sliding type expansion joints bind or if bellows type expansion joints flex incorrectly, shut down system, re-align, repeat start-up procedures.

.15 Re-tighten bolts using torque wrench, to compensate for heat-caused relaxation. Repeat several times during commissioning.

.16 Check operation of drain valves.

.17 Adjust valve stem packings as systems settle down.

.18 Fully open balancing valves (except those that are factory-set).

.19 Check operation of over-temperature protection devices on circulating pumps.

.20 Adjust alignment of piping at pumps to ensure flexibility, adequacy of pipe movement, absence of noise or vibration transmission.

3.4 CLEANING

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

.2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General

1.1 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 electric and electronic control system for HVAC and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

1.2 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.

.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 electric and electronic control systems from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

.4 Packaging Waste Management: in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

Part 2 Products

2.1 THERMOSTAT (LOW VOLTAGE)

.1 Low voltage wall thermostat:

.1 For use on 24 V circuit at 1.5 A capacity.

.2 With heat anticipator adjustable 0.1 to 1.2 A.

.3 Temperature setting range: 10 degrees C to 25 degrees C.

.4 With sub-base.

2.2 THERMOSTAT (REMOTE BULB)

.1 Line voltage remote bulb type thermostat with:

.1 8 A rating on 120 V.

.2 3 m copper capillary tube nylon coated.

.3 Moisture and dust-resistant enclosure.

2.3 THERMOSTAT (FAN COIL)

.1 Line voltage fan coil heating-cooling thermostat with:

.1 Full load rating: 6 A at 120 V.

.2 Four position fan switches for "Low- Medium-High-Off" fan switch.

.3 "Heat-Cool" switch and fan "Off" switch. Fan "Off" switch to break all circuits except heating.

.4 Two rocker switches for "Heat-Off-Cool" and "Low-Medium-High" fan switching. Isolate heating and cooling circuits. "Off" switch to break power to fan and thermostat.

2.4 LOW LIMIT TEMPERATURE ALARM

.1 Low limit temperature alarm with:

.1 Rating: 10.2 A at 120 V.

.2 Sensing bulb and 1.5m long capillary tube.

.3 Switching action: manual.

.4 Temperature setting range: 0 degrees C to 15 degrees C.

2.5 HIGH LIMIT TEMPERATURE ALARM

.1 High limit temperature alarm with:

.1 Rating 10 A at 120 V.

.2 Positive lock-out.

.3 Manual reset only after 14 degrees C drop-in temperature.

.4 Cutout setting: 50 degrees C.

2.6 SAIL SWITCH

.1 Sail switch, mercury bulb type with stainless steel sail, adjustable range set for 2.54 m/s air velocity. Full load: 15 A at 120 V. Maximum ambient temperature: 82 degrees C.

2.7 FLOW SWITCH

.1 Flow switch for 0.05 L/s water, pipe size as indicated, CSA Enclosure, rated at 16 A at 120 V. Maximum liquid temperature: 121 degrees C. Maximum liquid gauge pressure of 1034 kPa ambient temperature range 0 degrees C to 82 degrees C.

2.8 PRESSURE SWITCH

.1 Pressure switch for water, air to gauge pressure of 1034 kPa with auto reset, contacts open on rise. Maximum allowable gauge pressure of 1.2 MPa. Full load 16 A at 120 V, ULC rated.

2.9 CHILLER REFRIGERANT DETECTION/VENTILATION SYSTEM

.1 Wall-mounted controller in NEMA 4X polycarbonate enclosure with keypad, 2x8 character LED display, status LEDs.

.2 Controller complete with three single-pole double throw relays, 1.0A max at 30VDC (resistive load), 0.3A max at 125VAC (resistive load).

.3 Controller output signal RS-485, 4-20mA, 2-10VDC analog signal.

.4 Controller complete with 80dB buzzer at 10cm, 2700Hz

.5 Infrared temperature controlled refrigerant sensor for R410A refrigerant, 0-1000 PPM. Less than 30 seconds response for 90% of step change.

.6 Equivalent to QEL QIRF series to comply with CSA B52.

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 electric and electronic control systems installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate in presence of NRC Departmental Representative.

.2 Inform NRC 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 NRC Departmental Representative.

3.2 INSTALLATION

.1 Install control devices.

.2 On outside wall, mount thermostats on bracket or insulated pad 25 mm from exterior wall.

.3 Install remote sensing device and capillary tube in metallic conduit. Conduit enclosing capillary tube must not touch heater or heating cable.

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 Waste Management: in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 American National Standards Institute (ANSI)/American Welding Society (AWS)

.1 ANSI/AWS A5.8/A5.8M-11, AMD1 Specification Filler Metals for Brazing and Braze Welding.

.2 ASME

.1 ANSI/ASME B16.4-06, Gray-Iron Threaded Fittings Classes 125 and 250.

.2 ANSI/ASME B16.15-11, Cast Copper Alloy Threaded Fittings Classes 125 and 250.

.3 ANSI B16.18-12, Cast Copper Alloy, Solder Joint Pressure Fittings.

.4 ANSI/ASME B16.22-12, Wrought Copper and Copper-Alloy Solder Joint Pressure Fittings.

.3 ASTM International

.1 ASTM B32-08, Standard Specification for Solder Metal.

.2 ASTM B61-08, Standard Specification for Steam or Valve Bronze Castings.

.3 ASTM B62-09, Standard Specification for Composition Bronze or Ounce Metal Castings.

.4 ASTM B88M-05(2011), Standard Specification for Seamless Copper Water Tube Metric.

.5 ASTM E202-12, Standard Test Methods for Analysis of Ethylene Glycols and Propylene Glycols.

.4 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

.5 Manufacturers Standardization Society (MSS)

.1 MSS SP67-2011, Butterfly Valves.

.2 MSS SP70-2011, Cast Iron Gate Valves, Flanged and Threaded Ends.

.3 MSS SP71-2011, Grey Iron Swing Check Valves, Flanged and Threaded Ends.

.4 MSS SP80-2008, Bronze Gate, Globe, Angle and Check Valves.

.5 MSS SP85-2011, Cast Iron Globe and Angle Valves, Flanged and Threaded Ends.

1.2 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 hydronic systems and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Submit 2 copies of WHMIS MSDS in accordance with Section 01 35 29.06 - Health and Safety Requirements.

.3 Shop Drawings:

.1 Indicate on manufacturers catalogue literature the following: valves.

.4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

1.3 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

.2 Operation and Maintenance Data: submit operation and maintenance data for hydronic systems for incorporation into manual.

.3 Submit 3 copies of operation and maintenance manual.

1.4 MAINTENANCE MATERIALS SUBMITTALS

.1 Extra Materials:

.1 Furnish following spare parts:

.1 Valve seats: one for every ten valves, each size. Minimum one.

.2 Discs: one for every ten valves, each size. Minimum one.

.3 Stem packing: one for every ten valves, each size. Minimum one.

.4 Valve handles: two of each size.

.5 Gaskets for flanges: one for every ten flanges.

1.5 QUALITY ASSURANCE

.1 Regulatory Requirements: ensure Work is performed in compliance with applicable Provincial /Territorial regulations.

1.6 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 in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect hydronic systems from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

.4 Packaging Waste Management: remove for reuse and return of pallets, crates, padding, packaging materials as specified in Construction Waste Management Plan in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

Part 2 Products

2.1 TUBING

.1 Type L hard drawn copper tubing: to ASTM B88M.

2.2 FITTINGS

.1 Cast bronze threaded fittings: to ANSI/ASME B16.15.

.2 Wrought copper and copper alloy solder joint pressure fittings: to ANSI/ASME B16.22.

.3 Cast iron threaded fittings: to ANSI/ASME B16.4.

.4 Cast copper alloy solder joint pressure fittings: to ANSI B16.18.

2.3 FLANGES

.1 Brass or bronze: threaded.

.2 Cast iron: threaded.

.3 Orifice flanges: slip-on, raised face, 2100 kPa.

2.4 JOINTS

.1 Solder, tin-antimony, 95:5: to ASTM B32.

.2 Silver solder BCUP: to ANSI/AWS A5.8.

.3 Brazing: as indicated.

2.5 VALVES

.1 Connections:

- .1 NPS 2 and smaller: ends for soldering.
- .2 NPS 2 1/2 and larger: flanged ends.

.2 Gate Valves: application: isolating equipment, control valves, pipelines:

- .1 NPS 2 and under:
  - .1 Mechanical Rooms: Class 125, rising stem split wedge disc, as specified Section 23 05 23.01 - Valves - Bronze.
  - .2 Elsewhere: Class 125, non- rising stem, solid wedge disc, as specified Section 23 05 23.01 - Valves - Bronze.
- .2 NPS 2 1/2 and over:
  - .1 Mechanical Rooms: rising stem, split wedge disc, bronze trim, as specified Section 23 05 23.02 - Valves - Cast Iron.
    - .1 Operators: handwheel.
  - .2 Elsewhere: Non- rising stem, solid wedge disc, bronze trim, as specified Section 23 05 23.02 - Valves - Cast Iron.
    - .1 Operators: handwheel.

.3 Butterfly valves: application: isolating each cell or section of multiple component equipment (i.e. multi-section coils, multi-cell cooling towers):

.1 NPS 2 1/2 and over: lug type: as specified Section 23 05 17 - Pipe Welding.

.4 Globe valves: application: throttling, flow control, emergency bypass:

.1 NPS 2 and under:

.1 Mechanical Rooms: withPTFE disc, as specified Section 23 05 23.01 - Valves - Bronze.

.2 Elsewhere: globe, with composition disc, as specified Section 23 05 23.01 - Valves - Bronze.

.2 NPS 2 1/2 and over:

.1 With composition bronze disc, bronze trim, as specified Section 23 05 23.02 - Valves - Cast Iron.

.5 Balancing, for TAB:

.1 Sizes: calibrated balancing valves, as specified.

.2 NPS 2 and under:

.1 Mechanical rooms: globe, with plug disc as specified Section 23 05 23.01 - Valves - Bronze.

.2 Elsewhere: globe, with plug disc as specified Section 23 05 23.01 - Valves - Bronze.

.6 Drain valves: gate, Class 125 23 05 23.01 - Valves - Bronze.

.7 Swing check valves:

.1 NPS 2 and under:

.1 Class 125, swing, with composition disc, as specified Section 23 05 23.01 - Valves - Bronze.

.2 NPS 2 1/2 and over:

.1 Flanged ends: as specified Section 23 05 23.02 - Valves - Cast Iron.

.8 Silent check valves:

.1 NPS 2 and under:

.1 As specified Section 23 05 23.01 - Valves - Bronze.

.2 NPS 2 1/2 and over:

.1 Flanged Grooved ends: as specified Section 23 05 23.02 - Valves - Cast Iron.

.9 Ball valves:

.1 NPS 2 and under: as specified Section 23 05 23.01 - Valves - Bronze.

.10 Lubricated Plug Valves:

.1 NPS 2 1/2 and over: as specified Section 23 05 23.02 - Valves - Cast Iron.

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 hydronic systems installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate in presence of NRC Representative.

.2 Inform NRC 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 NRC Representative.

3.2 MANUFACTURER'S INSTRUCTIONS

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

3.3 PIPING INSTALLATION

.1 Connect to equipment in accordance with manufacturer's instruction unless otherwise indicated.

.2 Install concealed pipes close to building structure to keep furring space to minimum. Install to conserve headroom and space. Run exposed piping parallel to walls. Group piping where ever practical.

.3 Slope piping in direction of drainage and for positive venting.

.4 Use eccentric reducers at pipe size change installed to provide positive drainage or positive venting.

.5 Provide clearance for installation of insulation and access for maintenance of equipment, valves and fittings.

.6 Assemble piping using fittings manufactured to ANSI standards.

3.4 VALVE INSTALLATION

.1 Install rising stem valves in upright position with stem above horizontal.

.2 Install butterfly valves on chilled water and condenser water lines only.

.3 Install ball valves at branch take-offs and to isolate each piece of equipment, and as indicated.

.4 Install globe valves for balancing and in by-pass around control valves as indicated.

.5 Install silent check valves on discharge of pumps, in vertical pipes with downward flow and as indicated.

.6 Install swing check valves in horizontal lines on discharge of pumps and as indicated.

.7 Install chain operators on valves NPS 2 1/2 and over where installed more than 2400 mm above floor in Mechanical Equipment Rooms.

.8 Install ball valves for glycol service.

3.5 CIRCUIT BALANCING VALVES

.1 Install flow measuring stations and flow balancing valves as indicated.

.2 Remove handwheel after installation and TAB is complete.

.3 Tape joints in prefabricated insulation on valves installed in chilled water mains.

3.6 FLUSHING AND CLEANING

.1 Flush and clean in presence of NRC Representative.

.2 Flush after pressure test for a minimum of 4 hours.

.3 Fill with solution of water and non-foaming, phosphate-free detergent 3% solution by weight. Circulate for minimum of 8 hours.

.4 Refill system with clean water. Circulate for at least 4 hours. Clean out strainer screens/baskets regularly. Then drain.

.5 Refill system with clean water. Circulate for at least 2 hours. Clean out strainer screens/baskets regularly. Then drain.

.6 Drainage to include drain valves, dirt pockets, strainers, low points in system.

.7 Re-install strainer screens/baskets only after obtaining NRC Representative's approval.

3.7 FILLING OF SYSTEM

.1 Refill system with clean water adding water treatment as specified, or glycol for glycol systems.

3.8 FIELD QUALITY CONTROL

.1 Testing:

.1 Test system in accordance with Section 21 05 01 - Common Work Results for Mechanical.

.2 For glycol systems, retest with ethylene glycol to ASTM E202, inhibited for use in building system after cleaning. Repair leaking joints, fittings or valves.

.2 Balancing:

.1 Balance water systems to within plus or minus 5% of design output.

.2 Refer to Section 23 05 93 for applicable procedures.

.3 Glycol Charging:

.1 Provide mixing tank and positive displacement pump for glycol charging.

.2 Retest for concentration to ASTM E202 after cleaning.

.3 Provide report to NRC Representative.

3.9 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 in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 ASME

.1 ASME Boiler and Pressure Vessel Code (BPVC), Section VII-2013.

.2 ASTM International

.1 ASTM A47/A47M-99(2009), Standard Specification for Ferritic Malleable Iron Castings.

.2 ASTM A278/A278M-01(2011), Standard Specification for Gray Iron Castings for Pressure-Containing Parts for Temperatures up to 650 degrees F (350 degrees C).

.3 ASTM A516/A516M-10, Standard Specification for Pressure Vessel Plates, Carbon Steel, for Moderate - and Lower - Temperature Service.

.4 ASTM A536-84(2009), Standard Specification for Ductile Iron Castings.

.5 ASTM B62-09, Standard Specification for Composition Bronze or Ounce Metal Castings.

.3 CSA Group

.1 CSA B51-09, Boiler, Pressure Vessel, and Pressure Piping Code.

1.2 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 expansion tanks, air vents, separators, valves, and strainers and include product characteristics, performance criteria, physical size, finish and limitations.

1.3 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

.2 Operation and Maintenance Data: submit operation and maintenance data for hydronic specialties for incorporation into manual.

1.4 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 hydronic specialties from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

.4 Develop Construction Waste Management Plan Waste Reduction Workplan related to Work of this Section and in accordance with Section 01 35 21 - LEED Requirements.

.5 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, packaging materials as specified in Construction Waste Management Plan Waste Reduction Workplan in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal Section 01 35 21 - LEED Requirements.

Part 2 Products

2.1 DIAPHRAGM TYPE EXPANSION TANK

.1 Vertical steel pressurized diaphragm type expansion tank.

.2 Diaphragm sealed in EPDM suitable for 115 degrees C operating temperature.

.3 Working pressure: 860 kPa with ASME stamp and certification.

.4 Air precharged to 84 kPa (initial fill pressure of system).

.5 Saddles for horizontal installation, Base mount for vertical installation.

.6 Supports: provide supports with hold down bolts and installation templates incorporating seismic restraint systems.

.7 Replaceable bladder.

.8 AMTROL EXTROL

2.2 AUTOMATIC AIR VENT

.1 Standard float vent: brass body and NPS 1/2 connection and rated at 890 kPa working pressure, 132° C max temperature.

.2 Industrial float vent: solid brass and NPS 1/2 connection and rated at 860 kPa working pressure.

.3 Float: solid material suitable for 115 degrees C working temperature.

2.3 AIR SEPARATOR - IN-LINE

.1 Working pressure: 860 kPa, 132° C max temperature.

.2 Size: NPS 1 1/2.

.3 Steel

.4 Spirovent dirt

2.4 COMBINATION SEPARATORS/STRAINERS

.1 Steel, tested and stamped in accordance with ASME BPVC, for 860 kPa operating pressure, with galvanized steel integral strainer with 5 mm perforations, tangential inlet and outlet connections, and internal stainless steel air collector tube.

2.5 COMBINATION LOW PRESSURE RELIEF AND REDUCING VALVE

.1 Adjustable pressure setting: 206 kPa relief, 55 to 172 kPa reducing.

.2 Low inlet pressure check valve.

.3 Removable strainer.

2.6 PIPE LINE STRAINER

.1 NPS 1/2 to 2: bronze body to ANSI B16.11, solder end screwed connections, Y pattern.

.2 NPS 1/2 to 12: Type 316L stainless steel ASTM A351 GR CF 3M

.3 Blowdown connection: NPS 1.

.4 Screen: stainless steel with 1.19 mm perforations.

.5 Working pressure: 860 kPa.

.6 Spirax Sarco SS4

2.7 SUCTION DIFFUSER

.1 Body: cast iron with flanged screwed connections.

.2 Strainer: with built-in, disposable 1.19 mm mesh, low pressure drop screen and NPS 1 blowdown connection.

.3 Permanent magnet particle trap.

.4 Full length straightening vanes.

.5 Pressure gauge tappings.

.6 Adjustable support leg.

2.8 BYPASS FEEDER

.1 10 gauge steel 300 PSI max working pressure at 200^{o} F

.2 9 gauge steel tank head

.3 Cast iron cap with Buna N “O” ring

.4 Drew industrial 9233-04-0

2.9 FILTERS

.1 304 stainless steel housing with air vent

.2 Air vent

.3 860 kPa working pressure, 149^{o} C max temperature

.4 String wound polypropylene filters

.5 Pure aqua SSC

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 hydronic specialties installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate in presence of NRC Representative.

.2 Inform NRC 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 NRC Representative.

3.2 APPLICATION

.1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and data sheets.

3.3 GENERAL

.1 Run drain lines and blow off connections to terminate above nearest drain.

.2 Maintain adequate clearance to permit service and maintenance.

.3 Should deviations beyond allowable clearances arise, request and follow 's NRC Representative's 's directive.

.4 Check shop drawings for conformance of tappings for ancillaries and for equipment operating weights.

3.4 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 radiation and as indicated.

3.5 AIR VENTS

.1 Install at high points of systems.

.2 Install gate valve on automatic air vent inlet. Run discharge to nearest drain.

3.6 EXPANSION TANKS

.1 Adjust expansion tank pressure to suit design criteria.

.2 Install lockshield type valve at inlet to tank.

3.7 PRESSURE SAFETY RELIEF VALVES

.1 Run discharge pipe to terminate above nearest drain.

3.8 SUCTION DIFFUSERS

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

3.9 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 in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

Part 1 General

1.1 REFERENCES

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

.1 ANSI/ASHRAE/IES Standard 90.1-2010, Energy Standard for Buildings Except Low-Rise Residential Buildings.

.2 CSA Group

.1 CAN/CSA-B214-12, Installation Code for Hydronic Heating Systems.

.3 Electrical Equipment Manufacturers Association of Canada (EEMAC)

.4 National Electrical Manufacturers' Association (NEMA)

.1 NEMA MG 1-2011, Motors and Generators.

1.2 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 pump, circulator, and equipment and include product characteristics, performance criteria, physical size, finish and limitations indicate point of operation, and final location in field assembly.

.3 Shop Drawings:

.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.

1.3 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

.2 Operation and Maintenance Data: submit operation and maintenance data for hydronic pumps for incorporation into manual.

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 in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect hydronic pumps from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

.4 Packaging Waste Management: remove for reuse by manufacturer of pallets, crates, padding, packaging materials as specified in Construction Waste Management Plan in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal Section 01 35 21 - LEED Requirements.

Part 2 Products

2.1 EQUIPMENT

.1 Size and select components to: CAN/CSA-B214.

2.2 IN-LINE CIRCULATORS

.1 Volute: cast iron radially split, with screwed or flanged design suction and discharge connections.

.2 Impeller: alloy steel or stainless steel.

.3 Shaft: stainless steel with bronze sleeve bearing, integral thrust collar.

.4 Seal assembly: mechanical for service to 135 degrees C.

.5 Coupling: flexible self-aligning.

.6 Motor: Premium efficiency

.7 Design pressure: 860 kPa.

2.3 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: corrosion resistant steel.

.3 Shaft: stainless steel.

.4 Seal assembly: mechanical for service to 135 degrees C.

.5 Coupling: flexible self-aligning.

.6 Motor: Premium efficiency

.7 Design pressure: 1200 kPa.

2.4 SINGLE SUCTION CENTRIFUGAL PUMP

.1 General: all iron and cast steel pump complete with motor.

.2 Base: common cast iron with drip rim and tapping for drain connection.

.3 Volute: cast iron radially split, end suction, flanged suction and discharge, with drain plug and vent cock, suction and discharge pressure gauge tappings.

.4 Impeller: bronze or stainless steel, keyed drive with locking nut or screw.

.5 Shaft: alloy steel or stainless steel with two point support.

.6 Seal assembly: mechanical to seal, oil lubricated.

.7 Coupling: flexible self-aligning.

.8 Motor: continuous duty, drip proof, ball bearing, maximum temperature rise 50 degrees C.

.9 Design pressure: 1200 kPa.

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 hydronic pump installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate in presence of NRC Departmental Representative.

.2 Inform NRC 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 DCC Representative Consultant.

3.2 APPLICATION

.1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and data sheets.

3.3 INSTALLATION

.1 Install hydronic pumps to: CAN/CSA-B214.

.2 In line circulators: install as indicated by flow arrows.

.1 Support at inlet and outlet flanges or unions.

.2 Install with bearing lubrication points accessible.

.3 Base mounted type: supply templates for anchor bolt placement.

.1 Include anchor bolts with sleeves. Place level, shim unit and grout.

.2 Align coupling in accordance with manufacturer's recommended tolerance.

.3 Check oil level and lubricate. After run-in, tighten glands.

.4 Ensure that pump body does not support piping or equipment.

.1 Provide stanchions or hangers for this purpose.

.2 Refer to manufacturer's installation instructions for details.

.5 Pipe drain tapping to floor drain.

.6 Install volute venting pet cock in accessible location.

.7 Check rotation prior to start-up.

.8 Install pressure gauge test cocks.

3.4 START-UP

.1 General:

.1 In accordance with Section 01 91 13 - General Commissioning (Cx) Requirements: General Requirements; supplemented as specified herein.

.2 In accordance with manufacturer's recommendations.

.2 Procedures:

.1 Before starting pump, check that cooling water system over-temperature and other protective devices are installed and operative.

.2 After starting pump, check for proper, safe operation.

.3 Check installation, operation of mechanical seals, packing gland type seals. Adjust as necessary.

.4 Check base for free-floating, no obstructions under base.

.5 Run-in pumps for 12 continuous hours minimum.

.6 Verify operation of over-temperature and other protective devices under low- and no-flow condition.

.7 Eliminate air from scroll casing.

.8 Adjust water flow rate through water-cooled bearings.

.9 Adjust flow rate from pump shaft stuffing boxes to manufacturer's recommendation.

.10 Adjust alignment of piping and conduit to ensure true flexibility.

.11 Eliminate cavitation, flashing and air entrainment.

.12 Adjust pump shaft seals, stuffing boxes, glands.

.13 Measure pressure drop across strainer when clean and with flow rates as finally set.

.14 Replace seals if pump used to degrease system or if pump used for temporary heat.

.15 Verify lubricating oil levels.

3.5 PERFORMANCE VERIFICATION (PV)

.1 General:

.1 Verify performance in accordance with Section 01 91 13 - General Commissioning (Cx) Requirements: General Requirements, supplemented as specified herein.

.2 Verify that manufacturer's performance curves are accurate.

.3 Ensure valves on pump suction and discharge provide tight shut-off.

.4 Net Positive Suction Head (NPSH):

.1 Application: measure NPSH for pumps which operate on open systems and with water at elevated temperatures.

.2 Measure using procedures prescribed in Section 01 91 13 - General Commissioning (Cx) Requirements.

.3 Where procedures do not exist, discontinue PV, report to NRC Departmental Representative and await instructions.

.5 Mark points of design and actual performance at design conditions as finally set upon completion of TAB.

.6 Commissioning Reports: in accordance with Section 01 91 13 - General Commissioning (Cx) Requirements reports supplemented as specified herein. Reports to include:

.1 Record of points of actual performance at maximum and minimum conditions and for single and parallel operation as finally set at completion of commissioning on pump curves.

.2 Use Report Forms specified in Section 01 91 13 - General Commissioning (Cx) Requirements: Report Forms and Schematics.

.3 Pump performance curves (family of curves).

3.6 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 or recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 The most current version of the following codes are to be followed.

.2 American National Standards Institute (ANSI) / American Society of Mechanical Engineers (ASME)

.1 ASME B16.1, Cast Iron Pipe Flanges and Flanged Fittings: Class 25, 125, 250 and 800.

.2 ASME B16.25, Buttwelding Ends.

.3 ASME B16.3, Malleable Iron Threaded Fittings: Classes 150 and 300.

.4 ANSI/ASME B16.5, Pipe Flanges and Flanged Fittings: NPS through 24.

.5 ANSI/ASME B16.9, Factory-Made Wrought Steel Buttwelding Fittings.

.6 ANSI B18.2.1, Square and Hex Bolts and Screws (Inch Series).

.7 ANSI/ASME B18.2.2, Square and Hex Nuts (Inch Series).

.3 American National Standards Institute (ANSI) / American Water Works Association (AWWA)

.1 ANSI/AWWA C111/A21.11, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.

.4 ASTM International Inc.

.1 ASTM A47/A47M , Standard Specification for Ferritic Malleable Iron Castings.

.2 ASTM A53/A53M , Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated, Welded and Seamless.

.3 ASTM A126- , Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.

.5 Canadian Standards Association (CSA International)

.1 CSA W48- , Filler Metals and Allied Materials for Metal Arc Welding.

.6 Manufacturers Standardization Society of the Valve and Fittings Industry, Inc.

.1 MSS-SP-70- , Cast Iron Gate Valves, Flanged and Threaded Ends.

.2 MSS-SP-71- , Gray Iron Swing Check Valves, Flanged and Threaded Ends.

.3 MSS-SP-80- , Bronze Gate, Globe, Angle and Check Valves.

.4 MSS-SP-85- , Cast Iron Globe and Angle Valves, Flanged and Threaded Ends.

1.2 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 datasheets for valves and pipes and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:

.1 Provide drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.

1.3 CLOSEOUT SUBMITTALS

.1 Provide operation and maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals and include following:

.1 Special servicing requirements .

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements .

.2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

.3 Packaging Waste Management: remove for reuse and return by manufacturer of pallets crates padding packaging materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal .

1.5 EXTRA MATERIALS

.1 Extra Stock Materials:

.1 Provide spare parts as follows:

.1 Valve seats: one for every ten valves, each size. Minimum one.

.2 Discs: one for every ten valves, each size. Minimum one.

.3 Stem packing: one for every ten valves, each size. Minimum one.

.4 Valve handles: 2 of each size.

.5 Gaskets for flanges: one for every ten flanges.

Part 2 Products

2.1 PIPE

.1 Steel pipe: to ASTM A53/A53M, Grade B , as follows:

.1 Steam;

.1 Schedule 40 seamless to ASTM A 106/A106M.

.2 Condensate:

.1 Schedule 80 ASTM A 53/A53M

2.2 PIPE JOINTS

.1 NPS 2 and under: screwed fittings with lead-free dope.

.2 NPS 2-1/2 and over: welding fittings and flanges to CSA W48 .

.3 Flanges: plain or raised face. Flange gaskets to ANSI/AWWA C111/A21.11 .

.4 Pipe thread: taper.

.5 Bolts and nuts: carbon steel, to ANSI/ASME B18.2.1 .

.6 Buttwelding ends: to ANSI/ASME B16.28 .

2.3 FITTINGS-STEAM

.1 Screwed fittings: malleable iron to ASME B16.3, Class 150 .

.2 Steel pipe gaskets, flanges and flanged fittings: to ANSI/ASME B16.5.

.3 Buttwelding fittings: steel to ANSI/ASME B16.9.

.4 Unions: malleable iron, to ASME B16.3 .

2.4 FITTINGS-CONDENSATE

.1 Screwed fittings: 2000#, 3000# ASME B16.11/ASTM A105.

.2 Socket weld: 3000#, 6000# ASME B16.11/ASTM A105.

.3 Buttwelding fittings: Schedule 80 ASME B16.9/ASTM A234

2.5 VALVES

.1 Connections:

.1 NPS 2 and smaller: screwed ends.

.2 NPS 2 1/2 and larger:

.1 Equipment: Flanged ends.

.2 Elsewhere: Flanged ends.

.2 Gate valves: Application: Steam service, for isolating equipment, control valves, pipelines .

.1 NPS 2 and under:

.1 Class 125 , rising stem, split wedge disc, as specified Section 23 05 23.01 - Valves-Bronze .

.2 NPS 2 1/2 -8:

.1 Class 150 , rising stem, split wedge disc, cast iron, bronze trim, as specified Section 23 05 23.02 - Valves - Cast Iron .

.3 Globe valves: Application: Steam service, throttling, flow control, emergency bypass .

.1 NPS 2 and under:

.1 with PFTE disc as specified Section 23 05 23.01 - Valves - Bronze .

.2 NPS 2 1/2 and over:

.1 With composition bronze disc, cast iron with bronze trim, to Section 23 05 23.02 - Valves - Cast Iron .

.4 Gate valves: Application: pumped gravity condensate return service, steam drip point assemblies .

.1 NPS 2 and under:

.1 To BS 5154A: Class 125 , rising stem, plug valve, as specified Section 23 05 23.01 - Valves-Bronze .

.2 Elsewhere : Class 125 , non- rising stem, solid wedge disc, Bronze body/stainless steel/seat.

.3 Spirax Sarco HV3 stop valve or equivalent

.5 Drain valves: Gate, Class 125 , non-rising stem, solid wedge disc, as specified Section 23 05 23.01 - Valves - Bronze .

.6 Bypass valves around large size control valves to be line size class 150 ANSI 150 stainless steel seat.

.1 Spirax Sarco BSA3T bellows sealed stop valve or equivalent.

.7 Lift check valves:

.1 NPS 2 and under: Class 125 , lift, with composition disc.

.1 Bronze Spirax Sarco LCV1 or equivalent.

.2 NPS 2 1/2 and over: ANSI 150 Stainless steel Spirax Sarco DCV4 wafer check valve or equivalent.

2.6 VALVE OPERATORS

.1 Handwheel with chain operators: on valves installed more than 2400 mm above floor in Boiler Rooms Mechanical Equipment rooms .

Part 3 Execution

3.1 APPLICATION

.1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 PIPING

.1 Install pipework in accordance with Section 23 05 05 - Installation of Pipework , supplemented as specified below .

.2 Connect branch lines into top of mains.

.3 Install piping in direction of flow with slopes as follows, unless indicated:

.1 Steam: 1:240 .

.2 Condensate return: 1:70 .

.4 Make provision for thermal expansion as indicated and in accordance with manufacturer’s recommendations.

.5 Drip pocket: line size.

3.3 VALVES

.1 Bypass lines and valves: line size.

3.4 TESTING

.1 Test system in accordance with Section 21 05 01 - Common Work Results for Mechanical .

.2 Test pressure: 1-1/2 times maximum system operating pressure or 860 kPa whichever is greater.

3.5 SYSTEM START-UP

.1 In accordance with Section 23 08 02 - Cleaning and Start-up of Mechanical Piping Systems .

3.6 PERFORMANCE VERIFICATION (PV)

.1 General:

.1 Verify performance in accordance with Section 23 08 01 - Performance Verification Mechanical Piping Systems supplemented as specified herein.

.2 Timing, only after:

.1 Pressure tests successfully completed.

.2 Flushing as specified has been completed.

.3 Water treatment system has been commissioned.

.3 PV Procedures:

.1 Verify complete drainage of condensate from steam coils.

.2 Verify proper operation of system components, including, but not limited to:

.1 Steam traps - verify no blow-by.

.2 Flash tanks.

.3 Thermostatic vents.

.4 Vacuum breakers

.3 Monitor operation of provisions for controlled pipe movement including expansion joints, loops, guides, anchors.

.1 If sliding type expansion joints bind or if bellows type expansion joints flex incorrectly , shut down system, add pipe guides as required, re-align, repeat start-up procedures.

.4 Condensate pumping units: for commissioning procedures, refer to Section 01 91 13 - General Commissioning (Cx) Requirements .

3.7 CLEANING

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

.1 Remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 The most current versions of the following codes are to be followed.

.2 American Society for Mechanical Engineers (ASME International)

.3 ASTM International Inc.

.1 ASTM A126, Standard Specification for Gray Iron Castings for Valves, Flanges and Pipe Fittings.

.2 ASTM A167, Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet and Strip.

.3 ASTM A216/A216M, Standard Specification for Steel Castings, Carbon, Suitable for Fusion Welding for High-Temperature Service.

.4 ASTM A240/A240M, Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.

.5 ASTM A276, Standard Specification for Stainless Steel Bars and Shapes.

.6 ASTM A278/A278M, Standard Specification for Gray Iron Castings for Pressure - Containing Parts for Temperatures up to 650 Degrees F (350 degrees C).

.7 ASTM A351/A351M, Standard Specification for Castings, Austenitic, for Pressure-Containing Parts.

.8 ASTM A564/A564M, Standard Specification for Hot-Rolled and Cold-Finished Age-Hardening Stainless Steel Bars and Shapes.

.9 ASTM B62, Standard Specification for Composition Bronze or Ounce Metal Castings.

.4 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

1.2 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 Canadian Registration Number (CRN), and datasheets for steam traps, vacuum breakers, pressure reducing valves, air vents, safety relief valves, and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Provide two copies WHMIS MSDS - Material Safety Data Sheets in accordance with Section 01 35 29.06 - Health and Safety Requirements.

.3 Closeout Submittals:

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

.1 Special servicing requirements.

1.3 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle in accordance with Section01 61 00 - Common Product Requirements.

.2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

.3 Packaging Waste Management: remove for reuse and return by manufacturer of pallets crates padding packaging materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

Part 2 Products

2.1 MATERIALS

.1 Cast steel: to ASTM A216/A216M.

.2 Cast iron: to ASTM A278, Class 300.

.3 Bronze: to ASTM B62.

.4 Stainless steel: to ASTM A351/A351M.

2.2 FLOAT AND THERMOSTATIC STEAM TRAPS 0-206 KPA

.1 Application: for modulating steam service on heating coils, heat exchangers, unit heaters, steam mains to 206 kPa.

.2 Materials: body - cast iron; valve - stainless steel thermostatic type with stainless steel seat; float and mechanisms - stainless steel; air vent – stainless steel.

.3 Spirax sarco FT14 or equivalent.

2.3 INVERTED BUCKET STEAM TRAPS 0-1724 KPA

.1 Application: distribution main drip points.

.2 Material: ASTM A48 Cast Iron

.3 The trap shall employ a simple free floating stainless steel valve mechanism with no fixed pivots and no valve or bucket guides.

.4 The discharge valve shall be attached to the valve lever to be free to rotate for even wear distribution, and the valve and seat of the trap shall be lapped together as a matched as a matched set to insure tight shutoff.

.5 The piping configuration for the trap shall be side inlet/side outlet.

2.4 BALANCED PRESSURE THERMOSTATIC STEAM TRAPS 0-700 KPA

.1 Application: for modulating steam services on radiators as listed:

.2 Materials: body, union and cap – brass, valve, head and renewable seat - stainless steel; inlet with heavy brass union.

.3 Spirax Sarco BPT13

2.5 VACUUM BREAKERS 0.85-68 KPA

.1 Application: on inlets to steam coils, heat exchangers and as indicated.

.2 Materials: body and cap – brass; valve - stainless steel; valve seat - stainless steel; gasket-stainless steel.

.3 Spirax Sarco VB14.

2.6 PRESSURE REDUCING VALVE -PNEUMATICALLY OPERATED

.1 Location: as indicated.

.2 Pneumatic positioner operated, single seat, spring and diaphragm operated, with filter and internal relief.

.3 Connections:

.1 Under NPS 2: screwed ends.

.2 NPS 2-1/2 and over: flanged ends.

.4 Main valve:

.1 Body: WCC steel.

.2 Diaphragm: NBR

.3 Seat rings: stainless steel to S41600.

.4 Valve plug: stainless steel to S41600.

.5 Stem: stainless steel to S31600SST.

.6 Spring: carbon steel.

.7 Bolting: carbon steel.

.5 690 to 345kPa Service: NPS 1 Fischer EZ 657 Size 30 358255 or equivalent

.6 345 to 1033 kPa service: NPS 1.5 Fischer EZ Size 30 3582 or equivalent.

2.7 SAFETY AND RELIEF VALVES

.1 Spring loaded with open bonnet and easing lever and ASME code.

.2 Material: body -cast iron to ANSI 250. Flanged inlet, 250 psig max pressure 446 ºF max temperature.

.3 Spirax Sarco SV73.

2.8 DRIP PAN ELBOWS

.1 Application: on discharge of steam safety relief valves and as indicated.

.2 Cast iron or steel with screwed or flanged inlet and threaded drain connections.

2.9 PIPE LINE STRAINERS UP TO NPS 2

.1 Application: ahead of condensate pumps, steam traps, control valves and elsewhere as indicated.

.2 Working pressure: 860 kPa.

.3 Body: cast iron.

.4 Connections: screwed.

.5 Screen: stainless steel with 0.8 mm perforations.

.6 Spirax Sarco CT.

2.10 PIPE LINE STRAINERS NPS 2-1/2 AND OVER

.1 Application: ahead of condensate pumps, steam traps, control valves and as indicated.

.2 Working pressure: 860 kPa.

.3 Body: cast iron. Baffle type

.4 Connections: flanged.

.5 Blowdown connection: NPS 1-1/4 complete with gate valve and cap.

.6 Screen: stainless steel with 3.2 mm perforations.

.7 Spirax Sarco IT, CI-250, F-250.

2.11 FLASH TANKS

.1 Locations: as indicated.

.2 Tanks: vertical type with flanged drop tube connections.

.3 Construction: to ASME code.

.4 Maximum working pressure: 860 kPa.

.5 Connections: NPS 2 and under, screwed; NPS 2-1/2 and over, flanged.

.6 Finish: prime coated.

.7 Supports: vertical legs for vertical tank; saddles for horizontal tank.

2.12 CONDENSATE RECEIVERS

.1 Packaged factory assembled and wired unit.

.2 Two-pole level controls with stainless steel float and float rod, doublebreak silver-to-silver contacts, drip proof case.

.3 Receiver: cast iron, 15 gallon

.4 Volute: Cast iron

.5 Seal plate: cast iron

.6 Impeller: non-ferrous material

.7 Mechanical seal: JohnCrane type 6 or equal, ceramic and phenolic bonded carbon graphite seal faces

.8 Casing gasket: cellulose fibre chloroprene

.9 Close coupled motor: cast iron, 1/3 hp, 115V ODP, 12 gpm, permanently grease lubricated shielded ball bearings, threaded stainless steel shaft. Capacitor start, induction run, built-in thermal overload protection with automatic reset.

.10 Armstrong FHC series

Part 3 Execution

3.1 APPLICATION

.1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and datasheets.

.2 Maintain proper clearance around equipment to permit maintenance.

3.2 STRAINERS

.1 Install as indicated.

.2 Ensure clearance for removal of basket.

.3 Install valved blow-down as indicated.

3.3 SAFETY RELIEF VALVE

.1 Pipe to atmosphere independent of other vents and in accordance with applicable code.

.2 Support discharge pipe against reaction forces and to take up thermal movement.

.3 Drain pipe from drip pan elbow to terminate over floor drain.

3.4 STEAM TRAPS

.1 Install unions on inlet and outlet.

3.5 PRESSURE REDUCING VALVES

.1 Install on 3-valve bypass with strainer on inlet.

.2 Pipe as indicated. Follow manufacturer's installation instructions.

3.6 FLASH TANKS

.1 Pipe arrangement as indicated.

3.7 PERFORMANCE VERIFICATION

.1 In accordance with Section 23 08 01 - Performance Verification of Mechanical Piping Systems.

3.8 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 recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

END OF SECTION

Part 1 General

1.1 REFERENCES

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

.2 ASTM International

.1 ASTM A480/A480M-12, Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet and Strip.

.2 ASTM A635/A635M-09b, Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Hot-Rolled, Alloy, Carbon, Structural, High-Strength Low-Alloy, and High-Strength Low-Alloy with Improved Formability, General Requirements for.

.3 ASTM A653/A653M-11, Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.

.3 Green Seal Environmental Standards (GS)

.1 GS-36-11, Standard for Adhesives for Commercial Use.

.4 National Fire Protection Association (NFPA)

.1 NFPA 90A-12, Standard for the Installation of Air-Conditioning and Ventilating Systems.

.2 NFPA 90B-12, Standard for the Installation of Warm Air Heating and Air-Conditioning Systems.

.3 NFPA 96-11, Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.

.5 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)

.1 SMACNA HVAC Duct Construction Standards - Metal and Flexible, 2005.

.2 SMACNA HVAC Air Duct Leakage Test Manual, 2012.

.3 IAQ Guideline for Occupied Buildings Under Construction 2007.

.6 South Coast Air Quality Management District (SCAQMD), California State, Regulation XI. Source Specific Standards

.1 SCAQMD Rule 1168-A2005, Adhesives and Sealants Applications.

1.2 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 metal ducts 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 Province Territory of _____, Canada.

.4 Test and Evaluation Reports:

.1 Certification of Ratings:

.1 Catalogue or published ratings to be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.

1.3 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 in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect metal ducts from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

.4 Develop Construction Waste Management Plan related to Work of this Section.

.5 Packaging Waste Management: remove for reuse by manufacturer of pallets, crates, padding, packaging materials as specified in Construction Waste Management Plan in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

Part 2 Products

2.1 SEAL CLASSIFICATION

.1 Classification as follows:

Maximum Pressure Pa	SMACNA Seal Class
500	C
250	C
125	C
125	Unsealed
Zero Leakage Ductwork (round 304 SS)	All welded joints / airtight flanged equipment connections

.2 Seal classification:

.1 Class A: longitudinal seams, transverse joints, duct wall penetrations and connections made airtight with sealant and tape.

.2 Class B: longitudinal seams, transverse joints and connections made airtight with sealant.

.3 Class C: transverse joints and connections made air tight with gaskets sealant or combination thereof. Longitudinal seams unsealed.

.4 Unsealed seams and joints.

2.2 SEALANT

.1 Sustainability Characteristics:

.1 Adhesives and sealants: in accordance with Section 07 92 00 - Joint Sealants.

.2 Adhesives and sealants: VOC limit 250 g/L maximum to SCAQMD Rule 1168.

.2 Sealant: oil resistant, polymer type flame resistant duct sealant. Temperature range of minus 30 degrees C to plus 93 degrees C.

2.3 TAPE

.1 Tape: polyvinyl treated, open weave fiberglass tape, 50 mm wide.

2.4 DUCT LEAKAGE

.1 In accordance with SMACNA HVAC Air Duct Leakage Test Manual.

2.5 FITTINGS

.1 Fabrication: to SMACNA.

.2 Radiused elbows:

.1 Rectangular: centreline radius: 1.5 times width of duct.

.2 Round: smooth radius, centreline radius: 1.5 times diameter.

.3 Mitred elbows, rectangular:

.1 To 400 mm: with single double thickness turning vanes.

.2 Over 400 mm: with double thickness turning vanes.

.4 Branches:

.1 Rectangular main and branch: with radius on branch 1.5 times width of duct.

.2 Round main and branch: enter main duct at 45 degrees with conical connection.

.3 Provide volume control damper in branch duct near connection to main duct.

.4 Main duct branches: with splitter damper.

.5 Transitions:

.1 Diverging: 20 degrees maximum included angle.

.2 Converging: 30 degrees maximum included angle.

.6 Offsets:

.1 Full radiused elbows.

.7 Obstruction deflectors: maintain full cross-sectional area.

.1 Maximum included angles: as for transitions.

2.6 FIRE STOPPING

.1 Retaining angles around duct, on both sides of fire separation in accordance with Section 07 84 00 - Fire Stopping.

.2 Fire stopping material and installation must not distort duct.

2.7 GALVANIZED STEEL

.1 Lock forming quality: to ASTM A653/A653M, Z90 zinc coating.

.2 Thickness, fabrication and reinforcement: to SMACNA.

.3 Joints: to ASHRAE SMACNA. Proprietary manufactured flanged duct joint to be considered to be a class A seal.

2.8 STAINLESS STEEL

.1 To ASTM A480/A480M, Type 304.

.2 Finish: number 4.

.3 Thickness, fabrication and reinforcement: to SMACNA as indicated.

.4 Joints: to SMACNA be continuous inert gas welded.

.5 Gasket and flanged equipment connections

2.9 ALUMINUM

.1 To ASHRAE SMACNA. Aluminum type: 3003-H-14.

.2 Thickness, fabrication and reinforcement: to ASHRAE SMACNA as indicated.

.3 Joints: to ASHRAE SMACNA be continuous weld.

2.10 HANGERS AND SUPPORTS

.1 Hangers and Supports: in accordance with Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.

.1 Strap hangers: of same material as duct but next sheet metal thickness heavier than duct.

.1 Maximum size duct supported by strap hanger: 500.

.2 Hanger configuration: to SMACNA.

.3 Hangers: galvanized steel angle with black galvanized steel rods to SMACNA following table:

Duct Size (mm)	Angle Size (mm)	Rod Size (mm)
up to 750	25 x 25 x 3	6
751 to 1050	40 x 40 x 3	6
1051 to 1500	40 x 40 x 3	10
1501 to 2100	50 x 50 x 3	10
2101 to 2400	50 x 50 x 5	10
2401 and over	50 x 50 x 6	10

.4 Upper hanger attachments:

.1 For concrete: manufactured concrete inserts.

.2 For steel joist: manufactured joist clamp steel plate washer.

.3 For steel beams: manufactured beam clamps:

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 metal duct installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate in presence of NRC Departmental Representative.

.2 Inform NRC 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 NRC Departmental Representative.

3.2 GENERAL

.1 Do work in accordance with SMACNA.

.2 Do not break continuity of insulation vapour barrier with hangers or rods.

.1 Insulate strap hangers 100 mm beyond insulated duct Ensure diffuser is fully seated.

.3 Support risers in accordance with SMACNA as indicated.

.4 Install breakaway joints in ductwork on sides of fire separation.

.5 Install proprietary manufactured flanged duct joints in accordance with manufacturer's instructions.

.6 Manufacture duct in lengths and diameter to accommodate installation of acoustic duct lining.

3.3 HANGERS

.1 Strap hangers: install in accordance with SMACNA.

.2 Angle hangers: complete with locking nuts and washers.

.3 Hanger spacing: in accordance with SMACNA as follows:

Duct Size	Spacing
(mm)	(mm)
to 1500	3000
1501 and over	2500

3.4 ZERO LEAKAGE

.1 Provide zero leakage all welded stainless steel ductwork and flanged equipment connections for supply and return ducting serving 22-AHU-05 and 22-AHU-06 between bubble tight dampers CD01, 04, 11, 12, 16,17 and air flow stations capped connections within the Flight simulator Lab and the Flexible Cabin Lab.

3.5 WATERTIGHT DUCT

.1 Provide watertight duct for:

.1 Fresh air intake.

.2 Minimum 3000 mm from duct mounted humidifier in all directions.

.3 As indicated.

.2 Form bottom of horizontal duct without longitudinal seams.

.1 Solder joints of bottom and side sheets.

.2 Seal other joints with duct sealer.

.3 Fit base of riser with 150 mm deep drain sump and 32 mm drain connected, with deep seal trap and trap primer and discharging to open funnel drain.

3.6 SEALING AND TAPING

.1 Apply sealant in accordance with SMACNA.

.2 Bed tape in sealant and recoat with minimum of 1 coat of sealant to manufacturers recommendations.

3.7 LEAKAGE TESTS

.1 Refer to Section 23 05 94 - Pressure Testing of Ducted Air Systems.

.2 In accordance with SMACNA HVAC Duct Leakage Test Manual.

.3 Do leakage tests in sections.

.4 Zero leakage ductwork testing shall be entire duct segment between bubble tight dampers with all flanged equipment in place and blind flanges at end of runs.

.5 Make trial leakage tests as instructed to demonstrate workmanship.

.6 Do not install additional ductwork until trial test has been passed.

.7 Test section minimum of 30 m long with not less than three branch takeoffs and two 90 degrees elbows.

.8 Complete test before performance insulation or concealment Work.

3.8 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 recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

Part 1 General

1.1 REFERENCES

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

.2 ASTM International

.1 ASTM A653/A653M- 11 , Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

.2 ASTM C423- 09a , Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.

.3 ASTM E90- 09 , Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.

.4 ASTM E477- 06a , Standard Test Method for Measuring Acoustical and Airflow Performance of Duct Liner Materials and Prefabricated Silencers.

.3 National Building Code of Canada (NBC) 2011 .

.4 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)

1.2 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 acoustical air plenums and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:

.1 Submit separate drawings for each piece of attenuation equipment and system shop drawings complete with product data.

.4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

1.3 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements .

.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 in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect acoustical air plenums and silencers from nicks, scratches, and blemishes .

.3 Replace defective or damaged materials with new.

.4 Develop Construction Waste Management Plan related to Work of this Section

.5 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, packaging materials as specified in Construction Waste Management Plan

Part 2 Products

2.1 PERFORMANCE REQUIREMENTS

.1 Rating Data:

.1 Provide performance rating data, certified by professional engineer or accredited test laboratory and supported by calculations and verified by test results in accordance with referenced standards as follows:

.1 Silencer: insertion loss, pressure drop at design conditions, generated noise level .

.2 Acoustic plenums: transmission loss and acoustical absorption.

.3 Acoustical performance measurements in accordance with ASTM E477, ASTM E90 and ASTM C423, except where specified otherwise.

2.2 ABSORPTION AND INSULATING MEDIA

.1 Acoustic quality, glass fibre, bacteria and fungus resistant; free of corrosion causing or accelerating agents; packed to density to meet performance requirements; and meet NBC fire requirements or requirements of authority having jurisdiction for duct lining.

2.3 SILENCERS

.1 Factory manufactured of prime coated or galvanized steel, compatible with ductwork specified elsewhere and to ASHRAE and SMACNA standards.

.2 Outer casing and galvanized steel inner casing with clean cut circular perforations to enclose acoustic media. Inner casing to have pods running full length of silencer where any cross sectional dimension exceeds 450 mm. Protect media from erosion with glass fibre cloth between media and perforated metal.

.3 Return air T-silencer at AHU-03: 22ga casing with 22 ga galvanized steel perforated lining over fibreglass media to ASTM E84, NFPA 255, UL 723 flame and smoke spread rating. Equivalent to Kinetics model 1200(1000)KCTES-F/4.5 – 2000 x 1000 x 300-450/450. 3068 L/s, 70Pa pressure drop, dynamic insertion loss as follows:

.1 63 Hz band: 14dB

.2 125 Hz band: 20dB

.3 250 Hz band: 26 dB

.4 500 Hz band: 33 dB

.5 1000 Hz band: 26 dB

.6 2000 Hz band; 24 db

.7 4000 Hz band: 24 dB

.8 8000 Hz band: 20 dB

2.4 ACOUSTIC PLENUMS

.1 Panels: tongue and groove connection type, designed for individual panel removal for equipment access without major dismantling of plenum.

.1 Outer sheet: 1.3 mm thick galvanized steel to ASTM A653/A653M, with coating designation Z90 .

.2 Inner sheet: 0.085 mm thick galvanized steel to ASTM A653/A653M, with coating designation Z90 with 2 mm diameter clean cut perforations on 5 mm staggered centres.

.3 Fully framed with 1.3 mm thick galvanized steel channels.

.4 Horizontal stiffeners: 0.85 mm minimum galvanized steel on 800 mm centres to control media settlement.

.5 Access panels: sized for equipment removal; two handles per panel; screw at 100 mm maximum centres; perimeter neoprene sponge gasket; materials same as standard panel.

.6 Deflection: not to exceed 1/240 of unsupported panel span at design pressure differential of 100 Pa.

.2 Doors: access doors with minimum 510 x 1375 mm opening.

.1 Construction same as standard panel except interiors solid.

.2 Two butt-type nylon bushed hinges, two cam-type latches with inside and outside handles.

.3 Neoprene gasket seal.

.4 Zinc plated hardware.

.5 Open against air pressure.

.3 Windows: inspection windows, 305 x 305 mm, double glazed with 6 mm wire reinforced glass mounted in neoprene "U" channels .

.4 Assembly: base sections and flashings 1.3 mm minimum galvanized steel.

.1 Panel and flashing joints externally sealed with 5 mm diameter bead of non sag, non hardening sealant. Floor channel to floor connection sealed with 3 x 13 mm mono elastomeric tape.

.2 Factory cut and frame openings where greatest dimension exceeds 300 mm. Smaller panel openings, site located and cut 50 mm larger in diameter, sleeved with 0.75 mm minimum galvanized steel.

.3 Fill space between pipe or conduit and sleeve with acoustic media, covered and mastic sealed in accordance with manufacturer's instructions.

.4 No sensory leakage at design pressure differential of 100 Pa.

.5 Assembly RSI not less than 1.2 (m^2.degrees C)/W at 10 degrees C.

.6 Certified acoustical performance:

.1 Transmission loss to ASTM E90.

.2 Acoustical absorption to ASTM C423.

Octave bands, (Hz)	125	250	500	1000	2000	4000
Transmission loss, dB	21	28	39	50	53	56
Absorption coefficient	0.7	0.9	.99	.99	0.9	0.9

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 acoustical air plenum installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate in presence of NRC Departmental Representative .

.2 Inform NRC 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 NRC Departmental Representative .

3.2 MANUFACTURER'S INSTRUCTIONS

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

3.3 INSTALLATION

.1 Noise flanking: where indicated, install in wall sleeve with uniform clearance around to ensure no contact of silencer with wall sleeve. Pack with flexible, non hardening caulking on both sides of sleeves.

.2 Instrument test ports: install at inlet and outlet to permit measurement of insertion loss and pressure loss.

.3 Suspension: to manufacturer's instructions.

3.4 FIELD QUALITY CONTROL

.1 Testing:

.1 Experienced and competent sound and vibration testing professional engineer to take sound measurement after start up and testing, adjusting and balancing of systems to Section 23 05 93 - Testing, Adjusting and Balancing for HVAC .

.2 Sound measurements to extend over frequency range of 125Hz to 4000Hz and taken:

.1 Upstream and downstream of each silencer and plenum .

.2 In areas adjacent to mechanical equipment rooms, duct and pipe shafts.

.3 At 1800 mm above floor adjacent to first air terminal.

.4 At following critical locations: 1800mm above floor in center of Flexible Cabin Lab. 1800mm above floor in center of Flight Simulation Lab

.3 Provide NRC Departmental Representative 24 with notice hours in advance of commencement of tests.

.4 Establish adequacy of equipment isolation, acceptability of noise levels in occupied areas, other conditions affecting acoustics and, where appropriate, recommendation for remedial measures and costs.

.5 Submit complete report of test results including sound curves .

.2 Manufacturer's Field Services:

.1 Arrange with manufacturer's representative to review work of this Section and submit written reports to verify compliance with Contract Documents.

.2 Manufacturer's Field Services: consisting of product use recommendations and periodic site visits to review installation, scheduled as follows:

.1 After delivery and storage of products.

.2 After preparatory work is complete but before installation commences.

.3 Twice during the installation, at 25 % and 60 % completion stages.

.4 Upon completion of installation.

.3 Submit manufacturer's reports to NRC Departmental Representative within 3 days of manufacturer representative's review.

3.5 ADJUSTING

.1 Make adjustments and corrections in accordance with written report.

.2 Provide NRC Departmental Representative with notice 24 hours in advance of visit.

3.6 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 recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal .

.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)

.1 SMACNA - HVAC Duct Construction Standards - Metal and Flexible, [2005].

1.2 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 air duct accessories and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Indicate:

.1 Flexible connections.

.2 Duct access doors.

.3 Turning vanes.

.4 Instrument test ports.

1.3 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.

.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 air duct accessories from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

.4 Packaging Waste Management: in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

Part 2 Products

2.1 GENERAL

.1 Manufacture in accordance with SMACNA - HVAC Duct Construction Standards.

2.2 FLEXIBLE CONNECTIONS

.1 Frame: galvanized sheet metal frame with fabric clenched by means of double locked seams.

.2 Material:

.1 Fire resistant, self extinguishing, neoprene coated glass fabric, temperature rated at minus 40 degrees C to plus 90 degrees C, density of 1.3 kg/m^2.

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: neoprene.

.4 Hardware:

.1 Up to 300 x 300 mm: two sash locks complete with safety chain.

.2 301 to 450 mm: four sash locks [complete with safety chain].

.3 451 to 1000 mm: piano hinge and minimum two sash locks.

.4 Doors over 1000 mm: piano hinge and two handles operable from both sides.

.5 Hold open devices.

.6 300 x 300 mm glass viewing panels.

2.4 TURNING VANES

.1 Factory or shop fabricated double thickness with trailing edge, to recommendations of SMACNA and as indicated.

2.5 INSTRUMENT TEST

.1 1.6 mm thick steel zinc plated after manufacture.

.2 Cam lock handles with neoprene expansion plug and handle chain.

.3 28 mm minimum inside diameter. Length to suit insulation thickness.

.4 Neoprene mounting gasket.

2.6 SPIN-IN COLLARS

.1 Conical galvanized sheet metal spin-in collars with lockable butterfly damper.

.2 Sheet metal thickness to co-responding round duct standards.

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 air duct accessories installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate in presence of NRC Departmental Representative.

.2 Inform NRC 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 NRC Departmental Representative.

3.2 INSTALLATION

.1 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.

.3 As indicated.

.2 Length of connection: 100 mm.

.3 Minimum distance between metal parts when system in operation: 75 mm.

.4 Install in accordance with recommendations of SMACNA.

.5 When fan is running:

.1 Ducting on sides of flexible connection to be in alignment.

.2 Ensure slack material in flexible connection.

.2 Access Doors and Viewing Panels:

.1 Size:

.1 600 x 1200 mm for person size entry.

.2 900 x 900 mm for servicing entry.

.3 300 x 300 mm for viewing.

.4 As indicated.

.2 Locations:

.1 Fire and smoke dampers.

.2 Control dampers.

.3 Devices requiring maintenance.

.4 Required by code.

.5 Reheat coils.

.6 Elsewhere as indicated.

.3 Instrument Test Ports:

.1 General:

.1 Install in accordance with recommendations of SMACNA and in accordance with manufacturer's instructions.

.2 Locate to permit easy manipulation of instruments.

.3 Install insulation port extensions as required.

.4 Locations:

.1 For traverse readings:

.1 Ducted inlets to roof and wall exhausters.

.2 Inlets and outlets of other fan systems.

.3 Main and sub-main ducts.

.4 And as indicated.

.2 For temperature readings:

.1 At outside air intakes.

.2 In mixed air applications in locations as approved by NRC Departmental Representative.

.3 At inlet and outlet of coils.

.4 Downstream of junctions of two converging air streams of different temperatures.

.5 And as indicated.

.4 Turning Vanes:

.1 Install in accordance with recommendations of SMACNA and as indicated.

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

.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 Sheet Metal and Air Conditioning National Association (SMACNA)

.1 SMACNA HVAC Duct Construction Standards, Metal and Flexible-[2013].

1.2 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 dampers and include product characteristics, performance criteria, physical size, finish and limitations.

1.3 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

.2 Operation and Maintenance Data: submit operation and maintenance data for dampers for incorporation into manual.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.

.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 dampers from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

.4 Packaging Waste Management: in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal

Part 2 Products

2.1 GENERAL

.1 Manufacture to SMACNA standards.

2.2 SPLITTER DAMPERS

.1 Fabricate from same material as duct but one sheet metal thickness heavier, with appropriate stiffening.

.2 Double thickness construction.

.3 Control rod with locking device and position indicator.

.4 Rod configuration to prevent end from entering duct.

.5 Pivot: piano hinge.

.6 Folded leading edge.

2.3 SINGLE BLADE DAMPERS

.1 Fabricate from same material as duct, but one sheet metal thickness heavier. V-groove stiffened.

.2 Size and configuration to recommendations of SMACNA, except maximum height 100 mm].

.3 Locking quadrant with shaft extension to accommodate insulation thickness.

.4 Inside and outside nylon end bearings.

.5 Channel frame of same material as adjacent duct, complete with angle stop.

2.4 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: 100 mm.

.4 Bearings: self-lubricating nylon.

.5 Linkage: shaft extension with locking quadrant.

.6 Channel frame of same material as adjacent duct, complete with angle stop.

.7 Maximum leakage : 4% at 500 Pa.

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 damper installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate in presence of NRC Departmental Representative

.2 Inform NRC 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 NRC Departmental Representative.

3.2 INSTALLATION

.1 Install where indicated.

.2 Install in accordance with recommendations of SMACNA and in accordance with manufacturer's instructions.

.3 Locate balancing dampers in each branch duct, for supply, return and exhaust systems.

.4 Runouts to registers and diffusers: install single blade damper located as close as possible to main ducts.

.5 Dampers: vibration free.

.6 Ensure damper operators are observable and accessible.

.7 Corrections and adjustments conducted by NRC Departmental Representative.

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

.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 ASTM International

.1 ASTM A653/A653M-[11], Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by Hot-Dip Process.

1.2 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 dampers and include product characteristics, performance criteria, physical size, finish and limitations.

1.3 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

.2 Operation and Maintenance Data: submit operation and maintenance data for dampers for incorporation into manual.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.

.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 dampers from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

.4 Packaging Waste Management: in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

Part 2 Products

2.1 MULTI-LEAF DAMPERS

.1 Opposed blade type as indicated.

.2 Extruded aluminum, interlocking blades, complete with extruded vinyl seals, spring stainless steel side seals, extruded aluminum frame.

.3 Pressure fit self-lubricated bronze bearings.

.4 Linkage: plated steel tie rods, brass pivots and plated steel brackets, complete with plated steel control rod.

.5 Performance:

.1 Leakage: in closed position less than 2% of rated air flow at 1000 Pa differential across damper.

.2 Pressure drop: at full open position less than 25 Pa differential across damper at 2.54 m/s.

.6 Insulated aluminum dampers:

.1 Frames: insulated with extruded polystyrene foam with RSI 0.88.

.2 Blades: constructed from aluminum extrusions with internal hollows insulated with polyurethane or polystyrene foam, RSI 0.88.

2.2 BUBBLE TIGHT DAMPERS

.1 Frame: Damper frame shall be a minimum of 12 ga. Type 304SS formed into a rolled channel frame.

.2 Disc: Damper blades shall be a minimum 3/16 inch Type 304 SS blade and reinforced as required to meet the system pressures it will be installed in. Blade orientation is horizontal.

.3 Blade Stops: Pin stops.

.4 Seals: Silicone blade edges:

.5 Axles: Minimum 3 /4 inch diameter plated steel and as required to meet the system pressures the damper will be installed in. Stainless steel axles are optional.

.6 Gasket: extruded neoprene, field replaceable, with 10 year warranty.

.7 Bearings: Roller self lubricated and sealed.

.8 Axle Seals: Double gland stuffing boxes.

.9 Operator: compatible with damper, 120V – AC with spring return where designated normally open or normally closed complete with auxiliary end switches to verify damper position.

.10 Performance:

.1 Leakage: Dampers are to be Zero Leakage Bubble Tight type to 7.5 kPa (30 in. wg) as required by AMCA standard 500D.

.11 Pressure drop: at full open position less than 0.025 kPa differential across damper at 2.54 m/s.

.12 Velocity Rating: Damper shall have a velocity rating of 33 M/sec (6,500 fpm).

2.3 DISC TYPE DAMPERS

.1 Frame: brake formed, welded, 1.6 mm thick, galvanized steel to ASTM A653/A653M.

.2 Disc: spin formed, 1.6 mm thick, galvanized steel to ASTM A653/A653M.

.3 Gasket: extruded neoprene, field replaceable, with 10 year warranty.

.4 Bearings: roller self lubricated and sealed.

.5 Operator: compatible with damper, linear stroke operator, actuator, zinc-aluminum foundry alloy casting cam follower.

.6 Performance:

.1 Leakage: in closed position less than 0.001% of rated air flow at 1 kPa pressure differential across damper.

.2 Pressure drop: at full open position less than 0.025 kPa differential across damper at 2.54 m/s.

2.4 BACK DRAFT DAMPERS

.1 Automatic gravity operated, multi leaf, aluminum construction with nylon bearings, counterweighted.

2.5 RELIEF DAMPERS

.1 Automatic multi-leaf aluminum dampers with ball bearing centre pivoted and counter-weights set to open at 65 Pa static pressure – to be calibrated on site.

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 damper installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate in presence of NRC Departmental Representative.

.2 Inform NRC 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 NRC Departmental Representative.

3.2 INSTALLATION

.1 Install where indicated.

.2 Install in accordance with recommendations of SMACNA and manufacturer's instructions.

.3 Seal multiple damper modules with silicon sealant.

.4 Install access door adjacent to each damper. See Section 23 33 00 - Air Duct Accessories.

.5 Ensure dampers are observable and accessible.

.6 Contractor to coordinate flange mounting bolt hole with manufacturer prior to ordering dampers or field drill the holes as required.

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

.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 National Fire Protection Association (NFPA)

.1 NFPA 90A-[12], Standard for the Installation of Air Conditioning and Ventilating Systems.

.2 Underwriters Laboratories of Canada (ULC)

.1 CAN/ULC-S112-[10], Standard Test Method of Fire Test of Fire Damper Assemblies.

.2 CAN/ULC-S112.2-[07], Standard Method of Fire Test of Ceiling Fire Stop Flap Assemblies.

.3 ULC-S505-[1974], Standard for Fusible Links for Fire Protection Service.

1.2 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 fire and smoke dampers and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Indicate the following:

.1 Fire dampers.

.2 Smoke dampers.

.3 Fire stop flaps.

.4 Operators.

.5 Fusible links.

.6 Design details of break-away joints.

.3 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

1.3 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

.2 Operation and Maintenance Data: submit operation and maintenance data for fire and smoke dampers for incorporation into manual.

1.4 MAINTENANCE MATERIAL SUBMITTALS

.1 Extra Materials:

.1 Submit maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.

.2 Provide:

.1 6 fusible links of each type.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.

.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 fire and smoke dampers from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

.4 Packaging Waste Management: in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

Part 2 Products

2.1 FIRE DAMPERS

.1 Fire dampers: arrangement Type B, C, listed, bear label of ULC, meet requirements of NFPA 90A. Fire damper assemblies fire tested in accordance with CAN/ULC-S112.

.2 Mild steel, factory fabricated for fire rating requirement to maintain integrity of fire wall and/or fire separation.

.1 Fire dampers: 1-1/2 hour fire rated unless otherwise indicated.

.2 Fire dampers: automatic operating type and have dynamic rating suitable for maximum air velocity and pressure differential to which it will be subjected.

.3 Top hinged: round or square; multi-blade hinged; sized to maintain full duct cross section.

.4 Fusible link actuated, weighted to close and lock in closed position when released or having negator-spring-closing operator for multi-leaf type or roll door type in horizontal position with vertical air flow.

.5 40 x 40 x 3 mm retaining angle iron frame, on full perimeter of fire damper, on both sides of fire separation being pierced.

.6 Equip fire dampers with steel sleeve or frame installed disruption ductwork or impair damper operation.

.7 Equip sleeves or frames with perimeter mounting angles attached on both sides of wall or floor opening. Construct ductwork in fire-rated floor-ceiling or roof-ceiling assembly systems with air ducts that pierce ceiling to conform with ULC.

.8 Design and construct dampers to not reduce duct or air transfer opening cross-sectional area.

.9 Dampers shall be installed so that the centerline of the damper depth or thickness is located in the centerline of the wall, partition of floor slab depth or thickness.

.10 Unless otherwise indicated, the installation details given in SMACNA Install Fire Damp HVAC and in manufacturer's instructions for fire dampers shall be followed.

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 fire and smoke damper installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate in presence of NRC Departmental Representative.

.2 Inform NRC 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 NRC Departmental Representative.

3.2 INSTALLATION

.1 Install in accordance with NFPA 90A and in accordance with conditions of ULC listing.

.2 Maintain integrity of fire separation.

.3 After completion and prior to concealment obtain approvals of complete installation from authority having jurisdiction.

.4 Install access door adjacent to each damper. See Section 23 33 00 - Air Duct Accessories.

.5 Co-ordinate with installer of fire stopping.

.6 Ensure access doors/panels, fusible links, damper operators are easily observed and accessible.

.7 Install break-away joints of approved design on each side of fire separation.

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 Waste Management: in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 American National Standards Institute/Air Movement and Control Association (ANSI/AMCA)

.1 ANSI/AMCA Standard 99- 2010 , Standards Handbook.

.2 ANSI/AMCA Standard 210- 2007 /(ANSI/ASHRAE 51-07), Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.

.3 ANSI/AMCA Standard 300- 2008 , Reverberant Room Method for Sound Testing of Fans.

.4 ANSI/AMCA Standard 301- 1990 , Methods for Calculating Fan Sound Ratings from Laboratory Test Data.

.2 The Master Painters Institute (MPI)

.1 Architectural Painting Specification Manual - current edition.

.1 MPI #18, Primer, Zinc Rich, Organic.

1.2 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 HVAC fans and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:

.1 Provide:

.1 Fan performance curves showing point of operation, kW and efficiency.

.2 Sound rating data at point of operation.

.2 Indicate:

.1 Motors, sheaves, bearings, shaft details

.2 Minimum performance achievable with variable speed controllers.

1.3 MAINTENANCE MATERIAL SUBMITTALS

.1 Extra Materials:

.1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

.1 Provide:

.1 Matched sets of belts.

.2 Furnish list of individual manufacturer's recommended spare parts for equipment, include:

.1 Bearings and seals.

.2 Addresses of suppliers.

.3 List of specialized tools necessary for adjusting, repairing or replacing.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.

.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 HVAC fans from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

.4 Packaging Waste Management: in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

Part 2 Products

2.1 SYSTEM DESCRIPTION

.1 Performance Requirements:

.1 Catalogued or published ratings for manufactured items: obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency signifying adherence to codes and standards in force.

.2 Capacity: flow rate, total static pressure, W, efficiency, revolutions per minute, power, model, size, sound power data and as indicated on schedule.

.3 Fans: statically and dynamically balanced, constructed in conformity with ANSI/AMCA Standard 99.

.4 Sound ratings: comply with ANSI/AMCA Standard 301, tested to ANSI/AMCA Standard 300. Supply unit with ANSI/AMCA certified sound rating seal.

.5 Performance ratings: based on tests performed in accordance with ANSI/AMCA Standard 210. Supply unit with ANSI/AMCA certified rating seal, except for propeller fans smaller than 300 mm diameter.

2.2 FANS GENERAL

.1 Motors:

.1 In accordance with Section 23 05 13 - Common Motors Requirements for HVAC Equipment supplemented as specified herein.

.2 For use with variable speed controllers.

.3 Sizes as indicated.

.2 Accessories and hardware: matched sets of V-belt drives, fan inlet safety screens .

.3 Factory primed before assembly in colour standard to manufacturer.

.4 Bearing lubrication systems plus extension lubrication tubes where bearings are not easily accessible.

.5 Vibration isolation: to Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment.

.6 Flexible connections: to Section 23 33 00 - Air Duct Accessories.

2.3 CENTRIFUGAL FANS

.1 Fan wheels:

.1 Welded aluminum construction.

.2 Maximum operating speed of centrifugal fans not more than 40% of first critical speed.

.3 Air foil backward inclined blades, as indicated.

.2 Bearings: heavy duty split pillow-block grease lubricated ball or roller self aligning type with oil retaining, dust excluding seals and a certified minimum rated life of 200,000 hours.

.3 Housings:

.1 Volute with inlet cones: fabricated steel for wheels 300 mm or greater, aluminum, for smaller wheels, braced, and with welded supports.

.2 For horizontally and vertically split housings provide flanges on each section for bolting together, with gaskets of non-oxidizing non-flammable material.

.3 Provide latched airtight access doors with handles.

.4 Variable volume control devices:

.1 Mounted by fan manufacturer.

2.4 CABINET FANS - GENERAL PURPOSE

.1 Fan characteristics and construction: as centrifugal fans.

.2 Cabinet hung single centrifugal fans in factory fabricated casing complete with vibration isolators and seismic control measures, motor, variable speed drive inside casing.

.3 Fabricate casing of zinc coated or phosphate treated steel of 1.6 mm thickness reinforced and braced for rigidity. Provide removable panels for access to interior. Paint uncoated, steel parts with corrosion resistant paint to MPI #18. Finish inside and out, over prime coat, with rust resistant enamel.Internally line cabinet with 50 mm thick rigid acoustic insulation, pinned and cemented, complete with perforated metal liner complete with metal nosings on exposed edges.

2.5 AXIAL FLOW FANS (TUBE-AXIAL OR VANE-AXIAL)

.1 Casings: welded steel with welded motor support, hinged access plates, streamlined inlet cone and discharge bell sections and integral silencer casing.

.2 Blade material: steel. Hub material: steel.

.3 Supports:

.1 Floor mounted units: reinforced legs.

.2 Ceiling suspended units: support brackets welded to side of casing. Extend grease lubrication facilities to outside of casing.

.4 Bearings: ball or roller with extension tubes to outside of casing.

.5 Direct drive:

.1 Fixed blade wheels: totally-enclosed, air over motors.

.2 Diameter of wheel hub: at least equal to that of motor frame.

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 HVAC fans installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate in presence of NRC Departmental Representative.

.2 Inform NRC 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 NRC Departmental Representative.

3.2 FAN INSTALLATION

.1 Install fans as indicated, complete with resilient mountings specified in Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment, flexible electrical leads and flexible connections in accordance with Section 23 33 00 - Air Duct Accessories.

.2 Provide sheaves and belts required for final air balance.

.3 Bearings and extension tubes to be easily accessible.

.4 Access doors and access panels to be easily accessible.

3.3 ANCHOR BOLTS AND TEMPLATES

.1 Size anchor bolts to withstand seismic acceleration and velocity forces as specified

3.4 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: in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 American National Standards Institute/Air Movement and Control Association (ANSI/AMCA)

.1 ANSI/AMCA Standard 210-[2007]/(ANSI/ASHRAE 51-07), Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.

.2 International Organization of Standardization (ISO)

.1 ISO 3741-[2010], Acoustics-Determination of Sound Power Levels of Noise Sources Using Sound Pressure - Precision Methods for Reverberation Rooms.

.3 National Fire Protection Association (NFPA)

.1 NFPA 90A-[12], Standard for the Installation of Air Conditioning and Ventilating Systems.

.4 Underwriter's Laboratories (UL)

.1 UL 181-[2005(R2008)], Factory-Made Air Ducts and Air Connectors.

1.2 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 air terminal units and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:

.1 Indicate the following:

.1 Capacity.

.2 Pressure drop.

.3 Noise rating.

.4 Leakage.

.4 Samples:

.1 Submit duplicate samples of air valves for testing and client acceptance.

.5 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.6 Test and Evaluation Reports:

.1 Test data: to ANSI/AMCA Standard 210.

.1 Submit published test data on DIN (Direct Internal Noise), in accordance with ISO 3741 made by independent testing agency for 0, 2.5 and 6 m/s branch velocity or inlet velocity.

.2 Sound power level with minimum inlet pressure of 0.25 kPa in accordance with ISO 3741 for 2nd through 7th octave band, also made by independent testing agency.

.3 Pressure loss through silencer shall not exceed 60% of inlet velocity pressure maximum.

1.3 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

.2 Operation and Maintenance Data: submit operation and maintenance data for air terminal units for incorporation into manual.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.

.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 air terminal units from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

.4 Packaging Waste Management: in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

Part 2 Products

2.1 SYSTEM DESCRIPTION

.1 Performance Requirements:

.1 Catalogued or published ratings for manufactured items: obtained from tests carried out by manufacturer or those ordered by manufacturer from certified ADC (Air Diffusion Council) testing agency signifying adherence to codes and standards.

2.2 MANUFACTURED UNITS

.1 Terminal units of the same type to be product of one manufacturer.

2.3 VARIABLE VOLUME BOXES

.1 Pressure independent factory reset to air flow between zero and maximum air volume.

.2 Sizes, capacities, differential pressures and sound ratings: as indicated.

.3 Differential pressure not to exceed 25 Pa at inlet air velocity of 10 m/s.

.4 Sound ratings of assembly not to exceed 20 NC at 25 Pa.

.5 Complete with:

.1 Operator and controller

.2 Sound attenuator

.3 Multiport outlet adapter: as indicated.

.4 Reheat coil: as indicated.

.6 Operator to be factory mounted and calibrated:

.7 Casing: constructed of 18ga galvanized steel, internally lined with 25 mm, 0.7 kg density fibrous glass, to UL181. Mount control components inside protective metal shroud.

.8 Damper: 18 ga galvanized steel with peripheral gasket and self lubricating bearings. Air leakage past closed damper not to exceed 2% of nominal rating at 750 Pa inlet static pressure, in accordance with Air Diffusion Council test procedure.

.9 Air velocity sensor pitot rack as standard to manufacturer.

.10 Electronic control package factory calibrated and set at factory. Features to accommodate field calibration and readjustment of air volume settings to include:

.1 Metre taps for balancing with digital DC voltmeter.

.2 Adjustable flow settings at thermostat.

.11 Factory installed 20 VA transformer, 115 V to 24 V. Power consumption of terminal not to exceed 15 VA.

.12 Terminal unit to be CSA certified.

2.4 VENTURI AIR VALVES

.1 Pressure independent factory reset to air flow between zero and maximum air volume.

.2 Sizes, capacities, differential pressures and sound ratings: as indicated.

.3 Internal plunger assembly responds to static pressure changes in less than one second.

.4 Turndown 20:1

.5 Factory calibrated and characterized by by flow to valve position with N.I.S.T traceable equipment.

.6 Accurate to +/-5% of flow

.7 14 ga aluminum valve body, 16 ga aluminum cone, Teflon coated 316 stainless steel shaft, 316 stainless steel shaft supports, 316 stainless steel internal hardware.

.8 Low pressure application: 75Pa to 750Pa.

.9 Electronic control package factory calibrated and set at factory. Features to accommodate field calibration and readjustment of air volume settings to include:

.1 Metre taps for balancing with digital DC voltmeter.

.2 Adjustable flow settings at thermostat.

.10 Factory installed 20 VA transformer, 115 V to 24 V. Power consumption of terminal not to exceed 15 VA.

.11 Terminal unit to be CSA certified.

.12 Equivalent to EH Price Venturi Valve.

2.5 LOW PRESSURE SHUT-OFF AIR VALVES

.1 Pressure independent factory calibrated venture-type air valve with shut-off mode to provide isolation of n HVAC system.

.2 16 ga. Spun aluminum valve body with continuous welded seam

.3 Composite Teflon shaft bearings

.4 Spring grade stainless steel spring and polyester slide assembly

.5 Operating range: 32°C-122°C ambient. 10%-90% non-condensing RH

.6 Pressure independent over a 75 – 750PA pressure drop across valve

.7 Volume accurate to +/- 5%, 5 cfm of airflow command signal throughout normal operating range

.8 No additional straight duct runs needed before or after valve

.9 Less than 1 minute response time

.10 10VA – 70VA power consumption. 24VAC power at 60Hz

.11 VAV controller with 3 universal inputs, 1 digital output, 2 analog outputs, 1 digital output. Volts, mA, ohms or NTC 2 or 3 thermistor signals.

.1 Input accuracy: voltage, current, resistance: +/- 1% full scale

.2 Output accuracy:

.1 0 to 10VDC: +/- 1% full scale into 10 kOhms minimum

.2 4 to 20 mA: +/- 1% full scale into 500 Ohms +0/-50 Ohms

.12 CSA compliant

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 air terminal units installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate in presence of NRC Departmental Representative.

.2 Inform NRC 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 NRC Departmental Representative.

3.2 INSTALLATION

.1 Install in accordance with manufacturers recommendations.

.2 Support independently of ductwork.

.3 Install with at least 1000 mm of flexible inlet ducting and minimum of four duct diameters of straight inlet duct, same size as inlet.

.4 Locate controls, dampers and access panels for easy access.

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

.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

Part 1 General

1.1 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 diffusers, registers and grilles and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Indicate following:

.1 Capacity.

.2 Throw and terminal velocity.

.3 Noise criteria.

.4 Pressure drop.

.5 Neck velocity.

1.2 MAINTENANCE MATERIAL SUBMITTALS

.1 Extra Materials:

.1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.

.2 Include:

.1 Keys for volume control adjustment.

.2 Keys for air flow pattern adjustment.

1.3 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.

.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 diffuser, registers and grilles from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

.4 Packaging Waste Management: in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

Part 2 Products

2.1 SYSTEM DESCRIPTION

.1 Performance Requirements:

.1 Catalogued or published ratings for manufactured items: obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency signifying adherence to codes and standards.

2.2 GENERAL

.1 To meet capacity, pressure drop, terminal velocity, throw, noise level, neck velocity as indicated.

.2 Frames:

.1 Full perimeter gaskets.

.2 Plaster frames where set into plaster or gypsum board.

.3 Concealed fasteners.

.3 Colour: as directed by NRC Departmental Representative.

2.3 MANUFACTURED UNITS

.1 Grilles, registers and diffusers of same generic type, products of one manufacturer.

2.4 SUPPLY GRILLES AND REGISTERS

.1 General: with opposed blade dampers.

.2 Type SA: aluminum, 25 mm border, double deflection with airfoil shape, horizontal face and vertical rear bars.

2.5 RETURN AND EXHAUST GRILLES AND REGISTERS

.1 Type RA: aluminum, 19 mm border, single 45 degrees deflection, horizontal face bars.

2.6 DIFFUSERS

.1 Type DA: aluminum, round type, having fixed pattern, lay-in mounted. Model: Equivalent to EH Price RD.

.2 Type DB: aluminum, square type, having fixed pattern, lay-in mounted. Model: Equivalent to EH Price SCD.

.3 Linear Grilles: Extruded aluminum surface mount type with 25mm border and 12mm bar spacing, bars oriented in horizontal direction. Grille mated to factory-fabricated plenum with centred inlet collar.

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 diffuser, register and grille installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate in presence of NRC Departmental Representative.

.2 Inform NRC 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 NRC Departmental Representative.

3.2 INSTALLATION

.1 Install in accordance with manufacturers instructions.

.2 Install with flat head cadmium plated screws in countersunk holes where fastenings are visible.

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 Waste Management: in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

Approved: 2013-06-30

Part 1 General

1.1 REFERENCES

.1 The latest versions of the following codes are to be followed:

.2 ASTM International

.1 ASTM E90, Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.

.2

.3 National Fire Protection Association (NFPA)

.1 NFPA 96, Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.

.4 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)

.5 Society of Automotive Engineers (SAE)

1.2 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 louvers, intakes and vents and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Indicate following:

.1 Pressure drop.

.2 Face area.

.3 Free area.

.4 Finish

.3 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.4 Test Reports: submit certified data from independent laboratory substantiating acoustic and aerodynamic performance to ASTM E90.

1.3 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements .

.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 in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect louvers, intakes and vents from nicks, scratches, and blemishes .

.3 Replace defective or damaged materials with new.

.4 Develop Construction Waste Management Plan .

.5 Packaging Waste Management: remove for reuse by manufacturer of pallets, crates, padding, packaging materials as specified in Construction Waste Management Plan .

Part 2 Products

2.1 SYSTEM DESCRIPTION

.1 Performance Requirements:

.1 Catalogued or published ratings for manufactured items: obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency signifying adherence to codes and standards.

2.2 FIXED LOUVRES - ALUMINUM

.1 Construction: welded with exposed joints ground flush and smooth.

.2 Material: extruded aluminum alloy 6063-T5.

.3 Blade: stormproof pattern with centre watershed in blade , reinforcing bosses and maximum blade length of 1500 mm.

.4 Frame, head, sill and jamb: 100 mm deep one piece extruded aluminum, minimum 3 mm thick with approved caulking slot, integral to unit .

.5 Mullions: at 1500 mm maximum centres.

.6 Fastenings: stainless steel SAE-194-8F with SAE-194-SFB nuts and resilient neoprene washers between aluminum and head of bolt, or between nut, ss washer and aluminum body.

.7 Screen: 12 mm exhaust 19 mm intake mesh, 2 mm diameter wire aluminum birdscreen on inside face of louvres in formed U-frame.

.8 Finish: Anodized . Colour: to NRC Departmental Representative's approval.

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 louvres, intakes and vents installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate in presence of NRC Departmental Representative .

.2 Inform NRC 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 NRC Departmental Representative .

3.2 INSTALLATION

.1 In accordance with manufacturer's and SMACNA recommendations.

.2 Reinforce and brace as indicated.

.3 Anchor securely into opening. Seal with caulking to ensure weather tightness.

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

.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 American National Standard Institute (ANSI)/American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)

.1 ANSI/ASHRAE 52.2- 12 , Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particulate Size (ANSI approved).

.2 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-115.10- M90 , Disposable Air Filters for the Removal of Particulate Matter from Ventilating Systems.

.2 CAN/CGSB-115.11- M85 , Filters, Air, High Efficiency, Disposable, Bag Type.

.3 CAN/CGSB-115.12- M85 , Filters, Air, Medium Efficiency, Disposable, Bag Type.

.4 CAN/CGSB-115.13- 85 , Filter Media, Automatic Roll.

.5 CAN/CGSB-115.14- M91 , High Efficiency Cartridge Type Supported Air Filters for the Removal of Particulate Matter from Ventilating Systems.

.6 CAN/CGSB-115.15- M91 , High Efficiency Rigid Type Air Filters for Removal of Particulate Matter from Ventilating Systems.

.7 CAN/CGSB-115.16- M82 , Activated Carbon for Odor Removal from Ventilating Systems.

.8 CAN/CGSB-115.18- M85 , Filter, Air, Extended Area Panel Type, Medium Efficiency.

.9 CAN/CGSB-115.20- 95 , Polarized Media Air Filter.

.3 International Organization of Standardization (ISO)

.1 ISO 14644-1- 99 , Clean Rooms and Associated Controlled Environments - Part 1: Classification of Air Cleanliness.

.4 National Fire Protection Association (NFPA)

.1 NFPA 96- 11 , Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.

.5 Underwriters' Laboratories of Canada (ULC)

.1 ULC -S111- 07 , Standard Method of Fire Tests for Air Filter Units.

.2 ULC-S646- 06 , Exhaust Hoods and Related Controls for Commercial and Institutional Kitchens.

.6 US Department of Defense - Test Method Standard

.1 MIL-STS-282- 95 , Filter Units, Protective Clothing, Gas-Mask Components and Related Products; Performance Test Methods.

1.2 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 HVAC filters and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

1.3 MAINTENANCE MATERIAL SUBMITTALS

.1 Extra Materials:

.1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.

.2 Furnish list of individual manufacturer's recommended spare parts for equipment such as frames and filters, addresses of suppliers, list of specialized tools necessary for adjusting, repairing or replacing for inclusion in operating manual.

.3 Spare filters: in addition to filters installed immediately prior to acceptance by NRC Departmental Representative, supply 1 complete set of filters for each.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.

.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 HVAC filters from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

.4 Packaging Waste Management: in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

Part 2 Products

2.1 GENERAL

.1 Media: suitable for air at 100% RH and air temperatures between -40 and 50 degrees C.

.2 Number of units, size and thickness of panels, overall dimensions of filter bank, configuration and capacities: as indicated.

.3 Pressure drop when clean and dirty, sizes and thickness: as indicated on schedule.

2.2 ACCESSORIES

.1 Holding frames: permanent channel section construction of same material as casing/hood, 1.6 mm thick, except where specified.

.2 Seals: to ensure leakproof operation.

.3 Blank-off plates: as required, to fit all openings and of same material as holding frames.

.4 Access and servicing: through doors/panels on each side and/or from upstream face of filter bank.

2.3 COTTON PANEL FILTERS

.1 Disposable pleated reinforced cotton dry media: to CAN/CGSB 115.18.

.2 Holding frame: galvanized steel, or slide in channel for side access.

.3 Performance:

.1 Average atmospheric dust spot efficiency 30% to ANSI/ASHRAE 52.2.

.2 Average synthetic dust weight arrestance 90% to ANSI/ASHRAE 52.2.

.4 Fire Rated: to ULC -S111.

.5 Nominal thickness: 100 mm.

2.4 HEPA ABSOLUTE PACKAGE FILTERS 99.97% EFFICIENCY

.1 Media: water resistant fibrous glass.

.2 Holding frame: cadmium plated steel by unit manufacturer.

.3 Housing and sealing system: manufacturers' standard, suitable for pressure application.

.4 Unit bank installation: to ISO 14644-1.

.5 Efficiency: minimum 99.97% overall on hot DOP test, using 0.003 mm particles MIL-STD-282.

2.5 POLARIZED MEDIA AIR FILTERS

.1 Principle of operation:

.1 Polarized high voltage wire mesh screen sandwiched between 2 pads of polarized filter media, whole assembly contained within grounded screens.

.2 Manufacturer to guarantee that particulates leaving filter have neutral charge.

.2 To:

.1 CAN/CGSB-115.20.

.3 Polarizing screen:

.1 Electrically conductive wire mesh screen sandwiched between 2 layers of filter media.

.4 Filter media:

.1 Permanent, washable, replaceable fibrous glass, overall thickness as indicated 50 mm.

.5 External frames:

.1 Metal, hinged metal on each side of filter panel.

.6 Electrical:

.1 Connections: CSA certified, 120 - 9 volt direct plug-in adapter to match size and model of air filter, using less than 600 mW per panel and complete with 2000 mm extension cord.

.2 High voltage DC power supply having impedance of approximately 22 ohms.

.3 Use plenum mounting kits for multiple panel filter bank.

.4 Electrical rating of each filter panel visible.

.7 Ozone generation:

.1 Complete filter non-ozone generating.

.8 Filter efficiency:

.1 One-pass efficiency of 60% when using particulate of 3.0 micron or larger and tested in accordance with CEA 906 U 708.

.2 Submit copies of test reports with shop drawings.

2.6 ELECTRONIC AIR CLEANERS

.1 Electronic agglomerator: independently supported and nested collection cells including ionizing wires, grounded struts, positive and negative plates, insulators, ionizer and plate contacts. Insulators: locate out of air stream.

.2 Power pack:

.1 Self-contained, prewired rectifying unit for approximately 12,000V DC for ionizer and 6,000V DC for precipitator.

.2 Overload protection, on-off switch, pilot light indicating operating status and safety accessories.

.3 Control package complete with: airflow switch, manual reset, safety switches, warning lights, high voltage warning signs and signal lights.

.4 Efficiency electronic: 99% to ANSI/ASHRAE 52.2.

2.7 ACTIVATED CARBON TYPE FILTERS

.1 Media:

.1 Regenerative activated carbon from coconut shell: to CAN/CGSB-115.16.

.2 50-55 minute absorption capacity in accordance with standard accelerated chloropicrin test.

.3 Density: 550 kg/m^3.

.4 95 hardness in accordance with Ball abrasion test.

.5 Particle size (Tyler mesh screen): 6.3 x 10 mm.

.6 Quantity of media: 4.25 kg/100 L/s.

.2 Holding frame: removable, non-disposable, corrosion resistant steel.

.3 Filter housing: corrosion resistant steel.

.4 Test element:

.1 Detachable, to indicate extent of saturation of actual installation.

.2 1 per bank.

2.8 FILTER GAUGES - DIAL TYPE

.1 Diaphragm actuated, direct reading.

.2 Range: 0 to 2 times initial pressure.

2.9 FILTER GAUGES - MANOMETER TYPE

.1 Inclined acrylic tube.

.2 Complete with levelling screws.

.3 Range: 0 to 2 times initial pressure 0 to 250 Pa.

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 filter installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate in presence of NRC Departmental Representative.

.2 Inform NRC 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 NRC Departmental Representative.

3.2 INSTALLATION GENERAL

.1 Install in accordance with manufacturer's recommendations and with adequate space for access, maintenance and replacement.

3.3 ACTIVATED CARBON TYPE FILTERS

.1 During testing, adjusting and balancing, install substitute media.

.2 Install permanent media only after painting is completed.

3.4 REPLACEMENT MEDIA

.1 Replace media with new upon acceptance.

.2 Filter media new and clean, as indicated by pressure gauge, at time of acceptance.

3.5 HEPA FILTERS

.1 Use components and devices recommended by manufacturer to ensure complete integrity and to ensure easy removal and replacement, even when dressed in anti-contamination clothing.

.2 Provide proper permanent facilities for challenging integrity with aerosol injector downstream of pre-filters and test sampling manifold downstream of HEPA filter. Location of injector and sampling manifold approved by manufacturer.

.3 During TAB, install substitute media having similar pressure drop.

.4 Before acceptance, perform tests to demonstrate integrity of complete installation.

3.6 FILTER GAUGES

.1 Install type as indicated across each filter bank (pre-filter and final filter) in approved and easy readable location.

.2 Mark each filter gauge with value of pressure drop for clean condition and manufacturer's recommended replacement (dirty) value.

3.7 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: in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 CSA Group

.1 CSA C22.2 No.46- M1988(R2011) , Electric Air-Heaters.

1.2 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 duct heaters and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Submit product data and include:

.1 Element support details.

.2 Heater: total kW rating, voltage, phase.

.3 Number of stages.

.4 Rating of stage: rating, voltage, phase.

.5 Heater element watt/density and maximum sheath temperature.

.6 Maximum discharge temperature.

.7 Unit support.

.8 Clearance from combustible materials.

.9 Internal components wiring diagrams.

.10 Minimum operating airflow.

.11 Pressure drop at operating airflow.

1.3 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.

.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 duct heaters from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

.4 Packaging Waste Management: in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

Part 2 Products

2.1 ELECTRIC DUCT HEATERS

.1 Duct heaters: flange type.

.2 Frame: galvanized steel

.3 Elements:

- .1 Heating coils of open nickel chrome alloy resistance wire.
- .2 High temperature resistant ceramic coil supports

.4 Complete with magnetic contactors and primary automatic reset thermal cut-out to avoid overheating.

.5 Maximum temperature at discharge: 45 degrees Celsius.

.6 Controls:

- .1 Factory mounted and wired in control box. Use terminal blocks for power and control wiring to thermostat and sail switch.
- .2 With terminal strips in heater terminal box for power and control wiring.
- .3 Controls mounted in a CSA enclosure and to include:
  - .1 Magnetic contactors.
  - .2 Control transformers.
  - .3 SCR controller.
  - .4 Load fuses
  - .5 Stage fuses
- .4 Where controls are mounted in heater, exercise care in mounting contactors to minimize switching noise transmission through ductwork.
- .5 High temperature cutout and air proving switch.

.7 Main isolation disconnect switch.

2.2 GLYCOL DUCT HEATER – SERVING 22SAF01

.1 Copper tube with aluminum fins mechanically bonded to copper.

.2 Pressure and leak tested at factory

.3 500fpm maximum velocity over coil,

.4 18 GA sheet metal casing

.5 Performance certified to ARI Standard 410.

.6 1000cfm, 110mbh, -17F EAT, 85F LAT, 180F EWT, 160F LWT, 12 gpm 50% ethylene glycol flow.

2.3 STEAM DUCT HEATER – SERVING 22AHU04

.1 Seamless drawn copper tubes mechanically expanded to aluminum fins with die-formed self-spacing collars.

.2 Tubular copper headers silver brazed into the tube ends

.3 Coil casing is heavy gauge galvanised sheet steel

.4 Tube end plates have die-formed collared end holes to allow expansion and contraction

.5 Complete with flow regulator, air purge and vacuum breaker

.6 Performance certified to ARI Standard 410.

.7 2000cfm, 145mbh, -17F EAT, 50F LAT, 50psi steam.

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 duct heaters installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate in presence of NRC Departmental Representative.

.2 Inform NRC 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 NRC Departmental Representative.

3.2 INSTALLATION

.1 Make power and control connections to CSA C22.2 No.46.

3.3 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 01 91 13 - General Commissioning (Cx) Requirements and Section 26 05 00 - Common Work Results for Electrical.

.2 Perform tests in presence of NRC Departmental Representative.

.1 Provide test report and include copy with Operations and Maintenance Manuals.

3.4 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: in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 The most recent version of the following codes are to be followed

.2 American Society of Mechanical Engineers (ASME)

.1 ASME Boiler and Pressure Vessel Code.

.3 CSA International

.1 CSA B51- 09 , Boiler, Pressure Vessel, and Pressure Piping Code.

1.2 ADMINISTRATIVE REQUIREMENTS

.1 Pre-Installation Meetings:

.1 Convene pre-installation meeting 1 week prior to beginning work of this Section on-site installation , with NRC Departmental Representative in accordance with Section 01 31 19 - Project Meetings to:

.1 Verify project requirements.

.2 Review installation and substrate conditions.

.3 Co-ordination with other building subtrades.

.4 Review manufacturer's written installation instructions and warranty requirements.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for heat exchangers and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:

.1 Shop drawings to indicate project layout, including layout and dimensions of heat exchangers and system.

.1 Indicate manufacturer's recommended clearances for tube withdrawal and manipulation of tube cleaning tools.

.4 Test Reports: submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.

.5 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.6 Manufacturer's Instructions: submit manufacturer's installation instructions.

.7 Manufacturers Reports:

.1 Manufacturer's Field Reports: submit manufacturer's written reports 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 heat exchangers for incorporation into manual.

1.5 MAINTENANCE MATERIAL SUBMITTALS

.1 Extra Stock Materials:

.1 Submit in accordance with Section 01 78 00 - Closeout Submittals .

.1 Supply following spare parts:

.1 Head gaskets: 4_ .

1.6 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements .

.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 in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect heat exchangers from nicks, scratches, and blemishes .

.3 Replace defective or damaged materials with new.

.4 Develop Construction Waste Management Plan related to Work of this Section.

.5 Packaging Waste Management: remove for reuse by manufacturer of pallets, crates, padding, packaging materials as specified in Construction Waste Management Plan

Part 2 Products

2.1 EQUIPMENT

.1 Deigned built and tested in accordance with ASME Boiler and Pressure Vessel Code, Section VIII Division 1. A manufacturer’s data report for pressure vessels, form number U-1 or a manufacturer’s certificate of compliance form number U-3 as required by the previous provisions of the ASME code rules is to be furnished to the user or designated agent upon request. The form must be signed by the qualified inspector, holding a National Board Commission when required, certifying that construction conforms to the latest ASME code for pressure vessels for a minimum design metal temperature of 35 F, a tube side working pressure of 125 psi at 180 F and a shell side working pressure of 15psi at 250F.

.2 Tube-in-shell Heat Exchanger:

.1 Steam to glycol. Heating media in shell .

.2 Designed, constructed and tested in accordance with ASME Boiler and Pressure Vessel Code CSA B51 and provincial pressure vessel regulations.

.3 Shell: carbon steel 1 MPa working pressure. Flanged inlet connection, sizes as indicated . Flanged outlet connection, . Tappings for relief valve gauge drain vacuum breaker .

.4 Head: cast iron flanged inlet and outlet. Tapped connections for drain and vacuum breaker.

.5 Tubes: 20 ga copper . Maximum tube velocity: 2 m/s .

.6 Tube sheet: carbon steel .

.7 Fouling Resistance Coefficient: steam side 0.00009 m^2K/W water side 0.00018 m^2K/W .

.8 Capacity: 551 mbh .

.1 Primary:steam, 50psi

.2 Secondary: 50% Ethylene glycol, 155F inlet, 180F outlet, 50usgpm, 0.5psi pressure drop maximum.

.9 Mounting supports: steel or cast iron saddles and angle iron brackets to support from floor, 900mm AFF.

.10 Manufacturer: Armstrong WS-0605-200-1 or equivalent

Part 3 Execution

3.1 EXAMINATION

.1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for heat exchanger installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate in presence of NRC Departmental Representative

.2 Inform NRC 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 NRC Departmental Representative .

3.2 INSTALLATION

.1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, and data sheets.

.2 General: install level and firmly anchored to supports in accordance with manufacturer's recommendations .

.3 Tube in shell heat exchangers: arrange piping so that tube bundle can be removed after disconnecting two unions or flanges adjacent to head and without disturbing other equipment and systems.

.4 Plate exchangers: install in accordance with manufacturer's recommendations.

3.3 APPURTENANCES

.1 Install with safety relief valve piped to drain vacuum breaker steam trap hose bib drain valve .

.2 Install thermometer wells with thermometers on inlet and outlet of primary and secondary side.

.3 Install pressure gauge on steam inlet.

3.4 FIELD QUALITY CONTROL

.1 Site Tests and Inspections:

.1 Perform tests as directed by NRC Departmental Representative to ensure heat exchangers are functional.

.2 Obtain reports within 3 days of review and submit immediately to NRC Departmental Representative .

.2 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product.

.3 Manufacturer's Field Services:

.1 Submit manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

.2 Ensure manufacturer's representative is present before and during critical periods of installation .

.3 Schedule site visits:

.1 After delivery and storage of products, and when preparatory Work, or other Work, on which the Work of this Section depends, is complete but before installation begins.

3.5 SYSTEM START-UP

.1 General: perform start-up operations in accordance with Section 01 91 13 - General Commissioning (Cx) Requirements : General Requirements, supplemented as specified herein.

.2 Check heater for cleanliness on primary and secondary sides.

.3 Check water treatment system is complete, operational and correct treatment is being applied.

.4 Check installation, settings, operation of relief valves and safety valves.

.5 Check installation, location, settings and operation of operating, limit and safety controls.

.6 Check supports, seismic restraint systems.

.7 General: perform performance verification in accordance with Section 01 91 13 - General Commissioning (Cx) Requirements : General Requirements, supplemented as specified.

.8 Timing: only after TAB of hydronic systems have been successfully completed.

.9 Primary side:

.1 Measure flow rate, pressure drop, and either 1 steam pressure and temperature at heater inlet or 2 water temperature at heater inlet and outlet.

.1 Verify operation of steam traps. Measure temperature of condensate return at trap outlet.

.2 Control valve: verify proper operation without binding, slack in components. Measure either steam pressure and temperature at control valve inlet or 2 if control is three-port type, pressure drop across inlet to common, bypass to common, inlet to bypass.

.3 Secondary side:

.1 Measure flow rate, pressure drop and water temperature at heater inlet and outlet.

.2 Verify installation and operation of air elimination devices.

.4 Calculate heat transfer from primary and secondary sides.

.5 Simulate heating water temperature schedule and repeat above procedures.

.6 Verify settings, operation, safe discharge from safety valves and relief valves.

.7 Verify settings, operation of operating, limit and safety controls and alarms.

.8 Reports:

.1 In accordance with Section 01 91 13 - General Commissioning (Cx) Requirements : Reports, supplemented as specified herein.

3.6 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 .

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

.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.7 DEMONSTRATION

.1 Training: provide training in accordance with Section 01 91 13 - General Commissioning (Cx) Requirements : Training of O M Personnel, supplemented as follows:

3.8 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by heat exchanger installation.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 Air-Conditioning, Heating and Refrigeration Institute (AHRI)

.1 AHRI-550/590-03, Performance Rating of Water Chilling Packages Using the Vapor Compression Cycle.

.2 CSA International

.1 CSA B52-05 SMART, Mechanical Refrigeration Code.

.3 Environment Canada, (EC)/Environmental Protection Services (EPS)

.1 EPS 1/RA/2-1996, Environmental Code of Practice for Elimination of Fluorocarbons Emissions from Refrigeration and Air Conditioning Systems.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for chillers and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:

.1 Indicate:

.1 Equipment including connections, piping and fittings, valves, strainers, control assemblies and ancillaries, identifying factory and field assembled.

.2 Wiring as assembled and schematics.

.3 Dimensions, construction details, recommended installation and support, mounting bolt hole sizes and locations and point loads.

.4 Type of refrigerant used.

.4 Sustainable Design Submittals:

.1 Construction Waste Management:

.1 Submit project Waste Management Plan highlighting recycling and salvage requirements.

1.3 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

.2 Operation and Maintenance Data: submit operation and maintenance data for chillers for incorporation into manual.

.3 Data to include:

.1 Description of equipment giving manufacturers name, model type and year, capacity and serial numbers.

.2 Provide part load performance curves.

.3 Details on operation, servicing and maintenance.

.4 Recommended spare parts list.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.

.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 chillers from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

.4 Develop Construction Waste Management Plan related to Work of this Section.

.5 Packaging Waste Management: remove for reuse and return of pallets, crates, padding, packaging materials as specified in Construction Waste Management Plan.

Part 2 Products

2.1 GENERAL

.1 Provide complete chiller package including: compressor; evaporator; condenser, motor and motor starter; controls; control centre; piping; wiring; refrigeration and oil change; ready for connection to chilled water circuit and condenser water circuit interlocks, and electric power source, installed in welded steel frame panels and access doors finished to manufacturers standard.

2.2 BUILDING CHILLER 22-CCH-03

.1 Certified ratings based on AHRI 550/590:

.2 UNIT DESCRIPTION

.1 Provide and install as shown on the plans factory-assembled, factory-charged air-cooled scroll compressor packaged chiller. Each chiller shall consist of hermetic tandem scroll compressor sets (total four compressors), brazed plate evaporator, air-cooled condenser section, microprocessor-based control system and all components necessary for controlled unit operation.

.2 Each chiller shall be factory run-tested to verify operation. Operating controls and refrigerant charge shall be checked for proper operation and optimum performance.

.3 DESIGN REQUIREMENTS

.1 Flow Range: The chiller shall have the ability to support variable flow range down to 40% of nominal design (based on AHRI conditions).

.2 Operating Range: The chiller shall have the ability to control leaving chilled fluid temperature from 15F to 65F

.3 General: Provide a complete scroll compressor packaged chiller as specified herein and as shown on the drawings. The unit shall be in accordance with the standards referenced in section 1.02 and any local codes in effect.

.4 Performance: Refer to the schedule of performance on the drawings. The chiller shall be capable of stable operation to a minimum percentage of full load (without hot gas bypass) of 25%. Performance shall be in accordance with AHRI Standard 550/590.

.5 Acoustics: Sound pressure levels for the unit shall not exceed the following specified levels. All manufacturers shall provide the necessary sound treatment (parts and labor) to meet these levels if required. Sound data shall be provided with the quotation. Test shall be in accordance with AHRI Standard 370.

.1 63Hz Band: 65dB

.2 125 Hz Band: 64 dB

.3 250 Hz Band: 61 dB

.4 500 Hz Band: 60 dB

.5 1000 Hz Band: 56 dB

.6 2000 Hz Band: 51 dB

.7 4000 Hz Band: 46 dB

.8 8000 Hz Band: 41 dB

.9 Overall dBA: 61dBA

.4 CHILLER COMPONENTS

.1 Compressor

.1 The compressors shall be sealed hermetic, scroll type with crankcase oil heater and suction strainer. The compressor motor shall be refrigerant gas cooled, high torque, hermetic induction type, two-pole, with inherent thermal protection on all three phases and shall be mounted on vibration isolator pads. The compressors shall be equipped with an internal module providing compressor protection and communication capability.

.2 Evaporator

.1 The evaporator shall be a compact, high efficiency, dual circuit, brazed plate-to-plate type heat exchanger consisting of parallel stainless steel plates

.2 The evaporator shall be protected with an electric resistance heater (heat trace tape) and insulated with 3/4" (19mm) thick closed-cell polyurethane insulation. This combination shall provide freeze protection down to -20°F (-29°C) ambient air temperature.

.3 The water-side working pressure shall be a minimum of 653 psig (4502 kPa). Vent and drain connections shall be provided in the inlet and outlet chilled water piping by the installing contractor. Evaporators shall be

designed and constructed according to, and listed by, Underwriters Laboratories (UL).

.3 Condenser

.1 Condenser fans shall be propeller type arranged for vertical air discharge and individually driven by direct-drive fan motors. The fans shall be equipped with a heavy-gauge vinyl-coated fan guard. Fan motors shall be TEAO type with permanently lubricated ball bearings, inherent overload protection, three-phase, direct-drive, 1140 rpm. Each fan section shall be partitioned to avoid cross circulation.

.2 Coil shall be all aluminum alloy microchannel design and shall have a series of flat tubes containing multiple, parallel flow microchannels layered between the refrigerant manifolds. Coils shall consist of a two-pass arrangement. Each condenser coil shall be factory leak tested with high-pressure air under water. Coils shall withstand 1000+ hour acidified synthetic sea water fog (SWAAT) test (ASTM G85-02) at 120°F (49°C) with 0% fin loss and develop no leaks.

.4 Refrigerant Circuit

.1 R410A. Each of the two refrigerant circuits shall include a refrigerant filter-drier, sight glass with moisture indicator, liquid line solenoid valve (no exceptions), expansion valve, and insulated suction line.

.5 Construction

.1 Unit casing and all structural members and rails shall be fabricated of pre-painted or galvanized steel to meet ASTM B117, 500-hour salt spray test.

.6 Control System

.1 A centrally located weatherproof control panel shall contain the field power connection points, control interlock terminals, and control system. Power and starting components shall include factory circuit breaker for fan motors and control circuit, individual contactors for each fan motor, solid-state compressor three-phase motor overload protection, inherent fan motor overload protection and two power blocks (one per circuit) for connection to remote, contractor supplied disconnect switches. Hinged access doors shall be lockable. Barrier panels or separate enclosures are required to protect against accidental contact with line voltage when accessing the control system.

.2 Shall include optional single-point connection to a non-fused disconnect switch with through-the-door handle and compressor circuit breakers.

.7 Unit Controller

.1 An advanced DDC microprocessor unit controller with a 5-line by 22-character liquid crystal display provides the operating and protection functions. The controller shall take preemptive limiting action in case of high discharge pressure or low evaporator pressure. The controller shall contain the following features as a minimum:

.2 The unit shall be protected in two ways: (1) by alarms that shut the unit down and require manual reset to restore unit operation and (2) by limit

alarms that reduce unit operation in response to some out-of-limit condition. Shut down alarms shall activate an alarm signal.

.8 Shutdown Alarms
- .1 No evaporator water flow (auto-restart)
- .2 Sensor failures
- .3 Low evaporator pressure
- .4 Evaporator freeze protection
- .5 High condenser pressure
- .6 Outside ambient temperature (auto-restart)
- .7 Motor protection system
- .8 Phase voltage protection (Optional)

.9 Limit Alarms
- .1 Condenser pressure stage down, unloads unit at high discharge pressures.
- .2 Low ambient lockout, shuts off unit at low ambient temperatures.
- .3 Low evaporator pressure hold, holds stage #1 until pressure rises.
- .4 Low evaporator pressure unload, shuts off one compressor.

.10 Unit Enable Section
- .1 Enables unit operation from either local keypad, digital input, or BAS

.11 Unit Mode Selection
- .1 Selects standard cooling, ice, glycol, or test operation mode

.12 Analog Inputs:
- .1 Reset of leaving water temperature, 4-20 mA\
- .2 Current Limit

.13 Digital Inputs
- .1 Unit off switch
- .2 Remote start/stop
- .3 Flow switch
- .4 Ice mode switch, converts operation and setpoints for ice production
- .5 Motor protection

.14 Digital Outputs
- .1 Shutdown alarm; field wired, activates on an alarm condition, off when alarm is cleared
- .2 Evaporator pump; field wired, starts pump when unit is set to start

.15 Condenser fan control - The unit controller shall provide control of condenser fans based on compressor discharge pressure.

.16 Building Automation System (BAS) Interface
- .1 Factory mounted DDC controller(s) shall support operation on a BACnet®, Modbus® or LONMARK ® network via one of the data link / physical layers listed below as specified by the successful Building Automation System (BAS) supplier.

.2 BACnet MS/TP master (Clause 9)

.3 BACnet IP, (Annex J)

.4 BACnet ISO 8802-3, (Ethernet)

.5 LONMARK FTT-10A. The unit controller shall be LONMARK® certified.

.6 The information communicated between the BAS and the factory mounted unit controllers shall include the reading and writing of data to allow unit monitoring, control and alarm notification as specified in the unit sequence of operation and the unit points list.

.7 For chillers communicating over a LONMARK network, the corresponding LONMARK eXternal Interface File (XIF) shall be provided with the chiller submittal data.

.8 All communication from the chiller unit controller as specified in the points list shall be via standard BACnet objects. Proprietary BACnet objects shall not be allowed. BACnet communications shall conform to the BACnet protocol (ANSI/ASHRAE135-2001). A BACnet Protocol Implementation Conformance Statement (PICS) shall be provided along with the unit submittal.

.5 OPTIONS AND ACCESSORIES

.1 The following options are to be included:

.1 Hot Gas Bypass: allows unit operation to 10 percent of full load. Includes factory-mounted hot gas bypass valve, solenoid valve, and manual shutoff valve for each circuit. Shall be ready for field piping according to manufacturer instructions.

.2 Ground Fault Protection: Factory installed circuit breaker to protect equipment from damage from line-to-ground fault currents less than those required for conductor protection.

.3 Phase loss with under/over voltage protection and with LED indication of the fault type to guard against compressor motor burnout.

.4 BAS interface module to provide interface with the BACnet MSTP protocol.

.5 The following accessories, if selected, are to be included:

.1 Spring vibration isolators for field installation

.2 Rubber-in-shear vibration isolators for field installation

.3 Factory-mounted thermal dispersion type flow switch

.4 Field-mounted, paddle type, chilled water flow switch field wired to the control panel

.5 Evaporator inlet strainer, 40-mesh with extension pipe and Victaulic couplings (factory mounted or field installed)

.6 115V GFI convenience outlet

2.3 LABS CHILLER 22-CCH-04

.1 Composition

.1 The machine is set-up to manage both hydraulic circuits (evaporator and condenser), allowing operation in cooling and heat pump modes, via cycle reverse on the hydraulic side.

.2 Refrigerant

.1 Chillers in the NXW range use R410A refrigerant.

.3 Cooling Circuit

.1 Two cooling circuits, with four high-efficiency scroll type hermetic compressors. Both circuits are served by two compressors in tandem and are independent, thus guaranteeing greater operating safety. At partial loads, every operating compressor works in maximum yield conditions, thus allowing to maximize the efficiency of the entire machine. The unit is dual-circuit on the chiller side and single-circuit on the hydraulic side.

.4 Description of the cooling circuit

.1 Both circuits are made using copper pipes with welded joints in silver alloy including the following components:

.1 braze welded plate type evaporator and condenser (AISI 316);

.2 thermostatic valve;

.3 dehydrator filter;

.4 liquid indicator;

.5 liquid and pressing line taps;

.6 solenoid valve.

.2 The unit also has a liquid separator placed on the compressor intake for protection against any return of liquid.

.3 Version without condenser. Machines are delivered after being pre-charged.

.5 Partial Capacity Steps

.1 Four partial capacity steps.

.6 Thermostatic Valve:

.1 Mechanical thermostatic valve with external equalizer positioned at the exit of the evaporator and bulb sensitive to the intake temperature. Depending on the heat load it modulates the flow of gas, always maintaining the correct heating level of the intake gas to the compressor. This allows working with minimum temperature of the water produced from 17.6 °F to 39 °F.

.7 Version

.1 Silenced. Version with acoustic protection covering made with a galvanised sheet steel panel casing covered internally using sound-absorbent material, able to isolate the noise produced by the compressors. This leads to a noise reduction of 6 db(A).

.8 Support frame

.1 Made in hot galvanized sheet steel with suitable thickness and painted with polyester powders able to resist atmospheric agents through time.

.9 Compressors

.1 The scroll-type hermetic compressors mounted on the NXW are optimized to work with R410A refrigerant and are distinguished by high efficiency and low power absorption. They are supplied with an electric resistance on the oil sump as standard. The resistance is powered automatically when the unit stops as long as the unit is live. The scroll compressors are moved by 2-pole electric motors cooled by intake gas and are supported by rubber anti-vibration mounts placed at the base. Started depending on plant load requirements, the use of several scroll compressors allows an efficient "step" adjustment of the power distributed by the unit, thus obtaining much more efficient operation at partial loads with greater efficiency with respect to traditional partial load methods. All of this means noteworthy seasonal energy efficiency ratios ESEER, calculated according to Eurovent specifications.

.10 Thermostatic valve

.1 Standard mechanical thermostatic valve with external equalizer placed at the exit of the evaporator and bulb sensitive to the intake temperature. Depending on the heat load, it modulates the flow of gas, always maintaining the correct heating level of the intake gas to the compressor. This allows to work at a minimum temperature of the water produced at 39 °F.

.11 Heat exchangers

.1 Standard: Plate type Heat exchangers of the machine are optimized for R410A, made of AISI 316 steel and covered by closed cell expanded elastomeric insulating mattress, Victaulic hydraulic connections, with just one hydraulic circuit and two entry cooling circuits. They respect the PED standards.

.12 Evaporator side hydronic unit

.1 Heat exchanger has the function of evaporator in summer mode.

.13 Condenser side hydronic unit

.1 Heat exchanger has the function of condenser in summer mode.

.14 Protection and safety devices

.1 The following devices are present in the chiller:

.1 High pressure gauge with IP54 protection rate: it blocks the unit if the pressure of the refrigerant exceeds the maximum safety value of 580PSI.

.2 Chiller circuit safety valves calibrated at 653PSI: They intervene by discharging the refrigerant in case of anomalous pressures.

.3 High pressure transducer (one per circuit): allows to view the value of the compressor flow pressure on the microprocessor board display, also causing pre-alarms in case of anomalous work values; it is located in the high pressure side of the chiller circuit.

.4 Low pressure transducer.

.5 Water temperature probes on inlet and outlet to the evaporator and the condenser.

.6 Electric control board access door interlock system.

.7 Compressor magnet circuit-breaker protection.

.8 Power supply voltage check.

.2 Electric Control Board

.1 Contains the power section and the management of controls and safety devices. It is in compliance with the IEC 60204-1 Standard and the Directives regarding electromagnetic compatibility EMC 2004/108/EC and to the LVD (Low Voltage Directive) 2006/95/EC. It is always equipped with a door-lock isolating switch: the electric control board can be accessed by removing the voltage. Act on the opening lever of the control board itself. This lever can be locked using one or more padlocks during maintenance interventions to prevent the machine being powered up accidentally. The control keyboard is located on the door of the control board, which allows the complete control of the appliance.

.3 Power Supply

.1 Three-phase power supply, 575V, 60Hz with magnet circuit breakers.

.4 Electronic adjustment

.1 The electronic adjustment is consists of a control board and a control panel with display. Transducers, loads and alarms are connected to each board. The set program and parameters are memorized permanently on FLASH memory, allowing their storage even in case of lack of power supply. The microprocessor has the following functions:

.1 remote ON/OFF with external contact without voltage;

.2 phases sequence control;

.3 amperometric transformer;

.4 separate control of the individual compressors;

.5 the distributed power adjustment depends on the outlet water temperature (proportional+integral control), complete with “Switching Hysteresis” self-adapting work differential to always ensure the correct work schedule, even with low water flow rate (stand-by between peaks, stand-by between switch off and switch on, minimum operation time etc.);

.6 rotation of the compressors depending on working hours;

.7 PDC “Pull Down Control” system to prevent the activation of power steps when the temperature of the water quickly approaches the set-point; it optimizes machine operation when working normally and in the presence of load variations, ensuring the best efficiency in all conditions;

.8 "Always Working" function to prevent machine stopping in certain critical conditions, by means of a self-adjustment system;

.9 management of any anomalies by:

.1 alarms display;

.2 historical alarms;

.3 cumulative faults block signal;

.10 differential pressure switch and/or flow meter management;

.11 display of all main sizes regarding the operation of the machine;

.12 the main operation parameters can be changed;

.13 remote control by:

.1 remote panel with the main functions (PGD1 accessory);

.2 RS485 range and compatible Modbus protocol (AER 485P1 accessory);

.14 double set-point, both summer and winter, for the temperature of the water produced, pre-set at the menu;

.15 automatic compensation of the set points on the basis of an analogue input 4 ÷ 20 mA;

.16 pump management and rotation;

.17 programmable timer function;

.18 daily/weekly programming;

.19 inlet/outlet temperature display;

.20 multi-language display of the parameters.

2.4 FUSELAGE CHILLER 22-CCH-05

.1 GENERAL

.1 Semi-Hermetic compressor chiller shall be manufactured by Refplus. Unit(s) shall be CSA approved and UL listed.

.2 Unit shall meet the performance detailed in the schedule. Construction shall be in accordance with latest, ANSI/ASHRAE 15, CSA-B52 and ASME Code.

.3 The unit shall be completely factory assembled on a rugged steel base and shall be shipped with a full operating charge of R404A refrigerant.

.4 water-cooled chiller unit bases and electrical boxes are heavy-gauge galvanized steel (G90) with plated or stainless steel hardware for corrosion-free assembly.

.5 As standard, chiller components shall be housed in an acoustically treated enclosure designed specifically to reduce radiated noise transmission by a minimum of 6 db(A). Enclosure panels shall be G90 galvanized steel.

.6 Compressors shall have Spring vibration isolators shall be factory installed

.2 COMPRESSORS

.1 Compressors are air or suction cooled, refrigeration duty, accessible semi-hermetic. They are supplied with suction and discharge valves, suction strainer, oil filter, oil pump on model 3HP and larger, solid state or line break thermal protection, crankcase heater, Polyol Ester oil with HFC refrigerant..

.3 EVAPORATOR AND CONDENSER

.1 Evaporator and condensers shall be direct expansion type with stainless steel plates brazed together. Evaporator shall be insulated with closed cell polyurethane insulation.

.2 Flow switches shall be supplied loose for field installation by others. Provide a flow switch for both the evaporator and condenser water lines. Installing contractor shall wire flow switch back to main unit control panel.

.4 REFRIGERANT CIRCUIT

.1 All units shall feature a minimum of two independent refrigerant circuits coupled to a common hydraulic circuit for increased reliability. Unit shall be capable of operating at reduced load with one refrigerant circuit shut down.

.2 Each refrigerant circuit shall include a liquid line shutoff valve, replaceable core or sealed filter-drier, sight glass with moisture indicator, liquid line solenoid valve, thermal expansion valve, and insulated suction line.

.3 Receivers (6" dia. and smaller) are UL/CSA certified and are supplied with a fusible plug. Receivers (6 5/8" dia. and larger) are CRN or ASME "U" stamped and are supplied with relief valves. All receivers have inlet and outlet back-seated Rotalock valves**.**

.5 CONTROLS

.1 Control Panels are complete with terminal blocks, control transformer, control circuit fuses, compressor contactors, fan interlock, fix high and adjustable low pressure control, oil failure switch (for compressors with positive pressure oil pump), and a pump-down switch. The wires are numbered and color-coded, conveniently routed in wiring ducts. All terminal blocks are identified to match the wiring diagram.The control system shall stage the compressors based on the leaving water temperature.

.2 Equipment protection devices include motor protection, high pressure, loss of refrigerant, loss of water flow, and low refrigerant pressure. Controls shall include auto/stop switch, chilled water set point adjustment, anti-recycle timer, and with water temperature and set point, operating temperatures and pressures, and diagnostic messages.

.3 Control system shall monitor all system temperatures, pressures and safeties, and shall automatically shut down a refrigerant circuit or entire unit should a fault occur.

.6 ELECTRICAL

.1 Field power connection, control interlock terminals and unit control system shall be centrally located. Panel access door shall key lock to prevent unauthorized access. Dead front panel shall protect service personnel against accidental contact with line voltage components.

.2 Chiller shall be supplied with factory installed non fused disconnect.

.7 STARTUP SERVICE AND WARRANTY

.1 Manufacturer shall furnish a factory trained service technician to perform the unit startup. Manufacturer shall provide instruction of the owner's personnel on the operation and maintenance of the unit. The warranty period shall commence at the date of initial startup and shall continue for a period of one (1) year not to exceed eighteen (18) months from shipment. Manufacturer's warranty shall include all parts and labour to install parts.

Part 3 Execution

3.1 EXAMINATION

.1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for rotary-screw water chiller installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate.

.2 Inform NRC 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 NRC Representative.

3.2 APPLICATION

.1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, and data sheets.

3.3 GENERAL

.1 Provide appropriate protection apparatus.

.2 Install a field-supplied or optional manufacturer-supplied strainer in the chilled water return line at the evaporator inlet; 40 mesh on units with brazed plate evaporators.

.3 Install unit as indicated, to manufacturers recommendations, and in accordance with EPS 1/RA/2.

.4 Ensure adequate clearances for servicing and maintenance.

.5 Manufacturer to approve installation, to supervise startup and to instruct operators. Include 3 days per unit.

.6 Install units on a flat surface level within 1/8 inch and of sufficient strength to support concentrated loading.

.7 Provide components furnished as per manufacturer's literature.

.8 Provide all water piping so unit and water circuits are serviceable, without having to dismantle excessive lengths of pipe.multiple supply and return chilled water and condenser water connection required connecting to on the chiller

.9 Provide valves in water piping upstream and downstream of the evaporator and condenser water connections for isolating the shells for maintenance and to balance and trim the system.

.10 Provide pressure relief piping from relief valve to outside in accordance with manufacturer's instructions and CSA-B52.

.11 Provide certified wiring schematics to the electrical division for the chiller, associated equipment and controls.

.12 Provide all necessary control wiring as recommended by the manufacturer.

3.4 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.

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

.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.5 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by chiller installation.

END OF SECTION

Part 1 General

1.1 PRODUCTS SUPPLIED BUT NOT INSTALLED UNDER THIS SECTION

.1 Anchor bolts: size anchor bolts to withstand seismic acceleration and velocity forces as defined in Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment .

1.2 REFERENCES

.1 The most recent versions of the following codes are to be followed

.2 ASTM International

.1 ASTM A48/A48M, Standard Specification for Gray Iron Castings.

.2 ASTM A123/A/123M, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

.3 ASTM A153/A153M, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

.4 ASTM B117, Standard Practice for Operating Salt Spray (Fog) Apparatus.

.5 ASTM C67, Standard Test Methods for Sampling and Testing Brick and Structural Clay Tile.

.6 ASTM D520, Standard Specification for Zinc Dust Pigment.

.3 CSA Group

.1 CSA B52 , Mechanical Refrigeration Code.

.2 CAN/CSA-Z809 , Sustainable Forest Management.

.4 Cooling Technology Institute (CTI)

.1 CTI-ATC-105, Acceptance Test Code.

.5 National Electrical Manufacturers Association (NEMA)

.1 NEMA MG 1 , Motors and Generators.

.6 Sustainable Forestry Initiative (SFI)

.1 SFI Standard.

.7 Underwriters Laboratories of Canada (ULC)

.1 CAN/ULC-S102.2- , Method of Test for Surface Burning Characteristics of Flooring, Floor Coverings and Miscellaneous Materials and Assemblies.

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 condensers, coolers and cooling towers and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:

.1 Indicate on drawings:

.1 Connections, piping, fittings, valves, strainers, control assemblies and ancillaries, identifying factory and field assembled.

.2 Wiring as assembled and schematically.

.3 Dimensions, construction details, recommended installation and support, mounting bolt hole sizes and locations and point loads.

.4 Vibration and seismic control measures.

.5 Manufacturers recommended clearances.

.4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.5 Test reports:

.1 Submit certified test reports for closed circuit coolers from approved independent testing laboratories, indicating compliance with specifications for specified performance characteristics and physical properties.

.6 Manufacturer's Field Reports:

.1 Submit manufacturer's field reports specified.

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 condensers, coolers and cooling towers for incorporation into manual.

.3 Include:

.1 Description of equipment giving manufacturers name, type, model year, capacity.

.2 Start-up and commissioning procedures.

.3 Details of operation, servicing and maintenance.

.4 Recommended spare parts list.

1.5 MAINTENANCE MATERIAL SUBMITTALS

.1 Extra Materials:

.1 Furnish spare parts data for each different item of equipment specified.

.2 Include with data complete list of parts and supplies, list of parts recommended by manufacturer to be replaced on routine basis .

1.6 QUALITY ASSURANCE

.1 Qualifications:

.1 Installer: company or person specializing in closed circuit coolers .

.2 Regulatory Requirements: work to be performed in compliance with applicable Provincial regulations .

1.7 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements .

.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 in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect condensers and cooling equipment from nicks, scratches, and blemishes .

.3 Replace defective or damaged materials with new.

.4 Develop Construction Waste Management Plan related to Work of this Section .

.5 Packaging Waste Management: remove for and return by manufacturer of pallets, crates, padding, packaging materials as specified in Construction Waste Management Plan.

Part 2 Products

2.1 GENERAL

.1 Factory assembled forced draft vertical discharge closed circuit cooler .

.2 Ensure major equipment including gear drive assemblies, fans, and motors have manufacturer's name , address , style , model serial number , catalogue number on plate secured to item of equipment.

.3 Plates: durable and legible throughout equipment life and made of stainless steel .

.4 Fix plates in prominent locations with nonferrous screws or bolts.

2.2 CASING AND FRAMEWORK

.1 Materials: G90 galvanized steel sheet, angles and channels. Bolted construction. Access panels on side of unit.

2.3 COIL SECTION

.1 Seamless, deoxidized heavy wall microgroove copper tubes mechanically expanded in self-spaced full-collared aluminum corrugated plate fins for permanent bond and maximum heat transfer. Brazed connections and ends using high temperature brazing alloy. Factory leak tested at 400psig using -40 degree dry air. Sealed and pressurized before assembly.

2.4 FAN

.1 Fan: aluminium blade riveted to steel hub. Statically and dynamically balanced.

.2 Motors permanently lubricated sealed ball bearing with inherent thermal protection.

.3 Fan and motor guards are welded wire construction for full protection from moving parts with baked on power epoxy coating for corrosion protection.

.4 All motors wired to weather resistant box using liquid tight straight thru fitting terminations.

2.5 ACCESSORIES

.1 Control panel complete with motor contactors and fuses per motor, temperature fan cycling, terminal block and control transformer.

.2 Complete with extra closed relay contacts for summer/winter operation.

2.6 VIBRATION ISOLATORS

.1 To Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment .

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 condensers, coolers and cooling tower installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate in presence of NRC Departmental Representative .

.2 Inform NRC 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 NRC Departmental Representative .

3.2 GENERAL

.1 Mount on structural supports and vibration isolators and to manufacturer's recommendations.

.2 Ensure clearance for servicing and maintenance as recommended by manufacturer.

.3 Manufacturers field service representative to approve installation, to supervise start up and to instruct operators.

3.3 FIELD QUALITY CONTROL

.1 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.

3.4 ADJUSTING

.1 Lubricate bearings with oil or grease as recommended by manufacturer.

.2 Tighten belts to manufacturer's specified tension.

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 Wipe equipment clean, and remove traces of oil, dust, dirt, or paint spots.

.3 Maintain system in clean condition until final acceptance.

.4 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning .

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

.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

Part 1 General

1.1 REFERENCES

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

.1 ASHRAE 84- 2013 , Method of Testing Air-to-Air Heat/Energy Exchangers (ANSI approved).

1.2 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 energy recovery equipment and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:

.1 Indicate following: Airflow, pressure drop, thermal effectiveness at design conditions, dimensions, service clearances, controls, power requirements, installation requirements.

.4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.5 Test Reports:

.1 Catalogued or published ratings: obtained from tests carried out by manufacturer or those ordered from independent testing agency signifying adherence to codes and standards in force.

.2 Provide confirmation of testing.

.6 Manufacturers' Instructions: submit manufacturer's installation instructions.

.1 NRC Departmental Representative will make available 1 copy of systems supplier's installation instructions.

1.3 MAINTENANCE MATERIAL SUBMITTALS

.1 Submit maintenance materials in accordance with Section 01 78 00 - Closeout Submittals .

.2 Extra Materials:

.1 Furnish list of individual manufacturer's recommended spare parts for equipment include:

.1 Bearings and seals.

.2 Addresses of suppliers.

.2 List of specialized tools necessary for adjusting, repairing or replacing.

1.4 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 in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect energy recovery equipment from nicks, scratches, and blemishes .

.3 Replace defective or damaged materials with new.

.4 Develop Construction Waste Management Plan.

.5 Packaging Waste Management: remove for reuse by manufacturer of pallets, crates, padding, packaging materials as specified in Construction Waste Management Plan .

Part 2 Products

2.1 GENERAL

.1 Comply with ASHRAE 84.

2.2 AIR TO AIR HEAT EXCHANGER

.1 Capacity: as indicated.

.2 Casing: cold rolled structural steel, powder coated cabinet with hinged side panels.

.3 Motors: thermally protected

.4 Fans: statically and dynamically balanced

.5 Core: polypropylene core certified to AHRI Standard 1060

.6 Accessories:

.1 Ceiling suspension kit with vibration isolation

.2 Controller with input/output terminals for BAS integration

.3 Backdraft dampers

.7 Performance characteristics: 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 energy recovery equipment installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate in presence of NRC Departmental Representative .

.2 Inform NRC 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 NRC Departmental Representative .

3.2 INSTALLATION

.1 Install in accordance with manufacturers recommendations.

.2 Support independently of adjacent ductwork with flexible connections .

.3 Install access doors in accordance with Section 23 33 00 - Air Duct Accessories for access to coils, dampers.

3.3 FIELD QUALITY CONTROL

.1 Tests:

.1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical .

3.4 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 recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal .

.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 Definitions:

.1 Catalogued or published ratings: ratings obtained from tests carried out by manufacturer or manufacturer's designated independent testing agency which signify adherence to codes and standards in force.

.2 Reference Standards:

.1 American National Standards Institute/American Society of Heating, Refrigeration and Air Condition Engineers/Illuminating Engineering Society (ANSI/ASHRAE/IES)

.1 ANSI/ASHRAE 52.2-2012, Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size.

.2 ANSI/ASHRAE/IES 90.1-2010, Energy Standard for Buildings Except Low-Rise Residential Buildings.

.2 Green Seal (GS)

.1 GS-11-11, Standard for Paints and Coatings.

.3 Master Painters Institute (MPI)

.1 Architectural Painting Specification Manual - current edition.

.1 MPI #18.

.4 National Fire Protection Association (NFPA)

.1 NFPA 90A-12, Standard for the Installation of Air Conditioning and Ventilating Systems.

.5 Sheet Metal and Air-Conditioning Contractors' National Association (SMACNA)

.6 South Coast Air Quality Management District (SCAQMD)

.1 SCAQMD Rule 1113-11, Architectural Coatings.

1.2 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 refrigerant, insulation, filters, and paints and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:

.1 Indicate on drawings:

.1 Actual cooling and heating fluid entering and leaving conditions for stated air side requirements.

.2 Dimensions, including .

1.3 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

.2 Operation and Maintenance Data: submit operation and maintenance data for air handling equipment for incorporation into manual.

1.4 MAINTENANCE MATERIAL SUBMITTALS

.1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

.2 Furnish list of individual manufacturer's recommended spare parts for equipment such as bearings and seals, and addresses of suppliers, together with list of specialized tools necessary for adjusting, repairing or replacing, for placement into operating manual.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.

.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 in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect air handling equipment from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

.4 Develop Construction Waste Management Plan related to Work of this Section.

.5 Packaging Waste Management: remove for reuse and return of pallets, crates, padding, packaging materials as specified in Construction Waste Management Plan.

Part 2 Products

2.1 GENERAL

.1 Factory assembled components to form units supplying air at design conditions as indicated.

2.2 FANS

.1 In accordance with Section 23 34 00 - HVAC Fans.

2.3 BUILDING 22-AHU-3 BUILDING CONDITIONING UNIT

.1 Air Handling Units

.1 General Description

.1 Indoor air handling units shall include filters, supply fans, chilled water coil, hot water coil, humidifier section, energy wheel, mixing box, and unit controls.

.2 Variable volume control with inverter-duty motor and variable speed drive.

.3 Unit shall discharge air vertically.

.4 Unit shall be factory assembled and tested including leak testing of the cooling coil, leak testing of the hot water coil, and run testing of the supply fans and factory wired electrical system. Run test report shall be supplied with the unit.

.5 Unit shall have decals and tags to indicate lifting and rigging, service areas and caution areas for safety and to assist service personnel.

.6 Unit components shall be labeled, including pipe stub outs, electrical and controls components.

.7 Installation, Operation and Maintenance manual shall be supplied within the unit.

.8 Laminated color-coded wiring diagram shall match factory installed wiring and shall be affixed to the interior of the control compartment's hinged access door.

.9 Unit nameplate shall be provided in two locations on the unit, affixed to the exterior of the unit and affixed to the interior of the control compartment's hinged access door.

.2 Construction

.1 All cabinet walls, access doors, and roof shall be fabricated of double wall, impact resistant, rigid G90 galvanized steel panels with R-13 insulating foam injected between panels.

.2 Unit construction shall be double wall with G90 galvanized steel on both sides and a thermal break. Double wall construction with a thermal break prevents moisture accumulation on the insulation, provides a cleanable interior, prevents heat transfer through the panel, and prevents exterior condensation on the panel.

.3 Unit shall be designed to reduce air leakage and infiltration through the cabinet. Sealing shall be included between panels and between access doors and openings to reduce air leakage. Piping and electrical conduit through cabinet panels shall include sealing to reduce air leakage.

.4 Access to filters, cooling coil, heating coil, supply fans, and electrical and controls components shall be through hinged access doors.

.5 Access doors shall be flush mounted to cabinetry. Coil access door and supply fan access door shall include quarter-turn lockable handles. Supply fan access door shall include removable pin hinges.

.6 Units with a cooling coil shall include sloped 304 stainless steel drain pan. Drain pan connection shall be on the right hand side of unit.

.7 Cooling coil shall be mechanically supported above the drain pan by multiple supports that allow drain pan cleaning and coil removal.

.3 Electrical

.1 Unit shall be provided with an external control panel with separate low voltage control wiring with conduit and high voltage power wiring with conduit between the control panel and the unit. Control panel shall be field mounted.

.2 Unit shall include a factory installed 24V control circuit transformer.

.3 Unit shall be provided with phase and brown out protection which shuts down all motors in the unit if the electrical phases are more than 10% out of balance on voltage, the voltage is more than 10% under design voltage or on phase reversal.

.4 Supply Fans

.1 Unit shall include direct drive, unhoused, airfoil fans.

.2 Blower and motor assembly shall be dynamically balanced.

.3 Blower and motor assembly shall be mounted on vibration isolators.

.5 Cooling Coil

.1 Chilled Water Cooling Coil

.1 Coil shall be certified in accordance with AHRI Standard 410 and be hydrogen or helium leak tested.

.2 Coil shall be constructed of copper tubes with aluminum fins mechanically bonded to the tubes.

.3 Coil shall have half serpentine circuitry, 6 rows and 10 fins per inch.

.4 Coil shall have right hand external piping connections.. Coil connections shall be labeled, extend beyond the unit casing, and be factory sealed on both the interior and exterior of the unit casing, to minimize air leakage.

.6 Heating Coil

.1 Hot Water Heating Coil

.1 Coil shall be certified in accordance with AHRI Standard 410 and be hydrogen or helium leak tested.

.2 Coil shall be constructed of copper tubes with aluminum fins mechanically bonded to the tubes.

.3 Coil shall be 1 row and 12 fins per inch.

.4 Coil connections shall be labeled, extend beyond the unit casing and be factory sealed on both the interior and exterior of the unit casing, to minimize air leakage.

.5 Control valves shall be field supplied and field installed.

.7 Filters

.1 Unit shall include 2 inch thick, pleated panel filters with an ASHRAE efficiency of 30% and MERV rating of 8, in a prefilter box upstream of the cooling coil.

.2 A MERV 13 cartridge type final filter shall be provided.

.3 Unit shall include a clogged filter switch.

.4 Filter section to be complete with magnahelic gauge.

.8 Mixing Box

.1 Unit shall contain a mixing box with top return air opening and front outside air opening.

.2 Return air opening shall contain an adjustable, motor operated outside air damper assembly constructed of extruded aluminum, hollow core, airfoil blades with rubber edge seals and aluminum end seals. Damper blades shall be gear driven. Dampers shall be fixed position controlled by a fully modulating actuator.

.3 Outside air opening shall contain an adjustable, motor operated outside air damper assembly constructed of extruded aluminum, hollow core, airfoil blades with rubber edge seals and aluminum end seals. Damper blades shall be gear driven. Dampers shall be fixed position controlled by a fully modulating actuator.

.9 Controls

.1 Unit shall be provided with terminal wiring strip for external wiring of controls for damper actuators, fan start/stop, clogged filter switch, proof of air flow.

.10 Energy Recovery Wheel

.1 VFD controlled energy recovery wheel for sensible and latent heat recovery.

.2 Media: Synthetic fibre, 4 angstrom

.3 Complete with access door, prewired VFD, bypass dampers

.11 Humidifier Section

.1 Dispersion tube system shall be welded seam stainless steel tube and header system spanning the full width of the duct, insulated with plenum-rated insulation and provide absorption to preclude water accumulation within 500mm of dispersion tube.

.2 Two rows of steam discharge tubelets discharging steam in diametrically opposite directions perpendicular to airflow.

.3 Header pitched toward drain to prevent condensate accumulation in header.

.12 VFD

.1 Factory-installed variable frequency drive for exhaust fan, supply fan and energy wheel speed control.

.2 Complete with keypad, bypass, line reactors and non-fused disconnect in NEMA-1 enclosure.

2.4 22-AHU-4 DESICCANT OUTDOOR AIR UNIT

.1 AIR HANDLING UNIT CASING:

.1 Components forming an Air Handling Unit shall be completely factory assembled and shipped as one (1) piece.

.2 Casing shall be double wall construction supported by an internal channel "C" framing. This includes the side panels, the roof and the floor.

.3 Base shall be installed on the full perimeter of the unit. The base, the intermediate ribs and the structural supports shall form a channel made of heavy gauge steel. Structural girders and lifting lugs supporting the unit from below shall be dimensioned according to proven structural design methods.

.4 Floor, 4 in. (100mm) thick, shall have adequate structural supports to allow for access to maintenance personnel. The floor shall be made of a minimum of 12 gauge galvanized steel. All joints shall be continuously welded and protected with Galvicon. The floor shall act as an airtight drain pan. Fiberglass insulation, 2 in. (50 mm) thick, shall be installed underneath the floor and protected with a 22 gauge galvanized steel sheet. Walls and ceiling shall be double wall and shall be constructed with acoustical panels including 2" (50 mm) thick fiberglass insulation. All interior wall panels shall be screwed together. Exterior wall panels shall be sealed with a strip of polyurethane base caulking to allow for visual detection of impermeability. All units shall withstand pressure differences of up to 10" H_2O (3750 Pa). Maximum air leakage rate guaranteed by the manufacturer shall be 1%, in specified operating conditions.

.5 Exterior wall panels shall be made of 16 gauge galvanized steel. Insulating medium, consisting of long fibers bound together with a thermosetting resin, shall have a density 3 lbs./ft^3, and shall be compressed at least 10% during assembly.

.2 FAN SECTION:

.1 The fans and motors shall be installed on an integral or inertia base supported by anti-vibration springs ensuring a 1" (25mm) deflection. All fans shall be statically and dynamically balanced and shall be of a construction type complying to the requirements of AMCA (Air Moving and Conditioning Association) 99 Standard.

.2

.3 Fan bearings shall be designed for an average life of at least 200 000 hours, according to AFBMA (Anti-friction Bearing Manufacturers Association) L-50 Standard.

.4

.5 Fan discharge shall be connected to the fan cabinet using a flexible connection to ensure a vibration-free operation.

.3 BELT DRIVE:

.1 Motors shall be mounted on a sliding base for adequate alignment and adjustment for belt tension. Both fan belt and belt drives shall be protected by a metal belt guard permitting a reading of the revolutions on the shaft of the fan. Electrical motors shall be the high efficiency type, according to the requirements of the specifications.

.4 COILS

.1 Surface area of heat transfer coils shall consist of aluminum corrugated fins. Fins shall cover the entire surface of each tube in order to optimize heat transfer.

.2 Coil casings to be constructed of 16 gauge galvanized steel, with both ends containing a 1-1/2" flange.

.3 All unit coils shall be removable from the unit by the removal of a single screwed-on wall panel without disturbing the roof or adjoining panels of the unit. Panel construction shall be double wall with 2" (50 mm) thick insulation. An industrial quality neoprene gasket is provided on the full perimeter of the panel to obtain maximum airtightness and durability. Coils shall be placed on a slide base in order to remove the coils easily from the unit. Once the coil is in place, its distributor shall fit entirely inside the casing with only the connections extending to the exterior.

.4 Where coils are to be stacked, or under every cooling coil, intermediate drain pans, (double sloped), made of stainless steel and a drain of 1.5" dia. (40 mm) shall be provided.

.5 Coil impermeability shall be controlled by means of water immersion testing under 350 psi air pressure. Coils shall be designed to operate continuously at 250 psi. Supply and return connections to be NTP type steel.

.6 All coils shall have performance certified in accordance with ARI Standard 410.

.7 Pipefitting connections to the coils shall agree with industry standards. Pipes shall be supported separately from the coils and have sufficient flexibility to allow for thermal expansion. No load should be applied to the coil connections.

.5 FILTER SECTION:

.1 Flat or angled filters shall slide on rails. They shall be accessed through lateral panels mounted on hinges and fitted with latches.

.2 Access to high efficiency filters (cartridge or bag) shall be front or side loaded, through the adjoining section. Front loading filters shall be installed on restraint frames, permanently mounted on the inside of the section.

.3 Filter frames shall be provided with neoprene gaskets on the discharge side of the filter for increased airtightness.

.6 DAMPERS:

.1 All dampers are made of aluminum and high efficiency type. Dampers are insulated or uninsulated, opposite or parallel blades, all complying to the requirements of AMCA.

.7 ACCESS DOOR:

.1 Double wall access doors shall be provided to allow access and maintenance of air handling parts and components including fans, filters, air mixers, coils or other as indicated on drawings. Doors shall be of the same thickness and construction as the wall panels, i.e. made of 16 gauge galvanized steel on both sides including 2" (50 mm) thick insulation. Frame shall be made of 12 gauge galvanized steel. Door frame perimeter shall include 3" (75 mm) spokes in corners, as well as a neoprene sponge gasket (industrial quality), for maximum airtightness and durability.

.2 Each door shall be fitted with a heavy duty hinge made of stainless steel and two inside/outside operational handles. Doors shall be completely removable by removing the spindles from the hinges when desired. Doors shall always open against air pressure side.

.8 ACCESSORIES:

.1 Accessories such as low leak/ultra-low leak dampers, installation of controls, air blenders, economizers, diffusers, heat exchangers, silencers, and other special equipment, to be factory installed.

.9 All electrical installations inside the unit shall be CSA and UL certified.

.10 DEHUMIDIFIER – Desiccant wheel section

.1 Dehumidifier unit casing (for units with desiccant wheels below 61" diameter)

The unit casing shall be fabricated of strain-hardened aluminum with a minimum thickness of 0.125" for torsional rigidity and corrosion resistance. The casing shall be formed, welded and sealed as a single unified structure. Steel construction is not acceptable. Aluminum structures depending on screws for casing construction are not acceptable. In addition, the unit casing shall include:

.2 Insulation

.1 To avoid either condensation, heat loss or loss of cooling capacity, the unit casing shall be insulated such that the heat transfer rate through casing walls is less than 0.27 Btu/sq. ft./°F if the wall separates air streams which differ in temperature by more than 25°F.

.3 Wiring

.1 All wiring between dehumidifier components shall comply with the current National Electrical Code (NEC). Wiring unprotected by flexible conduit shall not be acceptable.

.4 Process and reactivation air flow gauges

.1 To set and verify the specified air flow rates through the unit, the casing shall be equipped with differential pressure gauges which measure and display the pressure drop across the desiccant wheel. The dial of the gauges shall include a warning zone to indicate when the air flow is above the recommended operating range of the equipment.

.5 Coating

.1 The exterior of the unit casing and all surfaces of access panels shall be degreased and cleaned, then primed with one coat of industrial wash primer and finished with one coat of catalyzed polyurethane enamel. All pieces shall be painted individually prior to assembly to assure complete protection.

.6 Weather tight construction

.1 The dehumidifier shall be capable of continuous outdoor operation when the air inlets are protected from flowing water by optional weather hoods or connected duct work. Consequently, all access panels shall be weather tight, as shall all joints between casing and electrical conduits and between the unit casing and any components mounted in separate enclosures.

.1 Weather Air Inlets

.1 Because the unit will pull in air directly from the weather, the inlets shall be protected from precipitation by weather hoods, and air flow control dampers.

.2 Weather hoods

.1 The weather hoods shall be welded aluminum and shall be finished to match the unit casing. The inlet air velocity shall not exceed 600 fpm.

.3 Air flow dampers

.1 Inlets shall be equipped with manual flow control dampers with locking hardware. For air inlets smaller than 15" in height or width, single-blade dampers shall be acceptable. When any inlet dimension exceeds 15", the manufacturer shall provide opposed-blade dampers with stainless steel end seals, elastomeric edge seals and oil-impregnated blade shaft bushings.

.7 Maintenance access and inspection panels

.1 The unit casing shall include access panels for inspection and for any maintenance required by the operating and maintenance manual. These panels shall be fastened by captive hardware permanently fixed to either the panel or the unit casing. The panels shall be airtight to the extent of not leaking more than 1% of the rated airflow when the interior of the casing is under 5" WC positive air pressure, nor more than 0.5% of the rated flow when the casing is under 5" WC of negative pressure. Panels without gaskets shall not be acceptable. Panels held in place by drill-screws shall not be acceptable. Equipment which requires disassembly of components rather than access through removable panels for any maintenance required by the operating and maintenance manual shall not be acceptable.

.11 Electrical control cabinet

.1 The electrical control cabinet shall be weather tight to NEMA 4 standards and shall include:

.1 Wiring to comply with the current National Electrical Code with further fuse and wiring sizing to meet or exceed UL 508A *Industrial Control Panel.*

.2 Wires shall be color-coded or numbered at both ends and all terminal block connection points shall be numbered. These markings shall correspond with the electrical diagram provided in the operating and maintenance manual.

.3 Components shall be UL or CSA approved.

.4 Programmable logic controller

.1 The unit sequence of operations shall be controlled by a programmable logic controller which includes separate indication for:

.1 Power on
.2 Unit running
.3 Desiccant wheel rotation fault
.4 Reactivation air overheat after heaters
.5 Reactivation air leaving below set point
.6 Motor overload

.5 Operating and maintenance manual

.1 The control cabinet shall include a copy of the O & M manual, mounted in a separate compartment or pocket to allow access to critical information by maintenance personnel after installation.

.6 Run-hour meter

.1 To allow for recording maintenance practices and to assist fault diagnosis, the cabinet shall have a run-hour meter mounted and visible from the exterior of the unit.

.12 Reactivation circuit

.1 The reactivation circuit shall conform in all respects to the current National Electrical Code.

.2 Indirect-fired natural gas reactivation

.1 Automatic energy modulation shall be provided by means of a modulating gas valve which varies gas flow in response to a temperature sensor mounted in the reactivation air as it leaves the dehumidifier.

.2 Gas fittings and any piping between multiple burners shall meet Canadian Gas Association standards and shall be provided as an integral part of the burner assembly by the manufacturer.

.3 Reactivation energy shall be automatically matched to dehumidification requirements by means of a modulating gas valve with proportional electric valve actuator. The valve/actuator assembly shall be connected to a temperature sensor/controller mounted in the discharge of the reactivation air stream.

.13 Desiccant Wheel

.1 The desiccant wheel media shall be a monolithic, extended-surface contact medium, fabricated entirely of inert, inorganic binders and glass fibers formed into narrow passages in the direction of airflow. The wheel shall be bacteriostatic and non-toxic. It shall also meet the following requirements:

.1 Materials

.1 The glass fibers which form the support matrix shall be made from uniform continuous strands larger than five microns in diameter which are nonrespirable and are not considered a possible health risk by the International Agency for Research on Cancer (IARC).

.2 Flame spread and smoke generation

.1 The wheel shall be tested according to ASTM E84-90 (Standard Test Method for Surface Burning of Building Materials) and shall achieve the following results:

.1 Flame spread index = 0

.2 Smoke developed index = 10

.3 Desiccant impregnation

.1 The desiccant shall be evenly impregnated throughout the structure for predictable, consistent performance and for maximum wheel life. Coatings applied on top of the contact medium shall not be acceptable unless the manufacturer can provide independent life tests demonstrating less than a 5% decline in desiccant capacity over a five year period of normal operation.

.4 Desiccant type

.1 Titanium-reinforced silica gel

.2 The Honeycombe® desiccant wheel shall be a fabricated extended surface contact media with a multitude of small passages parallel to the airflow. The rotary structure shall be a monolithic composite consisting of inert silicates with microscopic pores designed to remove water in a vapor phase. The desiccant shall be hydrothermally-stabilized silica gel reinforced with titanium for maximum strength and stability over time. The fabricated structure shall be smooth and continuous having a depth of 400 millimeters in the direction of airflow without interruptions or sandwich layers which restrict air flow or create a leakage path at joining surfaces. Nominal face velocity shall not exceed 600 fpm. The Honeycombe® wheel shall be manufactured in the United States. The manufacturer shall provide documentation to establish that:

.1 The desiccant retains more than 90% of its original capacity after ten years of continuous operation in clean air, with inlet air conditions up to an including 100% relative humidity.

.2 The wheel as impregnated with silica gel is capable of withstanding five complete water immersion cleaning cycles while retaining more than 95% of its original adsorption capacity.

.14 Desiccant Wheel Support and Drive Assembly

.1 For wheels of 60" diameter and smaller, the wheel shall be a single piece for fast removal and simple handling. In the smaller case, the desiccant wheel shall be supported by four rollers at the base of the unit so the wheel can be easily removed for maintenance by lifting it over the rollers using the drive belt. Center-axle support or any arrangement which requires disassembly of the support structure for wheel removal shall not be acceptable. In addition, the wheel drive assembly shall provide:

.1 Rotation speed

.1 To avoid excessive heat carryover from reactivation to the process air, the wheel rotation speed shall not exceed 10 rph while achieving the required moisture removal rate at the specified conditions.

.2 Drive belt

.1 The drive belt shall be the flat, toothed type, with aramid fiber reinforcement.

.3 Drive motor

.1 The drive motor shall be fractional horsepower and rated for continuous duty for a period of 20,000 hours under the load conditions imposed by the drive assembly.

.4 Rotation detection

.1 The drive assembly shall be equipped with a rotation detection circuit which shuts down the dehumidifier and signals the operator through an indicating light on the control cabinet if the wheel is not rotating.

.15 Air seals and internal air leakage

.1 The process and reactivation air streams shall be separated by air seals and internal partitions so that the humid reactivation air does not mix with the dry

process air. The proposed equipment shall meet the following minimum requirements:

.1 Wheel face seals

.1 For units with desiccant wheels under 61" in diameter, the dehumidifier shall have full-face seals on both the process air entering and the process air leaving sides of the wheel. These shall seal the entire perimeter of both air streams as they enter and leave the wheel. Partial seals shall not be acceptable. The seals shall be the silicone rubber bulb-type, with a protective strip of low-friction, abrasive-resistant tape to extend seal life and reduce the force needed to turn the desiccant wheel. Neither wiper-type seals nor brush-type nor any non-contact-type seal shall be acceptable. The seals shall be documented to have a minimum working life of 25,000 hours of normal operation.

.2 Total casing air leakage

.1 The unit shall not allow leakage to exceed the greater of the following values:

.1 One percent of the process air flow

.2 SMACNA (Sheet Metal & Air Conditioning Contractors National Association) Leakage class 6, which is defined by:

$F = C \times P^{0.65}$

$L = F \times A$

Where:

F = Leakage flow (cfm/sq.ft. housing area)
C = Leakage class (equal to 6)
P = Design static pressure (in. WC)
L = Total leakage (cfm)
A = Housing area (sq.ft.)

.3 Determine leakage using the testing methods described by SMACNA Publication 15d, *HVAC Air Duct Leakage Test Manual (Air Distribution Equipment and Ducts).*

.4 Terms are defined as follow:

.1 Design static pressure: Maximum positive or negative pressure referenced to the unit exterior (inches W.C.).

.2 Design airflow: Maximum unit air flow at the discharge connection (ft^3/min).

.3 Housing area: Total area of the unit air containment, including fan wall area (ft^2).

.16 Reactivation air fans

.1 Reactivation air fans shall be the single-inlet, single-width, centrifugal-type.

.1 Fan wheel type

.1 Fans driven by motors of 2 hp and below shall be the direct-drive, forward-curve centrifugal type. Fans driven by motors of 3 hp through 7.5 hp shall be backward-inclined, direct-drive centrifugal type. Fans driven by motors of 7.5 hp and larger shall be the backward-inclined, belt-driven centrifugal type.

.2 Balancing

.1 Fans shall be balanced after assembly and after coating at the speed the unit is scheduled to operate. Fans shall be balanced such that the maximum displacement in any plane is less than 1.0 mils, peak to peak.

.3 Fan motors

.1 Fan motors shall be the totally-enclosed, fan-cooled, high-efficiency type and shall be selected for a service factor of 1.15.

.17 Moisture removal capacity control

.1 The dehumidifier shall operate automatically, in response to the control system supplied by the manufacturer as follows:

.1 Process air face & bypass modulation

.1 The volume of process air passing through the dehumidifier shall be modulated by means of electric or pneumatic motor-driven dampers which cover the process air inlet and the bypass air inlet to the dehumidifier casing. The bypass air duct shall be included inside the dehumidifier casing such that no additional external ductwork need be added to the unit to achieve control. The bypass duct shall be equipped with an orifice plate to balance the pressure drop of the bypass to equal that of the desiccant wheel at full flow.

.1 Dampers

.1 Dampers shall be opposed-blade type, with galvanized steel frames, stainless steel end-seals,

elastomeric blade edge seals and oil-impregnated blade shaft bushings.

.2 Damper frames and casing

.1 The damper frames shall be fastened and sealed to eliminate air bypass around the damper assembly. The operator(s) and connecting linkages shall be mounted in a separate compartments sealed from the supply air stream and from the ambient environment. The compartment shall be equipped with an access panel for ease of adjustment and servicing without the need to disturb the supply air flow.

.3 Damper actuators

.1 Damper actuators shall be the proportional type with spring return on power loss. They shall operate in response to a continuous signal input signal. Pneumatic actuators shall be equipped with positive positioning relays.

.4 Responsibility for the control system shall be divided as follows:

.1 Dehumidifier manufacturer

.1 Provide the dehumidifier complete with dampers and motors mounted, wired and tested in the factory prior to shipment. The manufacturer shall provide the sensor/controller suitable for operation and control at the specified location and humidity control range.

.2 Installing contractor

.1 Install the humidity sensor in the location specified, and wire the sensor and controller to the dehumidifier. Reset the fixed-position bypass flow control damper such that pressure drop through the bypass equals the pressure drop through the desiccant wheel at the specified process air flow rate.

2.5 22-AHU-5,6,7 LAB UNITS

.1 General

.1 Equipment to include:

.1 ECM driven direct drive backward curved plenum supply fans

.2 Double wall cabinet construction

.3 Insulation with a minimum R-value of 6.25

.4 Double sloped stainless steel drain pans

.5 Hinged access doors with lockable handles

.2 Air Handling Units

.1 General Description

.1 Indoor air handling units shall include filters, supply fans, chilled water coil, mixing box, and unit controls.

.2 Unit shall have a draw-through supply fan configuration and discharge air horizontally.

.3 Unit shall be factory assembled and tested including leak testing of the chilled water coil, and run testing of the supply fans and factory wired electrical system. Run test report shall be supplied with the unit.

.4 Unit shall have decals and tags to indicate lifting and rigging, service areas and caution areas for safety and to assist service personnel.

.5 Unit components shall be labeled, including pipe stub outs, electrical and controls components.

.6 Installation, Operation and Maintenance manual shall be supplied within the unit.

.7 Laminated color-coded wiring diagram shall match factory installed wiring and shall be affixed to the interior of the control compartment's hinged access door.

.8 Unit nameplate shall be provided in two locations on the unit, affixed to the exterior of the unit and affixed to the interior of the control compartment's hinged access door.

.3 Construction

.1 All cabinet walls, access doors, and roof shall be fabricated of double wall, impact resistant, rigid polyurethane foam panels.

.2 Unit insulation shall have a minimum thermal resistance R-value of 6.25. Foam insulation shall have a minimum density of 2 pounds/cubic foot and shall be tested in accordance with ASTM D1929-11 for a minimum flash ignition temperature of 610°F.

.3 Unit construction shall be double wall with G90 galvanized steel on both sides and a thermal break. Double wall construction with a thermal break prevents moisture accumulation on the insulation, provides a cleanable interior, prevents heat transfer through the panel, and prevents exterior condensation on the panel.

.4 Unit shall be designed to reduce air leakage and infiltration through the cabinet. Sealing shall be included between panels and between access doors and openings to reduce air leakage. Piping and electrical conduit through cabinet panels shall include sealing to reduce air leakage.

.5 Access to filters, cooling coil, supply fans, and electrical and controls components shall be through hinged access doors.

.6 Access doors shall be flush mounted to cabinetry. Coil access door and supply fan access door shall include quarter-turn lockable handles. Supply fan access door shall include removable pin hinges.

.7 Units with a cooling coil shall include sloped 304 stainless steel drain pan. Drain pan connection shall be on the right hand side of unit.

.8 Cooling coil shall be mechanically supported above the drain pan by multiple supports that allow drain pan cleaning and coil removal.

.4 Electrical

.1 Unit shall be provided with an external control panel with separate low voltage control wiring with conduit and high voltage power wiring with conduit between the control panel and the unit. Control panel shall be field mounted.

.2 Unit shall be provided with standard power block for connecting power to the unit.

.3 Unit shall include a factory installed 24V control circuit transformer.

.4 Unit shall be provided with phase and brown out protection which shuts down all motors in the unit if the electrical phases are more than 10% out of balance on voltage, the voltage is more than 10% under design voltage or on phase reversal.

.5 Supply Fans

.1 Unit shall include direct drive, unhoused, backward curved, plenum supply fans.

.2 Blower and motor assembly shall be dynamically balanced.

.3 Blower and motor assembly shall be isolated with neoprene gasket.

.4 Motor shall be a high efficiency electronically commutated motor (ECM).

.6 Cooling Coil

.1 Chilled Water Cooling Coil shall be certified in accordance with AHRI Standard 410 and be hydrogen or helium leak tested.

.2 Coil shall be constructed of copper tubes with aluminum fins mechanically bonded to the tubes and aluminum end casings. Fin design shall be sine wave rippled.

.3 Coil shall have right hand external piping connections. Supply and return connections shall be sweat connection. Coil connections shall be labeled, extend beyond the unit casing, and be factory sealed on both the interior and exterior of the unit casing, to minimize air leakage.

.7 Filters

.1 Unit shall include 2 inch thick, pleated panel filters with an ASHRAE efficiency of 30% and MERV rating of 8, upstream of the cooling coil.

.2 Unit shall include a clogged filter switch.

.8 Mixing Box

.1 Unit shall contain a mixing box with top return air opening and front outside air opening.

.2 Return air opening shall contain an adjustable, motor operated outside air damper assembly constructed of extruded aluminum, hollow core, airfoil blades with rubber edge seals and aluminum end seals. Damper blades shall be gear driven. Dampers shall be fixed position controlled by a fully modulating actuator.

.3 Outside air opening shall contain an adjustable, motor operated outside air damper assembly constructed of extruded aluminum, hollow core, airfoil blades with rubber edge seals and aluminum end seals. Damper blades shall be gear driven. Dampers shall be fixed position controlled by a fully modulating actuator.

.9 Controls

.1 Unit shall be provided with terminal wiring strip for external wiring of controls for damper actuators, fan start/stop, clogged filter switch, proof of air flow.

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 air handling equipment installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate in presence of NRC Representative.

.2 Inform NRC Representative of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions have been remedied.

3.2 INSTALLATION

.1 Installation, Operation and Maintenance manual shall be supplied with the unit.

.2 Installing contractor shall install unit, including field installed components, in accordance with Installation, Operation and Maintenance manual instructions.

.3 Start up and maintenance requirements shall be complied with to ensure safe and correct operation of the unit.

3.3 DRIP PAN

.1 Install deep seal P trap and trap seal primer on drain lines.

.1 Depth of water seal to be 1.5 minimum times static pressure at this point.

3.4 ADDITIONAL WORK FOR AHU-4

1. Start-up BY MANUFACTURER

.1 The service technician shall start up and adjust the unit in accordance with instructions contained in the operating and maintenance manual provided by the manufacturer. The start up technician must pay particular attention to the following items:

1. Air flow
   The air flow volume of the process and reactivation air streams shall be set so that the reading on the manometers on the unit matches the values outlined on the technical data sheet provided by the manufacturer.

2. Utilities
   The power and reactivation energy connections shall be made carefully and checked against the unit specifications outlined on the technical data sheet provided by the manufacturer.

3. Documentation
   The start-up technician shall provide written documentation of compliance with procedures outlined by the manufacturer in the operating and maintenance manual. As a minimum, the technician shall measure and record the values for the electrical power, the air flow manometers and the run-hour meter. The technicians full name and telephone number and the start-up date shall be printed legibly on the start up documentation and on the copy of the technical data sheet in the operating and maintenance manual which is mounted inside the unit control cabinet.

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.

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

.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 American National Standards Institute/American Society of Heating, Refrigeration and Air-Conditioning Engineers (ANSI/ASHRAE)

.1 ANSI/ASHRAE 52.2-2007, Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particulate Size.

.2 ASTM International

.1 ASTM C547-11, Specification for Mineral Fiber Pipe Insulation.

.3 CSA International

.1 CSA B52-05(R2009), Mechanical Refrigeration Code.

.2 CAN/CSA-C656-05(R2010), Performance Standard for Single Package Central Air-Conditioners and Heat Pumps.

1.2 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 air conditioning components and accessories and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:

.1 Indicate on drawings:

.1 Major components and accessories including sound power levels of units.

.2 Type of refrigerant used.

1.3 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

.2 Operation and Maintenance Data: submit operation and maintenance data for air conditioning components for incorporation into manual.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.

.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 air conditioning components from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

.4 Packaging Waste Management: remove for reuse and return of pallets, crates, padding, packaging materials.

1.5 WARRANTY

.1 Contractor hereby warrants that computer room air conditioning will not spall or show visible evidence of cracking, except for normal hairline shrinkage cracks, but for 5 years.

Part 2 Products

2.1 PERFORMANCE

.1 Unit capacity: as follows:

.1 Total cooling: 3.5 kW minimum.

.2 Air flow quantity: 192 L/s minimum.

.3 Minimum external static pressure: 125 Pa.

.4 Electrical characteristics: 115V/1/60.

.5 Indoor unit dimensions: 300x750x200

.6 Outdoor unit dimensions: 600x850x300

2.2 INDOOR UNIT

.1 Powered from outdoor unit

.2 Wall mount evaporator complete with filter, drain pump, precharged R-410A.

.3 Wired remote controller controls scheduling, fan speed, temperature setpoint and displays temperature.

2.3 OUTDOOR UNIT – ULTRA LOW AMBIENT COOLING (-40°C)

.1 Variable speed inverter type, with:

.1 Vibration isolators.

.2 Adjustable high and low pressure switches.

.3 Anti-slug device.

.4 Motor overload and over temperature protection pump down controls.

.5 Crank case heater.

.6 Compressor lead/lag switch.

.7 Refrigerant service valves.

.8 Capacity controls.

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 air conditioning components installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate in presence of NRC Departmental Representative.

.2 Inform NRC 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 NRC Departmental Representative

3.2 GENERAL

.1 Install as indicated, to manufacturer's recommendations, and to EPS 1/RA/2.

.2 Manufacturer to certify installation.

.3 Run drain line from cooling coil condensate drain pan to terminate over nearest floor drain.

3.3 EQUIPMENT PREPARATION

.1 Provide services of manufacturer's field engineer to set and adjust equipment for operation as specified.

3.4 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 recycling

.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.5 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by room air conditioning installation.

END OF SECTION

Part 1 General

1.1 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 cabinet convector heaters and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Include:

.1 Mounting methods.

.2 kW rating, voltage, phase.

.3 Cabinet material thicknesses.

.4 Colour.

.3 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

1.2 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 00 - Closeout Submittals .

.2 Operation and Maintenance Data: submit operation and maintenance data for cabinet convector heaters for incorporation into manual.

1.3 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements .

.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 in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect cabinet convector heaters from nicks, scratches, and blemishes .

.3 Replace defective or damaged materials with new.

.4 Develop Construction Waste Management Plan .

.5 Packaging Waste Management: remove for reuse by manufacturer of pallets, crates, padding, packaging materials as specified in Construction Waste Management Plan .

Part 2 Products

2.1 CABINET CONVECTOR HEATERS

.1 Wall mounted cabinet: to CSA C22.2 No.46, pre-drilled back for securing to wall:

.1 1.2 mm thick, steel .

.2 Finish: phosphatized and finished with powder coated finish, confirm colour with NRC Departmental Representative.

.2 Elements: mineral insulated with copper sheath and pressed-on fins, secured and free-floating for expansion.

2.2 CONTROLS

.1 Wall mounted thermostats: type digital, low voltage to Section 23 09 33 - Electric and Electronic Control System for HVAC .

.2 Built-in thermostat: with tamperproof screws and cover and auxiliary relays, transformer.

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 cabinet convector heater installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate in presence of NRC Departmental Representative .

.2 Inform NRC 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 NRC Departmental Representative .

3.2 INSTALLATION

.1 Install baseboard convectors as indicated.

.2 Install wall mounted thermostats in locations indicated.

.3 Make power and control connections.

3.3 FIELD QUALITY CONTROL

.1 Tests:

.1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical .

3.4 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 recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal .

.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 ASTM International

.1 ASTM E84- 11a , Standard Test Method for Surface Burning Characteristics of Building Materials.

.2 ASTM C916- 1985(R2007) , Standard Specification for Adhesives for Duct Thermal Insulation.

.3 ASTM C1071- 05e1 , Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material).

.2 National Fire Protection Association (NFPA)

.1 NFPA 90A- 2012 , Standard for the Installation of Air Conditioning and Ventilating Systems.

.2 NFPA 90B- 2012 , Standard for the Installation of Warm Air Heating and Air Conditioning Systems (ANSI).

.3 Underwriters' Laboratories (UL) Inc.

.1 UL 2021- 1997 , Fixed and Location-Dedicated Electric Room Heaters.

1.2 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 unit heaters and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Manufacturer's Instructions: provide to indicate special handling criteria, installation sequence, cleaning procedures.

.4 Shop Drawings:

.1 Indicate on drawings:

.1 Equipment, capacity and piping connections.

.2 Dimensions, internal and external construction details, recommended method of installation with proposed structural steel support, sizes and location of mounting bolt holes.

1.3 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

.2 Operation and Maintenance Data: submit operation and maintenance data for unit heaters for incorporation into manual.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.

.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 unit heaters from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

.4 Packaging Waste Management: in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

Part 2 Products

2.1 UNIT HEATERS

.1 Cabinet Unit Heaters: to UL 2021.

.2 Cabinet: type recessed, 1.6 mm thick steel with rounded exposed corners and edges, removable panels, glass fibre insulation and integral air outlet and inlet

.1 Insulation Materials: to ASTM C1071; ensure surfaces exposed to airstream have aluminum-foil facing to prevent erosion of glass fibres.

.1 Thickness: 25 mm.

.2 Thermal conductivity (k-Value): 0.037 W/m x K at 24 degrees C mean temperature.

.3 Fire-hazard classification flame-spread index of 25 maximum and smoke-developed index of 50 maximum to ASTM E 84.

.3 Finish with factory applied primer coat.

.4 Factory prime painted front panels with countersunk screws and louvred face grilles..

.5 Hydronic coils: hydrostatically tested to 1 MPa.

.1 Hot water coil: copper tube, mechanically bonded aluminum fins spaced 25 mm maximum rated 1378 kPa minimum working pressure and 104 degrees C maximum entering-water temperature. Include manual air vent and drain.

.6 Electric coils: nickel-chrome resistance coils embedded in refractory material and enclosed in steel sheathing with low watt density extended fins.

.1 Two stage heating with magnetic contactors, high temperature limit switch, and fan override switch.

.2 Control heating elements in conjunction with fan by common control switch.

.7 Fans: centrifugal double width wheels, statically and dynamically balanced, direct driven, sleeve bearings, resilient mounted.

.8 Motor: multi-speed, tapped wound permanent split capacitor type with sleeve bearings, built-in thermal overload protection and resilient rubber isolation mounting.

.9 Capacity: as indicated.

.10 Control:

.1 on-off switch with integral overloads in cabinet.

.2 Low limit aquastat strapped on to hot water heating supply set to prevent fan operating below 27 degrees C.

.3 Control thermostat: electronic, rating to suit cabinet unit heater, set point locking device, concealed adjustment, brushed aluminum cover, thermometer in cover.

2.2 HORIZONTAL UNIT HEATERS

.1 Horizontal Unit Heaters: to UL 2021.

.2 Casing: 1.6 mm thick cold rolled steel, gloss enamel finish, with threaded connections for hanger rods.

.3 Coils: hydrostatically test to 1 MPa.

.1 Hot water coil: copper tube, mechanically bonded aluminum fins spaced 25 mm maximum rated 1378 kPa minimum working pressure and 104 degrees C maximum entering-water temperature. Include manual air vent and drain.

.4 Fan: direct drive propeller type, factory balanced, with anti-corrosive finish and fan guard.

.5 Motor: speed as indicated continuous duty, built-in overload protection, and resilient motor explosion proof supports.

.6 Air outlet: two-way adjustable louvres.

.7 Capacity: as indicated, base hot water heating capacity on 11 degrees C temperature drop

.8 Control room thermostat: electronic, set point locking device, concealed adjustment, brushed aluminum cover, thermometer in cover.

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 unit heaters installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate in presence of NRC Departmental Representative.

.2 Inform NRC 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 NRC Departmental Representative.

3.2 INSTALLATION

.1 Install in accordance with manufacturer's instructions.

.2 Include double swing pipe joints as indicated.

.3 Check final location with NRC Departmental Representative if different from that indicated prior to installation.

.1 Should deviations beyond allowable clearances arise, request and follow NRC Departmental Representative's directive.

.4 Hot water units: for each unit, install gate valve on inlet and calibrated balancing valve on outlet of each unit. Install drain valve at low point.

.1 Install manual air vent at high point.

.5 Clean finned tubes and comb straight.

.6 Provide supplementary suspension steel as required.

.7 Install thermostats in locations indicated.

.8 Before acceptance, set discharge patterns and fan speeds to suit requirements.

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

.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.4 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by unit heaters installation.

END OF SECTION

Part 1 General

1.1 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 humidifiers and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:

.1 Submit shop drawings to indicate project layout, dimensions and extent of humidification system.

.4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.5 Test Reports: submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.

.6 Manufacturer's Field Reports:

.1 Submit manufacturer's field reports specified.

1.2 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

.2 Operation and Maintenance Data: submit operation and maintenance data for humidifiers for incorporation into manual.

1.3 MAINTENANCE MATERIAL SUBMITTALS

.1 Extra Materials:

.1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.

.2 Furnish list of individual manufacturer's recommended spare parts for equipment, addresses of suppliers, list of specialized tools necessary for adjusting, repairing or replacing, for inclusion into operating manual.

.3 Provide following: one complete set of renewable evaporator media.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.

.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 humidifiers from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

.4 Packaging Waste Management: in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

Part 2 Products

2.1 ELECTRIC STEAM GENERATORS

.1 Humidifier shall generate steam from tap water with electrode-type heater to within 3% of modulating demand signal.

.2 Vented enclosure with digital display.

.3 Complete with:

.1 Fill cup

.2 Fill hose

.3 Fill valve

.4 Overflow

.5 Drain

.6 High water sensor

.7 Replaceable steam cylinder

.8 Control panel

.4 Control panel complete with push button operation, LED indicators for operating status and troubleshooting. PID tuning for RH control. BACnet or Lontalk for interoperability with automation system. Controller to record drain and fill events.

.5 Insulated steam hose to dispersion tubes.

.6 High-efficiency dispersion tubes with absorption distance less than 300mm, suitable for vertical or horizontal duct installation.

.7 High limit humidistat to shut down humidifier. Air flow proving switch to be provided to engage humidifier only when air handler is operating.

.8 Space-mounted humidistat by BAS supplier to provide modulating input signal to humidifier controller.

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 humidifiers installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate in presence of NRC Departmental Representative.

.2 Inform NRC 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 NRC Departmental Representative.

3.2 INSTALLATION

.1 Install in accordance with manufacturers instructions.

.2 Humidifier to be new and clean when project is accepted.

.3 Install humidistat in accessible location.

.4 Water service overflow drain: to manufacturers' recommendation.

.5 Install access doors or panels in adjacent ducting.

.6 When installing in ducting, provide waterproof duct up and downstream in accordance with Section 23 31 13.01 - Metal Ducts - Low Pressure to 500 Pa.

.7 Install capped drain connection at low point in duct.

3.3 FIELD QUALITY CONTROL

.1 Manufacturer's Field Services:

.1 Have manufacturer of products, supplied under this Section, review Work involved in the handling, installation/application, protection and cleaning, of its product[s] and submit written reports, in acceptable format, to verify compliance of Work with Contract.

.2 Manufacturer's Field Services: provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

.3 Schedule site visits, to review Work, at stages listed:

.1 After delivery and storage of products, and when preparatory Work, or other Work, on which the Work of this Section depends, is complete but before installation begins.

.2 Twice during progress of Work at 25% and 60% complete.

.3 Upon completion of the Work, after cleaning is carried out.

.4 Obtain reports, within 3 days of review, and submit immediately to NRC Departmental Representative.

.2 Performance Verification (PV):

.1 General: in accordance with Section 01 91 13 - General Commissioning (Cx) Requirements: General Requirements, supplemented as specified.

.2 Timing:

.1 After TAB of ducted air systems.

.2 At same time as PV of related air handling units.

.3 Start-up:

.1 General: in accordance with Section 01 91 13 - General Commissioning (Cx) Requirements: General Requirements, supplemented as specified.

.2 Verify:

.1 Steam lines are sloped to ensure steam condensate is drained away from the humidifier.

.2 Vapour lines and manifolds are sloped to ensure condensate is drained away from the duct system.

.3 Visually check distribution manifold to ensure:

.1 Even distribution of vapour.

.2 Freedom from water deposits.

.4 Commissioning Reports:

.1 General: in accordance with Section 01 91 13 - General Commissioning (Cx) Requirements: reports, supplemented as specified. Include:

.1 PV results on approved PV Report Forms.

.2 Product Information Report Forms.

3.4 DEMONSTRATION

.1 Training: in accordance with Section 01 91 13 - General Commissioning (Cx) Requirements: Training of O M Personnel.

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.

.3 Waste Management: in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes. EMCS:

.1 Methods and procedures for start-up, verification and commissioning, for building Energy Monitoring and Control System (EMCS) and includes:

.1 Start-up testing and verification of systems.

.2 Check out demonstration or proper operation of components.

.3 On-site operational tests.

.2 Related Sections.

.1 Section 01 33 00 - Submittal Procedures.

.2 Section 01 78 00 - Closeout Submittals.

.3 Section 01 91 13 - General Commissioning (Cx) Requirements.

.4 Section 01 79 00 - Demonstration and Training.

.5 Section 25 05 01 - EMCS: General Requirements.

1.2 DEFINITIONS

.1 For additional acronyms and definitions refer to Section 25 05 01 - EMCS: General Requirements.

.2 AEL: ratio between total test period less any system downtime accumulated within that period and test period.

.3 Downtime: results whenever EMCS is unable to fulfill required functions due to malfunction of equipment defined under responsibility of EMCS contractor. Downtime is measured by duration, in time, between time that Contractor is notified of failure and time system is restored to proper operating condition. Downtime not to include following:

.1 Outage of main power supply in excess of back-up power sources, provided that:

.1 Automatic initiation of back-up was accomplished.

.2 Automatic shut-down and re-start of components was as specified.

.2 Failure of communications link, provided that:

.1 Controller automatically and correctly operated in stand-alone mode.

.2 Failure was not due to failure of any specified EMCS equipment.

.3 Functional failure resulting from individual sensor inputs or output devices, provided that:

.1 System recorded said fault.

.2 Equipment defaulted to fail-safe mode.

.3 AEL of total of all input sensors and output devices is at least 99 % during test period.

1.3 DESIGN REQUIREMENTS

.1 Confirm with Departmental Representative that Design Criteria and Design Intents are still applicable.

.2 Commissioning personnel to be fully aware of and qualified to interpret Design Criteria and Design Intents.

1.4 SUBMITTALS

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

.2 Final Report: submit report to Departmental Representative.

.1 Bear signature of commissioning technician and supervisor

.2 Report format to be approved by Departmental Representative before commissioning is started.

.3 Revise "as-built" documentation, commissioning reports to reflect changes, adjustments and modifications to EMCS as set during commissioning and submit to Departmental Representative in accordance with Section 01 78 00 - Closeout Submittals.

.4 Recommend additional changes and/or modifications deemed advisable in order to improve performance, environmental conditions or energy consumption.

1.5 CLOSEOUT SUBMITTALS

.1 Provide documentation, O&M Manuals, and training of O&M personnel for review of Departmental Representative before interim acceptance in accordance with Section 01 78 00 - Closeout Submittals.

1.6 COMMISSIONING

.1 Do commissioning in accordance with Section 01 91 13 - General Commissioning (Cx) Requirements.

.2 Carry out commissioning under direction of Departmental Representative and in presence of Departmental Representative.

.3 Inform, and obtain approval from, Departmental Representative in writing at least 28 days prior to commissioning or each test. Indicate:

.1 Location and part of system to be tested or commissioned.

.2 Testing/commissioning procedures, anticipated results.

.3 Names of testing/commissioning personnel.

.4 Correct deficiencies, re-test in presence of Departmental Representative until satisfactory performance is obtained.

.5 Acceptance of tests will not relieve Contractor from responsibility for ensuring that complete systems meet every requirement of Contract.

.6 Perform tests as required.

1.7 COMPLETION OF COMMISSIONING

.1 Commissioning to be considered as satisfactorily completed when objectives of commissioning have been achieved and reviewed by Departmental Representative.

1.8 ISSUANCE OF FINAL CERTIFICATE OF COMPLETION

.1 Final Certificate of Completion will not be issued until receipt of written approval indicating successful completion of specified commissioning activities including receipt of commissioning documentation.

Part 2 Products

2.1 EQUIPMENT

.1 Provide sufficient instrumentation to verify and commission the installed system. Provide two-way radios.

.2 Instrumentation accuracy tolerances : higher order of magnitude than equipment or system being tested.

.3 Independent testing laboratory to certify test equipment as accurate to within approved tolerances no more than 3 months prior to tests.

.4 Locations to be approved, readily accessible and readable.

.5 Application: to conform to normal industry standards.

Part 3 Execution

3.1 PROCEDURES

.1 Test each system independently and then in unison with other related systems.

.2 Commission each system using procedures prescribed by the Departmental Representative.

.3 Commission integrated systems using procedures prescribed by Departmental Representative.

.4 Debug system software.

.5 Optimize operation and performance of systems by fine-tuning PID values and modifying CDLs as required.

.6 Test full scale emergency evacuation and life safety procedures including operation and integrity of smoke management systems under normal and emergency power conditions as applicable.

3.2 FIELD QUALITY CONTROL

.1 Completion Testing.

.1 General: test after installation of each part of system and after completion of mechanical and electrical hook-ups, to verify correct installation and functioning.

.2 Include following activities:

.1 Test and calibrate field hardware including stand-alone capability of each controller.

.2 Verify each A-to-D convertor.

.3 Test and calibrate each AI using calibrated digital instruments.

.4 Test each DI to ensure proper settings and switching contacts.

.5 Test each DO to ensure proper operation and lag time.

.6 Test each AO to ensure proper operation of controlled devices. Verify tight closure and signals.

.7 Test operating software.

.8 Test application software and provide samples of logs and commands.

.9 Verify each CDL including energy optimization programs.

.10 Debug software.

.11 Blow out flow measuring and static pressure stations with high pressure air at 700 kPa.

.12 Provide point verification list in table format including point identifier, point identifier expansion, point type and address, low and high limits and engineering units. Include space for the commissioning technician and Departmental Representative. This document will be used in final startup testing.

.3 Final Startup Testing: Upon satisfactory completion of tests, perform point-by-point test of entire system under direction of Departmental Representative and provide:

.1 Technical personnel capable of re-calibrating field hardware and modifying software.

.2 Detailed daily schedule showing items to be tested and personnel available.

.3 Departmental Representative's acceptance signature to be on executive and applications programs.

.4 Commissioning to commence during final startup testing.

.5 Commissioning to be supervised by qualified supervisory personnel and Departmental Representative.

.6 Commission systems considered as life safety systems before affected parts of the facility are occupied.

.7 Operate systems as long as necessary to commission entire project.

.8 Monitor progress and keep detailed records of activities and results.

.4 Final Operational Testing: to demonstrate that EMCS functions in accordance with contract requirements.

.1 Prior to beginning of 30 day test demonstrate that operating parameters (setpoints, alarm limits, operating control software, sequences of operation, trends, graphics and CDL's) have been implemented to ensure

proper operation and operator notification in event of off-normal operation.

.1 Repetitive alarm conditions to be resolved to minimize reporting of nuisance conditions.

.2 Test to last at least 30 consecutive 24 hour days.

.3 Tests to include:

.1 Demonstration of correct operation of monitored and controlled points.

.2 Operation and capabilities of sequences, reports, special control algorithms, diagnostics, software.

.4 System will be accepted when:

.1 EMCS equipment operates to meet overall performance requirements. Downtime as defined in this Section must not exceed allowable time calculated for this site.

.2 Requirements of Contract have been met.

.5 In event of failure to attain specified AEL during test period, extend test period on day-to-day basis until specified AEL is attained for test period.

.6 Correct defects when they occur and before resuming tests.

.7 Testing/verification of occupancy and seasonal-sensitive systems to take place during four (4) consecutive seasons, after facility has been accepted, taken over and fully occupied.

.1 Test weather-sensitive systems twice: first at near winter design conditions and secondly under near summer design conditions.

.5 Commissioning Manager to verify reported results.

3.3 ADJUSTING

.1 Final adjusting: upon completion of commissioning as reviewed by Departmental Representative, set and lock devices in final position and permanently mark settings.

3.4 DEMONSTRATION

.1 Demonstrate to Departmental Representative operation of systems including sequence of operations in regular and emergency modes, under normal and emergency conditions, start-up, shut-down interlocks and lock-outs in accordance with Section 01 79 00 - Demonstration and Training requirements.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes.

.1 Requirements and procedures for training program, instructors and training materials, for building Energy Monitoring and Control System (EMCS) Work.

.2 Training requirements, other than project specific operator's overview, are not applicable to Andover Control Systems unless requested by Departmental Representative.

.2 Related Sections.

.1 Section 01 33 00 - Submittal Procedures.

.2 Section 25 05 00 - Common Work for Building Automation.

1.2 DEFINITIONS

.1 CDL - Control Description Logic.

.2 For additional acronyms and definitions refer to Section 25 05 00 - Common Work for Building Automation.

1.3 SUBMITTALS

.1 Submittals in accordance with Section 01 33 00 - Submittal Procedures, supplemented and modified by requirements of this Section.

.2 Submit training proposal complete with hour-by-hour schedule including brief overview of content of each segment to Departmental Representative 30 days prior to anticipated date of beginning of training.

.1 List name of trainer, and type of visual and audio aids to be used.

.2 Show co-ordinated interface with other EMCS mechanical and electrical training programs.

.3 Submit reports within two week after completion of Phase 1 and Phase 2 training program that training has been satisfactorily completed.

1.4 QUALITY ASSURANCE

.1 Provide 1 competent instructors thoroughly familiar with aspects of EMCS installed in facility.

.2 Departmental Representative reserves right to approve and or have instructor replaced.

1.5 INSTRUCTIONS

.1 Provide instruction to designated personnel in adjustment, operation, maintenance and pertinent safety requirements of EMCS installed.

.2 Training to be project-specific.

1.6 TIME FOR INSTRUCTION

.1 Number of days of instruction to be as specified in this section (1 day = 8 hours including two 15 minute breaks and excluding lunch time).

1.7 TRAINING MATERIALS

.1 Provide equipment, visual and audio aids, and materials for classroom training.

.2 Supply manual for each trainee, describing in detail data included in each training program.

.1 Review contents of manual in detail to explain aspects of operation and maintenance (O&M).

1.8 TRAINING PROGRAM

.1 To be in 2 phases over 6 month period.

.2 Phase 1: 2 day program to begin before 30 day test period at time mutually agreeable to Contractor, Departmental Representative.

.1 Train O&M personnel in functional operations and procedures to be employed for system operation.

.2 Supplement with on-the-job training during 30 day test period.

.3 Include overview of system architecture, communications, operation of computer and peripherals, report generation.

.4 Include detailed training on operator interface functions for control of mechanical systems, CDL's for each system, and elementary preventive maintenance.

.3 Phase 2: 3 day program to begin 8 weeks after acceptance for operators, equipment maintenance personnel and programmers.

.1 Provide multiple instructors on pre-arranged schedule. Include at least following:

.1 Operator training: provide operating personnel, maintenance personnel and programmers with condensed version of Phase 1 training.

.2 Equipment maintenance training: provide personnel with 1 days training within 5 day period in maintenance of EMCS equipment, including general equipment layout, trouble shooting and preventive maintenance of EMCS components, maintenance and calibration of sensors and controls.

.3 Programmers: provide personnel with 2 days training within 5 day period in following subjects in approximate percentages of total course shown:

Software and architecture: [10]% Logiciel et architecture : [10] %
Application programs: [15]% Programmes d'application : [15] %
Controller programming: [50]% Programmation du contrôleur : [50] %
Trouble shooting and debugging:[10]% Dépannage et mise au point : [10] %
Colour graphic generation: [15]% Génération de graphiques en couleur : [15] %

1.9 ADDITIONAL TRAINING

.1 List courses offered by name, duration and approximate cost per person per week. Note courses recommended for training supervisory personnel.

1.10 MONITORING OF TRAINING

.1 Departmental Representative to monitor training program and may modify schedule and content.

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 Labour, products, equipment and services necessary to complete the work of this Section.

.2 Provide labour, installation materials and control equipment to provide a complete and satisfactory building automation system in accordance with the intent and meaning of the Drawings and Specifications. Include:

.1 Wire or pipe remote instrumentation required to operate packaged systems supplied by others. Modulating thermostats for these systems must match the system component characteristics.

.2 Supply, install and connect all control wiring for the systems described.

.3 Control wiring of components for systems listed herein requiring 120V or less. Included are such items as remotely mounted interlocks, sensors, 120V supply to refrigerated air dryers, seven day timers, etc.

.3 Refer to and comply with requirements specified in Basic Mechanical Requirements, Section 23 05 01 and also Division 26, Electrical Work.

.4 Co-ordinate the work of this Division with other Trades to obtain their electrical input for the electrical control schematics.

.5 Advise and co-ordinate this work with all associated trades and balancing technicians.

1.2 CODES, REGULATIONS AND STANDARDS

.1 Comply with Municipal or Provincial Codes, Rules and Regulations and/or Authorities having jurisdiction.

.2 Comply with the National Building Code in areas where Municipal or Provincial Regulations and/or Codes are not mandatory.

.3 Revisions issue: latest version as amended to date.

1.3 MATERIAL APPROVALS

.1 Obtain special inspection and approvals by CSA and/or local authorities, for materials where specified.

.2 Obtain such approval for the particular installation with the co-operation of the material supplier.

1.4 PERMITS AND INSPECTIONS

.1 Obtain permits required for the installation of mechanical trades work including:

.1 Electrical inspection

.2 Arrange for inspections and tests and pay all fees and costs for the permits, inspections and tests. Obtain permits immediately after notification of award of Contract.

.1 Obtain copies of Drawings from the Consultant for submission with application for permits.

1.5 **RELATED WORK**

.1 The following equipment will be supplied and installed under other Sections or Divisions.

.1 Manual balancing dampers, fire dampers and gravity dampers: Division 23.

.2 Automatic control dampers supplied as an integral part of equipment. e.g. mixing box dampers and face and bypass dampers unless otherwise noted: Division 23.

.3 Control and power wiring between components of "packaged" systems: Division 21, 22, 23 and 26.

.4 Direct expansion cooling valves: Division 23.

.5 Refrigerant solenoid valves: Division 23.

.6 Multizone dampers unless otherwise noted: Division 23.

.7 Humidifier control valves complete with operators: Division 23.

.8 Return air fan variable vane linkage: Division 23.

.9 Supply air fan intake variable vanes and linkage: Division 23.

1.6 **ITEMS TO BE SUPPLIED UNDER THIS SECTION AND INSTALLED UNDER OTHER SECTIONS**

.1 Supply the following equipment to the appropriate Mechanical Trades for installation in accordance with instructions from, and under the supervision of, the Automatic Controls Subcontractor:

.1 Motorized dampers.

.2 Automatic control valves.

.3 Temperature control wells for pipe or tank mounted sensors.

.4 Roof mounted relief dampers, with operators and linkage.

.5 Variable volume terminal unit operators. (These operators will be installed on the terminal units by the terminal unit supplier).

1.7 **WORK UNDER OTHER CONTRACTS OR DIVISIONS**

.1 The following equipment will be supplied and installed by other trades or Contractors:

.1 Door limit switches for automatic temperature controls.

.2 Electrical items of work as defined hereinafter.

.3 All line side power wiring.

.4 Combination starters or contactors complete with integral pushbuttons, Hand-Off-Auto switches, etc. unless otherwise specified.

.5 Alternators for pump sequencing.

.6 All controls and wiring for:

.1 Fire alarm control system.

.2 Electric baseboard heaters.

.3 Electric forced flow heaters with integral thermostats.

1.8 **REFERENCE STANDARDS**

.1 Input/Output devices:

.1 To ASCII (American Standard for Communication and Information Exchange) code and standard EIA (Electronic Industry Association) interfaces.

.2 RFI interference: To F.C.C. regulation Part 15 Section 15 governing radio frequency electromagnetic interference and devices so labeled.

.2 Codes and Standards: comply with the following as a minimum:

.1 UL-916-PAZX listed

.2 Electrical Safety Code

.3 ASHRAE/ANSI 135-1995 (BACnet)

1.9 **PRODUCT AVAILABILITY**

.1 Product Development

.1 All products to be new, currently under manufacture, and have been applied in similar installations for a minimum of two (2) years.

.2 This installation shall not be used as a test site for new products unless explicitly approved by the Owner's representative in writing prior to bid date.

.2 Spare Parts

.1 Spare parts to be available for at least five (5) years after completion of this contract.

1.10 **WORKING DRAWINGS AND DOCUMENTS**

.1 Design Drawing Intent

.1 The design Drawings are schematic in arrangement, and describe the general design intent but do not show the exact details for the installation. They are not fabrication or installation drawings.

.2 The Work is suitably outlined on the Drawings with regard to sizes, locations, general arrangements and installation details, and has been generally coordinated for routing of services. The routing of ductwork, piping and equipment arrangement are shown more or less in diagram

except where in certain cases the Drawings may include details giving the exact locations and arrangements required.

.3 The location of equipment, and the associated arrangement of piping, ductwork, and other material describes the general requirements of the Work. Final location is dependant on the actual equipment supplied. The Consultant reserves the right to make reasonable adjustment of up to 1 m to the location of equipment, floor drains, routing of major piping and ductwork, at no cost to the Owner.

.4 In order to provide clarity to the arrangement of the work, not all details including valves, thermometers, pressure gauges, etc. are shown on the plan drawings. Refer to schematic drawings, standard details and the specification for these requirements.

.5 Where specific installation dimensions for location of equipment and access space requirements are indicated on the drawings, install to these requirements.

.6 Where Standard Details are provided, these show the general installation requirements, and are applicable to each occurrence in the Work, unless otherwise specified or shown.

.2 Contractor Coordination Responsibilities

.1 Provide the services of a mechanical/electrical coordination supervisor, to coordinate this Division of the Work, as well as providing coordination with other Divisions and/or contracts. This supervisor may be full time or part time on site, as appropriate to the work stage and complexity of the work, at the discretion of the Owner.

.2 Where multiple trades are required, the mechanical coordinating supervisor shall be the lead coordinator.

.3 The Owner reserves the right to require the coordinating supervisor to increase their attendance at site, at no cost to the Owner, if in the Owner's opinion the current level of coordination is not sufficient for the progress of the Work.

.4 Make changes and modifications as necessary to ensure coordination and to avoid interference and conflicts with other trades.

.5 Prepare construction / installation / fabrication drawings, coordinated with other trades and contracts, as required. Provide these drawings to other trades for coordination with their Work.

.6 Update these drawings as part of the As-built drawings, showing actual locations of major equipment, services, access doors, shut-off valves, etc.

.7 The design drawings show the major requirements for the installation of equipment based on one manufacturer's requirements, but may not show all installation requirements. The Contractor will include as part of the Work the specific manufacturer's installation requirements for the equipment actually provided by the Contractor.

.8 The construction / installation / fabrication drawings are not to be submitted as shop drawings. Make them available for viewing at site when requested by the Consultant.

.3 Review before proceeding (HOLD)

.1 Where the word "HOLD" appears on Drawings and other Contract Documents, the Work is included in the Contract.

.2 Execute such Work only after verification of dimensions, verification of materials and obtaining Consultant's written permission to proceed.

1.11 **COORDINATION AND EXAMINATION**

.1 Examination

.1 Carefully examine Work and Drawings of all related trades and thoroughly plan the Work so as to avoid interferences.

.2 Report defects which would adversely affect the Work. Do not commence installation until such defects have been corrected.

.2 Coordination

.1 Coordinate Work of this Division such that items will properly interface with Work of other Divisions. Prepare installation drawings of critical locations and submit to Consultant for review.

.2 Architectural Drawings, or in their absence, Mechanical Drawings govern all locations.

1.12 **PROVISION FOR FUTURE**

.1 Future equipment:

.1 Where indicated as reserved for future equipment or services, leave identified space clear and install services and equipment so that connections can be made in the future.

1.13 **EQUIPMENT NOT IN CONTRACT**

.1 Supplied By Owner (S.B.O.) equipment:

.1 Owner will receive, check and temporarily store this equipment in Building M19 located on the NRC Montreal Rd. Campus.

.2 Contractor under Division 1 will check for damage, will load and transport from M19 storage building to M22 construction site and be responsible for this equipment.

.3 Contractor under Division 1 will unpack, and assemble this equipment, and locate them in building.

.4 Connect mechanical services to accommodate this equipment.

.5 Owner shall hold equipment warrantee and Contractor shall be responsible for installation warrantee.

1.14 **PRE-PURCHASED EQUIPMENT**

.1 The following equipment has been pre-purchased by the Owner:

.1 Quantity two (2) Sewage Vacuum Tanks; refer to specification 22 42 01 section 2.13.

.2 The purchase value of the equipment is not included as part of the Work.

.3 Include as part of this Work the following:

.1 Scheduling and coordination for removal from storage and delivery of point of installation.

.2 Check, store, rigging, installation and otherwise be responsible for this equipment.

.3 All other provisions of this work including but not limited to Start-up and Performance Testing, manufacturers start-up services, training , Operating and Maintenance materials, coordination of installation, and warranty of installation provisions.

1.15 **SUBMITTALS**

.1 Shop Drawings

.1 Submit shop drawings in accordance with Section 01 33 00. Partial or incomplete submittals of data and/or drawings will be returned without review.

.2 Commence installation of the controls only after the shop drawings have been reviewed by the Consultant.

.3 Include the following in the shop drawings:

.1 Pneumatic piping and/or electric schematic drawings for the various control systems including component make and model numbers in accordance with the operating sequences on the instrument data sheets.

.2 Description and sequence of operation for each system in accordance with the Drawings. The preferred location for the operating sequence is on the Schematic Drawing.

.3 Drawings for control panels showing control equipment arrangement.

.4 Point address

.5 Manufacturer’s data/specification sheets. Indicate supplied model and options.

.6 Location of local support office

.7 Location of local parts supply

.8 Names of subcontractors, if any

.9 BMS Architecture schematic(s)

.10 System capacity and identified points reserve

.11 Software programs included

.12 Sample of commissioning plan and documentation

.4 Include electric control schematics for all systems in this Section. Schematic format and wire numbering:

.1 In accordance with the typical schematics attached to this Specification and on drawings.

.2 Include electrical components, e.g. control transformers, relays, overloads selector switches, running lights, thermostats, etc. which are necessary to provide a complete schematic.

.5 Use contact identification identical to the contacts shown on the suppliers shop drawings. List the reference shop drawing numbers on each schematic drawing.

.6 Revise the suppliers shop drawings for the systems listed herein to show the appropriate power demand, master clock and fire alarm contacts and the reference drawing numbers.

1.16 **"AS-BUILT" RECORD DRAWINGS**

.1 Reference

.1 Conform to Section 01 77 00 Contract Closeout.

.2 Maintain an accurate dimensional record of all underground piping and all deviations and changes in aboveground piping and equipment.

1.17 **INSTALLATION AND START-UP INSTRUCTIONS**

.1 Reference

.1 Conform to Section 01 77 00 Contract Closeout.

.2 Submit copies of installation instructions and copies of start-up instructions for any item of equipment when requested by the Consultant.

1.18 **OPERATING AND MAINTENANCE INSTRUCTION MANUALS**

.1 Reference

.1 Conform to Section 01 77 00 Contract Closeout.

.2 In addition, include the following in the manuals:

.1 Non-dimensional layout showing location of all electrical devices on mechanical equipment.

.2 Operating instructions, including start-up and shut-down procedure.

.3 Lubricating instructions and recommended cycle of lubrication for each item of equipment, including various types of lubricants.

.4 List of spare parts.

.3 All the above applies to component parts of equipment whether they are manufactured by the supplier of the equipment or are supplied as a component part of an item of equipment.

1.19 **TRADE QUALIFICATIONS**

.1 Applicable to the following trades

.1 Electricians

.2 Requirements

.1 Trade workers to have a Certificate of Qualification as Journeyman or Apprentice Registration for the province where the work is performed or an Interprovincial Certificate.

.2 Ratio of journeyman to apprentice: not to exceed the defined ratio in the Apprenticeship Act of Ontario.

.3 Certificates and Registration must be provided to the Consultant on request.

.4 Maintain on-site an up-to-date record listing journeyman and apprentices working on site.

1.20 **PRODUCT DELIVERY, STORAGE AND HANDLING**

.1 Seal instruments after manufacture and inspection and remain sealed until ready for installation.

.2 Handle instruments and equipment carefully handled and protect from weather, dust and construction materials.

PART - 2 PRODUCTS

2.1 **MATERIALS AND EQUIPMENT**

.1 Use new materials and equipment, free from defects impairing strength and durability, as specified or specified equivalent.

.2 Of Canadian manufacture wherever possible.

.3 Labelled or listed as required Code and/or inspection authorities.

2.2 **B.M.S. GENERAL SYSTEM PERFORMANCE REQUIREMENTS**

.1 General

.1 Distributed, microprocessor based, direct digital control system, capable of performing binary and PID control loop operations independent of communications with external controllers.

.2 Design Intent: the design documentation is schematic in nature. Provide hardware, software, and system architecture design to implement the functions, performance and control sequences shown.

.3 Any items required to complete the work and not specifically mentioned herein shall be supplied to the same quality standards as the specified items.

.2 Performance Standards: BMS system to conform to the following:

.1 Graphic Display: display a graphic with a minimum of 20 dynamic points. All current data displayed within 20 seconds of the request.

.2 Graphic Refresh: update all dynamic points with current data within 30 seconds.

.3 Object Command: maximum time between the command of a binary object by the operator and the reaction by the device not to exceed 10 seconds. Analog object to begin adjusting within 10 seconds of command input.

.4 Object Scan: all changes of state and change of analog values to be transmitted over the high-speed network and displayed at a controller or Workstation with 60 seconds of change.

.5 Alarm Response Time: maximum 45 seconds between alarm condition and annunciation at the work station.

.6 Program Execution Frequency: custom and standard application executions run a minimum of once every 5 seconds. Contractor to select execution times consistent with the mechanical process under control.

.7 Control Loop Performance: execute PID control loops at a selectable frequency, at least once every 5 seconds. Scan and update the process value and output generated by this calculation at the same frequency.

.8 Multiple Alarm Annunciation: all work stations on the network to receive alarms within 5 seconds of each other.

.3 Network Communications General Requirements:

.1 Communications designed such that each control system is capable of operating under stand-alone control during network communication failure.

.2 Network communication: high-speed peer based network.

.3 Building Management System LAN : BACnet TCP/IP protocol (10baseT Ethernet).

.4 Fault Tolerance:

.1 All system components are to be designed, built, and installed to be fault tolerant as follows:

.1 Satisfactory operation without damage at 110% above and 85% below rated voltage and at +3 hertz variation in line frequency.

.2 Static, transient, and short circuit protection on all inputs and outputs.

.3 Communications lines protected against incorrect wiring, static transients and induced magnetic interference.

.4 All real time clocks and data file RAM shall be battery backed for a

minimum of 72 hours.

.5 Bus connected devices to be a.c. coupled or equivalent so that any single device failure will not disrupt or halt bus communication.

.5 Building Services NRC Network Systems Reporting Accuracy:

Space Temperature	±0.5℃	±1℉
Ducted Air	±0.5℃	±1℉
Outside Air	±1.0℃	±2℉
Water Temperature	±0.5℃	±1℉
Delta-T	±0.15℃	±0.25℉
Relative Humidity	±1% RH	
Water Flow	±5% full scale reading	
Air flow (terminal unit)	±10% full scale reading	
Air flow (measuring station)	±5% full scale reading	
Air pressure (ducts)	±25 Pa	±0.1 in.wc.
Air pressure (space)	±3 Pa	±0.01 in.wc.
Water pressure	±2% full scale reading	
Non-utility electrical metering	5% of reading	
Carbon Monoxide (CO)	±50 ppm	
Carbon Dioxide (CO2)	±5 ppm	

.6 Process BAS Systems Reporting Accuracy:

Space Temperature	±0.5℃	±1℉
Ducted Air	±0.5℃	±1℉
Outside Air	±1.0℃	±2℉
Water Temperature	±0.5℃	±1℉
Delta-T	±0.15℃	±0.25℉
Relative Humidity	±1% RH	
Water Flow	±5% full scale reading	
Air flow (terminal unit)	±10% full scale reading	
Air flow (measuring station)	±5% full scale reading	
Air pressure (ducts)	±25 Pa	±0.1 in.wc.
Air pressure (space)	±3 Pa	±0.01 in.wc.
Water pressure	±2% full scale reading	
Non-utility electrical metering	5% of reading	

Carbon Monoxide (CO)	±50 ppm
Carbon Dioxide (CO2)	±5 ppm

.7 Suppliers/Installers:

.1 Supplied and installed by a Control Subcontractor specializing in such work. As far as practical, all control equipment to be the products of a single manufacturer.

.2 Bids by Wholesalers, Contractors, Franchised Dealers or any firm whose principal business is not that of manufacturing and installing automatic temperature control systems shall not be acceptable.

.3 Single source responsibility of supplier shall be the complete installation and proper operation of the BMS and control system, including commissioning and proper calibration of each component in the entire system.

.4 An in-place support facility within 50 kilometers of the site with technical staff, spare parts inventory and all necessary test and diagnostic equipment.

.5 Standard of Acceptance:

.1 Airtron

2.3 LOCAL CONTROL PANELS

.1 Type: wall or floor mounted

.1 EEMAC 12: sheet metal cubicles for indoor use.

.2 EEMAC 4: sheet metal cubicles with hinged and locking front panels, for outdoor use.

.2 Construction:

.1 Suitable knockouts and hinged, lockable doors all keyed alike.

.2 Factory piped, wired, assembled and ready for field installation.

.3 Door mounted temperature gauges, filter gauges, pneumatic selector switches, etc.

.4 Interior compartment mounted DDC Controllers, controllers, air solenoid valves, relays, air gauges, etc.

.5 Nameplates for components mounted in and on local control panels in accordance with the Nameplate Article of this Section.

.6 Where one panel serves more than one system in a Mechanical Room, clearly separate the system components on the front of the panel.

.3 Panel Wiring:

.1 Wire electrical components mounted in local control panels.

.2 Terminate wire at terminal blocks located near the top or bottom of the panel to suit incoming conduit.

.1 Terminal blocks: Electrovert WK Series.

.3 Number and identify each terminal block point to tie in with the control drawings.

.4 Wire panel neatly and conform to all applicable codes.

.5 Identify control wires terminating at terminal strips.

.1 Markers: Electrovert Type Z

2.4 WIRING

.1 Wiring Standards

.1 To Section 25 05 00 requirements and the Electrical Safety Code as amended to date.

.2 Conduit:

.1 Wiring in ceilings, furred spaces, in hollow walls and partitions and where not exposed to mechanical injury: thin wall up to 32 mm.

.2 Wiring in poured concrete, where exposed and for conduit 40 mm: rigid galvanized.

.3 Wiring used as part of a smoke control/venting system, all locations: 40 mm: rigid galvanized.

.3 Power Wiring:

.1 Colour coded No. 14 gauge for control

2.5 IDENTIFICATION

.1 Lamacoid Nameplates:

.1 75 x 50 mm, 10 mm high black lettering on white background. Include the following information:

.1 Component name/ID

.2 Data Cards:

.1 100 x 150 mm (nominal) pre-printed data card, mounted in a hard plastic case, secured to device with nylon tie-wraps. Include the following information:

.1 Device Tag Identification

.2 Device Name

.3 BCU or ECU address

.4 Power Requirements

.3 Brass Valve Tags:

.1 25 mm dia. circular brass tag, fastened to valve body with keychain. Include the following information:

.1 Valve Tag ID (to correspond with manual valve tags under Section 23 05 53)

2.6 **EQUIPMENT SUPPORTS**

.1 Support Frames: galvanized modular framing system: Unistrut.

.2 Backboards: 20 mm fire rated plywood.

PART - 3 EXECUTION

3.1 **EXAMINATION**

.1 Thoroughly examine the design documentation for control devices and equipment, Notify the consultant of any discrepancies, conflicts or omissions prior to commencement of rough-in work.

3.2 **INSTALLATION**

.1 The BAS system is to be divided into two separate architectures, one with and one without a local front end.

.1 Those systems designated for general Building Services HVAC system applications and that support laboratory / research functional programs will NOT require a local work station but rather be interconnected with the NRC campus wide network. These shall include Zones “Terminal Units”, Mics Equipment, 20, 27 and 28.

.2 Those systems that are dedicated to process and laboratory / research functional programs will require a local front end that will be housed in the Flight Simulator Observation Room 26. These shall include all remaining Zones.

.3 Refer to the Points list tabulated in Section 25 95 00_01 for details.

.2 Execute work in accordance with requirements specified in the various Sections of Division 25, and where referenced to other Divisions.

.3 Lay out the work so that it does not interfere with work under other Divisions of Specifications.

.4 Make good any damage to Owner’s property or other trade’s work caused by improperly locating or carrying out of work.

.5 Location of pipes, ductwork, raceways and equipment may be altered without extra cost provided alteration is made before installation.

3.3 **PROTECTION**

.1 Protect work and materials before, during and after erection from weather and other hazards and keep in a clean and orderly manner.

.2 Protect pipe ends, valves and parts of equipment left unconnected to prevent damage or intrusion of foreign matter. Provide pipe caps for threaded male connections and plugs for threaded female connections.

3.4 **PAINTING**

.1 With the exception of prime painting of miscellaneous steel or any other specific requirements as specified under the respective Sections of this Work, or equipment otherwise factory painted, all painting will be provided under Division 09 (under a Separate Contract).

.2 Field prime painting:

.1 Mechanical rooms, boiler rooms, fan rooms, crawl spaces, pipe tunnels and penthouses: paint exposed galvanized metal surfaces with one coat of zinc dust galvanized primer and one coat of 100% alkyd base enamel.

.2 Clean rust and oil from exposed iron and steel work provided under this Division, whether or not it has been factory prime painted. Paint this equipment with one coat of chrome oxide phenolic base primer and one coat of 100% alkyd base enamel in an approved colour.

3.5 **CONSTRUCTION REVIEW**

.1 The construction review will include milestone and periodic reviews.

.2 Milestone Reviews

.1 Specific milestone reviews will be performed by the Consultant for compliance with the Ontario Building Code, including any or all of the following:

.1 Equipment Demonstration and Training

.2 Substantial Performance and Deficiency Review

.3 Total Performance

.2 Some or all of these reviews are of portions of the work which may be concealed. If work is enclosed before the Consultant can review the installation, the Consultant may direct the Contractor to expose the Work for it to be examined, at no additional cost to the project including rework affecting other Trades.

.3 If deficiencies are noted during any review where work will be enclosed, correct noted deficiencies and have them reviewed by the Consultant prior to the Work being enclosed.

.4 Provide a minimum of seven (7) calendar days written notice to the Consultant when requesting each review date.

.5 The Consultant will provide a check-list to the Contractor of required milestone reviews which must be completed. Maintain this list on site along with identified test reports, and make available for Consultants review when requested. When completed, include this checklist form with the Test Reports forms specified in this Division.

.3 Periodic Reviews

.1 The Consultant will conduct periodic reviews, as required for the project. These reviews are for the benefit of the Owner to describe the progress and workmanship of the Work, and are not intended as any form of quality assurance for the Contractor.

.2 Deficiencies will generally not be reported as part of this review, as the work has not been reported by the Contractor as being complete. However, deficiencies may be reported where it may not be possible to correct the work at a later date, or at great expense.

.3 The Contractor shall not relay on these Periodic Reviews to identify deficiencies during the progress of the Work.

.4 Deficiency Review

.1 The Consultant will conduct a deficiency review only after the Contractor submits an application for Substantial Performance. As part of this application, the Contractor shall submit their own comprehensive deficiency list of incomplete or incorrect work. Failure by the contractor to list any deficiency does not relieve the Contractor from correcting or completing the Work.

.2 The Consultant shall review the work and any deficiencies noted will be classified as Major or Minor.

.1 Major deficiencies are required to be corrected as part of obtaining Substantial Performance.

.2 Minor deficiencies may be corrected before or after Substantial Performance.

.5 Final Review

.1 The Consultant will conduct a final review only after the Contractor submits a declaration that all of the following has been completed:

.1 Noted deficiencies have been corrected

.2 Final As-built drawings have been submitted to the Owner

.3 Final Operating and Maintenance manuals have been submitted to the Owner

.4 Final Test reports, including Alternate season tests have been submitted to the Owner.

.6 The Consultant will only review the deficiency list to confirm these deficiencies have been corrected.

.7 Tubing and Conduit

.1 Tubing and conduit: follow horizontal and perpendicular building lines to fit into the layout of the area. Properly support and install in a neat and workmanlike manner throughout.

.2 Install panels in readily accessible locations. Unless other wise shown, mount control panels at a height of 1800 mm from the floor to the top of the cabinet for units without operator input devices (LCD screens, keypads, etc). For units with operator input devices, mount unit so that the horizontal centerline of the LCD display is located 1650 mm above the floor.

.3 Verify integrity of all wiring to ensure continuity and freedom from shorts and grounds.

3.6 LOCAL CONTROL PANELS

.1 Install BCU and ECU controllers in separate EEMAC 4 or 12 panels, to suit location. Install operator LCD screen, where specified, on the front panel door to allow operator access without opening door.

.2 Install BCU and ECU controllers, complete with OEM factory installed EEMAC 1 enclosures, directly to walls or support stands as described below. On systems requiring pneumatic control elements including pressure gauges, selector switches, etc., mount controller and pneumatic devices in an EEMAC 1 sheet metal enclosure. Install operator LCD screen, where specified, on the front panel door to allow operator access without opening door.

.3 Support local control panels from fixed masonry or concrete walls. Do not support from drywall partition walls. Provide free standing support frames in other locations.

3.7 VIBRATION ISOLATION

.1 Provide sufficient slack and flexible connections to allow for vibration of piping and equipment.

.2 Sensing elements in ductwork: substantially supported and protected from vibration.

.3 Vibration sensitive controllers: isolate either by location or by mounting device.

.4 Tubing and conduit: install to preserve vibration isolation of equipment and ducting.

3.8 WIRING COORDINATION

.1 Provide wiring and conduit under this Section of the work as follows:

.1 Between ceiling mounted junction boxes and terminal unit controllers.

.2 Between MCC mounted receptacle panels in mechanical rooms and controllers and control devices within the same area.

.3 Provide circuit breakers in "RP" and "ERP" panels; provide breaker locks to prevent unauthorized use of the breaker.

.2 Power wiring provided under Division 26 as follows:

.1 120 VAC power and conduit to a junction box located in the ceiling adjacent to each terminal unit.

.2 120 VAC normal power panels labeled "RP" with spaces available for use.

.3 120 VAC emergency power panels labeled "ERP" with spaces available for use.

.3 Termination at Packaged Equipment and Systems:

.1 Terminate wiring at packaged equipment and system controllers provided under Mechanical Division.

.2 For equipment or systems panels provided under other Divisions of the Work, pull wire into control panel as per OEM manufacturers instructions. Final termination at equipment or panel will be by the trade Contractor providing/installing the equipment.

3.9 **WIRING**

.1 Maximum control voltage : 120 V.

.2 Supply, install and connect power transformers as required for each system.

.3 Sizing of conduit and selection of size and type of wire is by the Contractor under this Section of the Work.

.4 Flexible metal and liquid tight conduit:

.1 Maximum 1000 mm length

.2 Minimum size: 20 mm

.3 Supported at each end

.5 Control and Status Relays:

.1 Provide relays in designated enclosures only. Relays may be installed within packaged equipment control panels.

.2 Do not install relays within motor starter enclosures. Install relays in spare MCC sections, or provide a NEMA 1 enclosure mounted adjacent to the MCC or starter.

.6 Control and interlock wiring: comply with Ontario Electrical Safety Code and Division 26, and as specified herein.

.7 Wire:

.1 All cables ULC listed for application.

.2 Exposed cable in ceiling plenums: FT6 plenum rated.

.8 Conduit:

.1 Wiring in ceiling plenum spaces to be in conduit or be FT6 plenum rated cable.

.2 Wiring in all other areas to be in conduit.

.3 Wiring for rated smoke venting/control system to be FT6 plenum rated cable and be installed conduit.

.9 Sleeves:

.1 Provide wall sleeves for plenum rated cable passing through walls.

.2 Maintain fire rating at all penetrations.

3.10 FIBRE OPTIC CABLE SYSTEM

.1 Install cable to maintain the minimum cable and unjacketed fiber bend radii as specified by the manufacturer.

.2 Do not exceed maximum pulling tensions as specified by the manufacturer. Do not exceed manufacturer's ratings for post installation residual cable tension.

.3 Install fiber optic cabinets, hardware, and cable entering the cabinet as per manufacturer's instructions.

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3.11 ARCHITECTURE

.1 Refer to drawings for system architecture schematic. The system architecture shown provides a general summary of the design intent, and does not show all control devices.

.1 Obtain a CAD design file form the consultant and complete the development of the system architecture drawing. In the absence of a design architecture, provide an architecture drawing as required.

.2 Include on the architecture drawing the following:

.1 Operator work stations

.2 Building LAN network

.3 Field LAN network

.4 BCU units, with identification label, and room location

.5 ECU units, with identification label, and room location

.6 LAN system repeaters

.2 Controllers:

.1 Provide a separate ECU for each piece of major equipment.

.2 Provide a separate ECU for each major system, including hydronic system water pumps.

.3 A universal programmable style ECU may be used to terminate miscellaneous I/O including system instrumentation, freestanding fans and pumps, etc. which may not form part of a more complex system.

.4 Select ECU's to provide a minimum of 15% spare capacity for each point type at each controller, but in no case less than 1 spare point.

3.12 PROGRAMMING

.1 General

.1 Point Naming: modular description without written point index.

.1 Use naming convention as indicated in contract documents.

.2 Provide programming for the system as specified and control sequence requirements. Include for additional programming necessary for the operation of the system but not specifically identified herein.

.3 Imbed sufficient comments in programming logic to clearly describe each section of the program. Comment statements to reflect language used in the sequences of operation.

.4 Enter all computer programs and data files into the related computers including English descriptors, control programs, approved parameters, and settings.

.2 Graphics

.1 Provide graphics for each major piece of equipment/system and for each floor plan in the building. Design CAD files will be provided to the controls Contractor for this purpose. Equipment to include:

.1 Chillers

.2 Cooling Towers

.3 Air Compressors

.4 Boilers

.5 Air Handling units

.6 Terminal box units

.7 Fan coils, unit heaters, etc

.8 Any integrated system including fire alarm, lighting control, security, etc.

.3 Reporting Information

.1 Implement samples of the following features:

.1 Bar chart (four different bars on one chart)

.2 Curve plot (five curves on one plot)

.3 Trend log

.4 Alarm message (action taking message)

.5 Run time maintenance message

.6 Trouble action message

3.13 NAMEPLATES

.1 Provide Nameplates:

.1 Lamacoid type:

.1 On each BMS control device, indicating device number.

.2 On the panel front to identify each system being controlled and to

identify each front mounted component.

.2 Laminated Data Card:

.1 Field devices

.2 Damper actuators

.3 DDC terminal unit box controllers

.4 Automatic control valve actuators

.3 Brass Valve Tags:

.1 Pipe mounted valves, etc., supplied under this section.

.2 Control valves supplied under other Sections of the Specifications but controlled under this Section. Radiator valves do not require valve tags.

.2 Warning Labels:

.1 Provide plastic adhesive-backed labels, black lettering on yellow background, on each starter and equipment automatically controlled through the BMS system, as follows:

CAUTION
This equipment is operating under automatic control and may start at any time without warning.
ATTENTION
Cet équipement fonctionne sous contrôle automatique et peut commencer à tout moment et sans avertissement .

.3 Securely fasten Lamacoid nameplates to the equipment or adjacent to the equipment, with round-head cadmium plated steel self-tapping screws.

3.14 **OPERATING INSTRUCTIONS**

.1 Provide the services of a competent technician qualified to instruct the operating personnel in maintenance and operating procedures, after commissioning, for a period of not less than 1 day. Training to include:

.1 Overall operational program

.2 Equipment functions

.3 Commands

.4 Graphics generation

.5 Appropriate operator intervention following system's operation.

.2 Provide Operating instructions for the control system in accordance with Section 23 05 01, and include a description of the sequence of operation, and reproducible drawings of the "as-built" system schematics.

.3 Maintain CD-R copies of all data file and application software for reload use in the event of a system crash or memory failure. Deliver one copy to the owner during training sessions, and archive one copy in the control manufacturer's local software vault.

.4 "As-built" system schematics:

.1 Changes made during construction.

.2 Component final set points.

.3 Controller sensitivity and authority settings.

.5 Include maintenance instructions for control components supplied under this Section.

3.15 ADJUSTMENT AND DEMONSTRATION OF SYSTEMS

.1 After completion of the installation, regulate and adjust all sensors, motors and other equipment provided under this contract and place them in complete operating condition. Coordinate this work with the Mechanical Contractor and system balancing technicians.

.2 During the balancing and adjustment of the heating and ventilating systems, assist the Mechanical Contractor and system balancing technicians in the complete balancing of the systems.

.3 After this work is completed, advise the Consultant in writing that the installation is complete and ready for inspection.

3.16 TESTING AND REPORTING

.1 Conduct complete performance tests to demonstrate to the Consultant the correct operation of each individual control system and each item of control equipment. Repeat performance tests as necessary until all systems are proven satisfactory.

.2 Report Format

.1 Prepare test forms in MS Excel, Word, Access or other Database format.

.2 Include the following header information for each test report:

.1 Owner Name

.2 Project Name

.3 Contractor Name

.4 Consultant Name

.5 Name of Test Report

.3 Include the following on the front sheet of the consolidated report:

.1 Contractor Company Name

.2 Name and signature of the person submitting the report

.3 Date of report

.4 The following statement: “The undersigned certifies that the test results recorded in this report are correct, and that results have been witnessed by the trade responsible for the test”.

.4 Submit the above tests in a hardcopy form, separately bound from the Operations and Maintenance manuals, and in Adobe Acrobat PDF format, in accordance with Section 01 33 00.

.3 Controls Report:

.1 Provide a test report in spreadsheet format which summarizes the following data for each piece of controls operation.

.1 Equipment ID and name

.2 Device Location

.3 ECU reference

.4 BCU reference

.5 I/O reference

.2 Record the following tests for each device as applicable:

.1 Communications Loop Integrity Test

.2 Sensor Range Test

.3 Actuator Stroke Test

.4 Controls logic function test – single loop.

.5 Controls logic function test – equipment or system test.

.3 Communications Loop integrity test

.1 Check communications between DDC controller and remote I/O device

.4 Sensor Range Calibration Test

.1 Provide data for minimum and maximum sensor values, setpoint value, and current value at time of test.

.5 Actuator Stroke Test

.1 Provide data on actuator stroke from 0-100% full stroke.

.2 Indicate output value vs. actuator position (i.e. 20 mA = 100% open)

.6 Controls Logic Function Test – Single Loop

.1 Two position actuators: use manual control function from operators workstation to change current state of controller output.

.2 Modulating valves: vary Setpoint of control variable to modulate valve from 0-100% opening, at nominal 25% increments.

.7 Controls Logic Function Test – Equipment or System Test

.1 Create a point form checklist of the Sequence of Operation for each system.

.2 Operate system through each control sequence element specified.

.3 Operate each system through an actual power outage, and restart on power resumption.

.4 Operate each applicable system for automatic restart on emergency power.

.5 Operate each system through scheduled operation.

.8 Trend Logs

.1 Provide a copy of each trend log specified or requested.

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3.17 **COMMISSIONING ASSISTANCE**

.1 Provide (fifteen) (15) days of 8 hours each (net of travel time) after Substantial Performance for on-site programming in conjunction with the Owner's commissioning agent.

.2 (Perform commissioning of the controls system in accordance with Section 23 08 23).

3.18 **SERVICE AND GUARANTEE**

.1 The controls systems herein specified shall be free from defects in workmanship and material under normal use and service after commissioning and acceptance of the complete control system.

.2 After acceptance of the systems by the Consultant, provide any service required for the proper performance of the control systems for a period of one (1) year or one complete heating and cooling cycle.

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.3 This service shall include readjustment of the controls for proper balance of the systems under the direction of the Testing and Balancing firm six months after the initial adjustment. The controls shall be adjusted and set for optimum performance under the changed operating conditions during this system rebalancing.

.4 Include replacement parts for defective components and any labour to remove and replace such parts at no cost to the Owner.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 General requirements for building Energy Monitoring and Control System (EMCS) that are common to NMS EMCS Sections.

.2 Related Sections:

.1 Section 01 33 00 - Submittal Procedures.

.2 Section 01 35 29.06 - Health and Safety Requirements.

.3 Section 01 74 21 - Construction/Demolition Waste Management And Disposal.

.4 Section 09 91 23 - Interior Painting.

.5 Section 25 05 02 - EMCS: Shop Drawings, Product Data and Review Process.

.6 Section 25 05 54 - EMCS: Identification.

.7 Section 25 90 01 - EMCS: Site Requirements Applications and Systems Sequences of Operation.

.8 Section 260521 - Wires and Cables (0-1000 V)

.9 Section 260534 - Conduits, Conduit Fastenings and Conduit Fittings

1.2 REFERENCES

.1 American National Standards Institute (ANSI)/The Instrumentation, Systems and Automation Society (ISA).

.1 ANSI/ISA 5.5-1985, Graphic Symbols for Process Displays.

.2 American National Standards Institute (ANSI)/ Institute of Electrical and Electronics Engineers (IEEE).

.1 ANSI/IEEE 260.1-1993, American National Standard Letter Symbols Units of Measurement (SI Units, Customary Inch-Pound Units, and Certain Other Units).

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

.1 ASHRAE STD 135-R2001, BACNET - Data Communication Protocol for Building Automation and Control Network.

.4 Canadian Standards Association (CSA International).

.1 CAN/CSA-Z234.1-89(R1995), Canadian Metric Practice Guide.

.5 Consumer Electronics Association (CEA).

.1 CEA-709.1-B-2002, Control Network Protocol Specification.

.6 Department of Justice Canada (Jus).

.1 Canadian Environmental Assessment Act (CEAA), 1995, c. 37.

.2 Canadian Environmental Protection Act (CEPA), 1999, c. 33.

.7 Electrical and Electronic Manufacturers Association (EEMAC).

.1 EEMAC 2Y-1-1958, Light Gray Colour for Indoor Switch Gear.

.8 Health Canada/Workplace Hazardous Materials Information System (WHMIS).

.1 Material Safety Data Sheets (MSDS).

.9 Transport Canada (TC).

.1 Transportation of Dangerous Goods Act (TDGA), 1992, c. 34.

1.3 ACRONYMS AND ABBREVIATIONS

.1 Acronyms used in EMCS:

.1 AEL - Average Effectiveness Level.
.2 AI - Analog Input.
.3 AIT - Agreement on International Trade.
.4 AO - Analog Output.
.5 BACnet - Building Automation and Control Network.
.6 BC(s) - Building Controller(s).
.7 BECC - Building Environmental Control Center.
.8 CAD - Computer Aided Design.
.9 CDL - Control Description Logic.
.10 CDS - Control Design Schematic.
.11 COSV - Change of State or Value.
.12 CPU - Central Processing Unit.
.13 DI - Digital Input.
.14 DO - Digital Output.
.15 DP - Differential Pressure.
.16 ECU - Equipment Control Unit.
.17 EMCS - Energy Monitoring and Control System.
.18 HVAC - Heating, Ventilation, Air Conditioning.
.19 IDE - Interface Device Equipment.
.20 I/O - Input/Output.
.21 ISA - Industry Standard Architecture.
.22 LAN - Local Area Network.
.23 LCU - Local Control Unit.
.24 MCU - Master Control Unit.
.25 NAFTA - North American Free Trade Agreement.
.26 NC - Normally Closed.
.27 NO - Normally Open.
.28 OS - Operating System.
.29 O&M - Operation and Maintenance.
.30 OWS - Operator Work Station.
.31 PC - Personal Computer.
.32 PCI - Peripheral Control Interface.
.33 PCMCIA - Personal Computer Micro-Card Interface Adapter.
.34 PID - Proportional, Integral and Derivative.
.35 RAM - Random Access Memory.

.36 SP - Static Pressure.

.37 ROM - Read Only Memory.

.38 TCU - Terminal Control Unit.

.39 USB - Universal Serial Bus.

.40 UPS - Uninterruptible Power Supply.

.41 VAV - Variable Air Volume.

1.4 DEFINITIONS

.1 Point: may be logical or physical.

.1 Logical points: values calculated by system such as setpoints, totals, counts, derived corrections and may include, but not limited to result of and statements in CDL's.

.2 Physical points: inputs or outputs which have hardware wired to controllers which are measuring physical properties, or providing status conditions of contacts or relays which provide interaction with related equipment (stop, start) and valve or damper actuators.

.2 Point Name: The Andover™ system utilizes an **[Area/System/Point]** naming convention. To maximize the potential of the Continuum software it is essential to maintain a standard point naming convention.

.1 Master Control Unit Names **[Area]**: Naming the **Area** is the first name to consider. This name should be simple and reflective of the area in which this MCU shall be controlling.

Example:	M50MAST/xxx/xxx	(Montreal Road Campus Building M50 Master)
	M36BCX1/xxx/xxx	(Montreal Road Campus Building M36 BACnet Master/Router)

.2 LCU's, ECU's,TCU's, IOU Modules Names **[System]**: Naming the **System** controller is the second name to consider. This name should reflect the building in which it is located and the primary equipment this controller is controlling. As much as is possible, the NRC Equipment name is to be embedded into the code via the point naming convention.

Example:	XXX/AHU02/xxx	(Air Handling Unit 02)
	XXX/BLR01/xxx	(Boiler 01)
	XXX/MISC3/xxx	(Miscellaneous 3)
	XXX/Rm103/xxx	(Room 103)
	XXX/IOU1/xxx	(Input Output Module 1)

In the event that there are multiple pieces of equipment being controlled i.e.: 2 air handling units, the controller name shall follow the following standard.

Example:	XXX/AHU01_02/xxx	(Air Handling Units 01 and 02)

.3 Point Inputs/Outputs Names **[Point]**: The **Point** name is an abbreviation of the input/output function. Each type of equipment (chilled water system controllers, terminal unit controllers, etc.) has a standard list of input and output

abbreviations (see attached list). Again, as much as is possible, the NRC Equipment name is to be embedded into the code via the point naming convention.

E*xample:*	XXX/xxx/SFA	(Supply Fan Amperage)
	XXX/xxx/CCV	(Cooling Coil Valve)
	XXX/xxx/RMT	(Room Temperature)
	XXX/xxx/WTM01	(Water Meter)
	XXX/xxx/CHWST	(Chilled Water Supply Temperature)

In the event that there are multiple end devices on the same controller with the same function these would be first identified by the type of input/output followed by an underscore and an abbreviation of the location/description of the multiple type input.

Example:	XXX/xxx/RMT_102	(Room 102 Room Temperature)
	XXX/xxx/DCP01	(Domestic Circulating Pump 01)
	XXX/xxx/HCV2	(Heating Coil Valve Secondary)
	XXX/xxx/RM02_FLOOD	(Room 02 Flood Alarm)

.4 Numeric (virtual points) Names: The numeric should take on a similar naming standard as the point names. The numeric is a virtual point whose value is calculated by programs within the operator work station. The name for these virtual points should refer first to the point it is directly effecting followed by its function.

Example:	XXX/xxx/DATSp	(Discharge Air Temperature Setpoint)
	XXX/xxx/ RFS	(Return Fan Status)
	XXX/xxx/SFm	(Supply Fan Mode)

Other numeric's that do not involve points directly but programs shall be named for the function they server.

Example:	XXX/xxx/WINTER	(Winter Flag)
	XXX/xxx/SiteOAT	(Site Outside Air Temperature)
	XXX/xxx/CTL	(Pseudo System Control Value)

.5 Control Program Names:

Program names should be names in the same convention as Point and Numeric Names. The program name should first start with a description of its function followed by the point that the program controls.

Example:	XXX/xxx/CtlCCV	(Cooling Coil Valve Control)
	XXX/xxx/CtlMode	(Mode Control)
	XXX/xxx/VARCALC	(Variable Calculations)

.3 Point expansion : comprised of three fields, one for each descriptor. Expanded form of shortform or acronym used in "area", "system" and "point" descriptors is placed into appropriate point expansion field. Database must provide [32] [___] character field for each point expansion.

.4 Point Object Type: points fall into following object types:

.1 AI (analog input).

.2 AO (analog output).

.3 DI (digital input).

.4 DO (digital output).

.5 Symbols and engineering unit abbreviations utilized in displays: to ANSI/ISA S5.5.

.1 Printouts: to ANSI/IEEE 260.1.

.2 Refer also to Section 25 05 54- EMCS: Identification.

1.5 CONTRACTOR'S QUALIFICATIONS

.1 The EMCS controls systems contractor shall:

.1 Be an authorized distributor of the product lines listed in these specifications and on the drawings.

.2 Have at least five (5) years experience in the installation and maintenance of DDC control systems.

.3 Have in-house qualified technicians and tradesmen for the installation, maintenance and repair of systems.

.4 Have an office within 20 km of the project site and shall be able to offer emergency service 24 hrs/day, 365 days/year.

1.6 SYSTEM DESCRIPTION

.1 Refer to control schematics for system architecture.

.2 Work covered by sections referred to above consists of fully operational EMCS, including, but not limited to, following:

.1 Building Controllers.

.2 Control devices as listed in I/O point summary tables.

.3 OWS(s).

.4 Data communications equipment necessary to effect EMCS data transmission system.

.5 Field control devices.

.6 Software/Hardware complete with full documentation.

.7 Complete operating and maintenance manuals.

.8 Training of personnel.

.9 Acceptance tests, technical support during commissioning, full documentation.

.10 Electrical 120 volt power distribution and low voltage power wiring as required for controllers and devices.

.11 Wiring interface co-ordination of equipment supplied by others.

.12 Control air piping and tubing as required for controllers and devices.

.13 Miscellaneous work as specified in these sections and as indicated.

.3 Design Requirements:

.1 Design and provide conduit and wiring linking elements of system.

.2 Supply sufficient programmable controllers of types to meet project requirements. Quantity and points contents as reviewed by Departmental Representative prior to installation.

.3 Location of controllers as reviewed by Departmental Representative prior to installation.

.4 Provide utility power to EMCS as indicated.

.5 Imperial references: in accordance with CAN/CSA Z234.1.

.4 Language Operating Requirements:

.1 Provide English operator selectable access codes.

.2 Use non-linguistic symbols for displays on graphic terminals wherever possible. Other information to be in English.

.3 Operating system executive: provide primary hardware-to-software interface specified as part of hardware purchase with associated documentation to be in English.

.4 System manager software: include in English system definition point database, additions, deletions or modifications, control loop statements, use of high level programming languages, report generator utility and other OS utilities used for maintaining optimal operating efficiency.

.5 Include, in English:

.1 Input and output commands and messages from operator-initiated functions and field related changes and alarms as defined in CDL's or assigned limits (i.e. commands relating to day-to-day operating functions and not related to system modifications, additions, or logic re-definements).

.2 Graphic "display" functions, point commands to turn systems on or off, manually override automatic control of specified hardware points. To be in English at specified OWS and to be able to operate one terminal in English and second in French. Point name expansions in both languages.

.3 Reporting function such as trend log, trend graphics, alarm report logs, energy report logs, maintenance generated logs.

1.7 SUBMITTALS

.1 Make submittals in accordance with Section 01 33 00 - Submittal Procedures and 25 05 02 - EMCS: Shop Drawings, Product Data and Review Process.

.2 Submit for review:

.1 Equipment list and systems manufacturers within 10 days after award of contract.

.3 Quality Control:

.1 Provide equipment and material from manufacturer's regular production, CSA certified, manufactured to standard quoted plus additional specified requirements.

.2 Where CSA certified equipment is not available submit such equipment to inspection authorities for special inspection and approval before delivery to site.

.3 Submit proof of compliance to specified standards with shop drawings and product data in accordance with Section 25 05 02 - EMCS: Shop Drawings, Product Data and Review Process. Label or listing of specified organization is acceptable evidence.

.4 In lieu of such evidence, submit certificate from testing organization, approved by Departmental Representative, certifying that item was tested in accordance with their test methods and that item conforms to their standard/code.

.5 For materials whose compliance with organizational standards/codes/specifications is not regulated by organization using its own listing or label as proof of compliance, furnish certificate stating that material complies with applicable referenced standard or specification.

.6 Permits and fees: in accordance with general conditions of contract.

.7 Submit certificate of acceptance from authority having jurisdiction to Departmental Representative

.8 Existing devices intended for re-use: submit test report.

1.8 QUALITY ASSURANCE

.1 Have local office within 20km of project, staffed by trained personnel capable of providing instruction, routine maintenance and emergency service on systems,

.2 Provide record of successful previous installations submitting tender showing experience with similar installations utilizing computer-based systems.

.3 Have access to local supplies of essential parts and provide 7 year guarantee of availability of spare parts after obsolescence.

.4 Ensure qualified supervisory personnel continuously direct and monitor Work and attend site meetings.

.5 Health and Safety:

.1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

1.9 DELIVERY, STORAGE AND HANDLING

.1 Material Delivery Schedule: provide Departmental Representative with schedule within 2 weeks after award of Contract.

.2 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.

.2 Remove from site and dispose of packaging materials at appropriate recycling facilities.

.3 Place materials defined as hazardous or toxic in designated containers.

.4 Handle and dispose of hazardous materials in accordance with Regional and Municipal regulations.

.5 Ensure emptied containers are sealed and stored safely.

1.10 EXISTING CONDITIONS - CONTROL COMPONENTS

.1 Utilize existing control wiring and piping as indicated.

.2 Re-use field control devices that are usable in their original configuration provided that they conform to applicable codes, standards specifications.

.1 Do not modify original design of existing devices without written permission from Departmental Representative.

.2 Provide for new, properly designed device where re-usability of components is uncertain.

.3 Inspect and test existing devices intended for re-use within 30 days of award of contract, and prior to installation of new devices.

.1 Furnish test report within 40 days of award of contract listing each component to be re-used and indicating whether it is in good order or requires repair by Departmental Representative.

.2 Failure to produce test report will constitute acceptance of existing devices by contractor.

.4 Non-functioning items:

.1 Provide with report specification sheets or written functional requirements to support findings.

.2 Departmental Representative will repair or replace existing items judged defective yet deemed necessary for EMCS.

.5 Submit written request for permission to disconnect controls and to obtain equipment downtime before proceeding with Work.

.6 Assume responsibility for controls to be incorporated into EMCS after written receipt of approval from Departmental Representative.

.1 Be responsible for items repaired or replaced by Departmental Representative.

.2 Be responsible for repair costs due to negligence or abuse of equipment.

.3 Responsibility for existing devices terminates upon final acceptance of EMCS applicable portions of EMCS as approved by Departmental Representative.

.7 Remove existing controls, conduit, wiring and pneumatic tubing (poly or copper) not re-used or not required. Place in approved storage for disposition as directed.

Part 2 Products

2.1 SUSTAINABLE REQUIREMENTS

.1 [___].

2.2 EQUIPMENT

.1 Control Network Protocol and Data Communication Protocol: to CEA 709.1 or ASHRAE STD 135.

.2 Complete list of equipment and materials to be used on project and forming part of tender documents by adding manufacturer's name, model number and details of materials, and submit for approval.

Part 3 Execution

3.1 MANUFACTURER'S RECOMMENDATIONS

.1 Installation: to manufacturer's recommendations.

3.2 ELECTRICAL POWER AND CONTROL WIRING

.1 Provide 120 volt electrical power and low voltage control wiring to controllers and devices in accordance with specification sections 260521 and 260534, and coordinate work with the main electrical contractor.

3.3 CONTROL AIR PIPING AND TUBING

.1 Use type “L” air copper pipe with silver brazed joints in the following locations:

.1 In mechanical rooms.

.2 -Areas of ambient temperature above 80C.

.3 In fire rated walls and ceilings.

.4 Areas where piping may be subject to damage.

.5 In other locations polyethylene plastic tubing with barbed type fittings is acceptable.

3.4 PAINTING

.1 Painting: in accordance with Section 09 91 23 - Interior Painting, supplemented as follows:

.1 Clean and touch up marred or scratched surfaces of factory finished equipment to match original finish.

.2 Restore to new condition, finished surfaces too extensively damaged to be primed and touched up to make good.

.3 Clean and prime exposed hangers, racks, fastenings, and other support components to match existing building standards.

.4 Paint unfinished equipment installed indoors to EEMAC 2Y-1.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes.

.1 Methods and procedures for shop drawings submittals, preliminary and detailed review process including review meetings, for building Energy Monitoring and Control System (EMCS).

.2 Related Sections. EMCS:

.1 Section 01 33 00 - Submittal Procedures.

.2 Section 25 05 00 - Common Work for Building Automation.

.3 Section 25 01 11 - EMCS: Start-up, Verification and Commissioning.

1.2 DEFINITIONS

.1 Acronyms and definitions: refer to Section 25 05 01 - EMCS: General Requirements.

1.3 SUBMITTALS

.1 Submittals in accordance with Section 01 33 00 - Submittal Procedures and coordinate with requirements in this Section.

.2 Submit shop drawing documents within 45 working days after contract award, for review by Departmental Representative.

.3 Shop Drawings to consist of 1 soft copy of design documents, shop drawings, product data and software.

.4 Soft copy to be in PDF format, structured using menu format for easy loading and retrieval on OWS.

1.4 SHOP DRAWING REVIEW

.1 Shop drawings to include the following.

.1 Location of local office.

.2 Names of project manager and project engineer.

.3 Item-by-item statement of compliance.

.4 Proof of demonstrated ability of system to communicate utilizing Proprietary Communications Protocol (Andover Infinet).

.5 Detailed system architecture showing all points associated with each controller identifying the following:

.1 Controller locations.

.2 Auxiliary control cabinet locations.

.6 Points list to include the following item:

.1 Input output termination location

.2 Input output type

.3 Point name see Section 250501 for NRC point naming convention

.4 Point description

.5 Point revision

.6 Product part number

.7 Product wiring details

.7 System Schematic Diagrams and Sequence of Events detailing the following but not limited to:

.1 Display of [air] [and] [water] systems with point identifiers, textual description of system, [electrical ladder diagrams], [areas served] [location of equipment] as specified.

.2 Narrative descriptions of each automatic and manual procedure required to achieve proper operation of the mechanical equipment associated with this project, including the proceedures used during the complete failure of EMCS.

.1 List of time of day schedules.

.8 Equipment Schedule

.1 Valves: complete schedule listing including following information: designation, service, manufacturer, model, design flow rate, design pressure drop, Valve size, actual Cv, spring range, pilot range and close off pressure (actual).

.2 Dampers: interconnecting hardware, operator locations, operator spring range, pilot range, actual torque.

.3 Flow measuring stations: complete schedule listing designation, service, manufacturer, model, size, velocity at design flow rate, manufacturer.

.9 Specification sheets to include:

.1 Manufacturer's descriptive literature, manufacturer's installation recommendations, specifications, drawings, diagrams, performance and characteristic curves, catalogue cuts, manufacturer's name, trade name, catalogue or model number, nameplate data, size, layout, dimensions, capacity, other data to establish compliance.

.10 Interface wiring diagrams showing termination connections and signal levels,for equipment to be supplied by others.

.11 Outline of proposed start-up and verification procedures. Refer to Section 25 01 11 - EMCS: Start-up, Verification and Commissioning.

1.5 QUALITY ASSURANCE

.1 Shop Drawing Review Meeting: Participate in meeting within 10 working days of receipt of reviewed shop drawings. Meeting to be convened by NRC:

.1 Undertake functional review of shop drawing documents, resolve inconsistencies.

.2 Resolve conflicts between contract document requirements and actual items (e.g.: points list inconsistencies).

.3 Review interface requirements of materials supplied by others.

.4 Review "Sequence of Operations".

.2 Departmental Representative retains right to revise sequence or subsequent CDL prior to software finalization without cost to Departmental Representative.

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. EMCS:

.1 Requirements and procedures for warranty and activities during warranty period and service contracts, for building Energy Monitoring and Control System (EMCS).

.2 Related Sections.

.1 Section 01 33 00 - Submittal Procedures.

.2 Section 01 78 00 - Closeout Submittals.

.3 Section 25 05 00 - Common Work for Building Automation.

.3 References.

.1 Canada Labour Code (R.S. 1985, c. L-2)/Part I - Industrial Relations.

.2 Canadian Standards Association (CSA International).

.1 CSA Z204-94(R1999), Guidelines for Managing Indoor Air Quality in Office Buildings.

1.2 DEFINITIONS

.1 For acronyms and definitions refer to Section 25 05 01 - EMCS: General Requirements.

1.3 SUBMITTALS

.1 Not Used.

.1 Not Used.

1.4 MAINTENANCE SERVICE DURING WARRANTY PERIOD

.1 Provide services, materials, and equipment to maintain EMCS for specified warranty period. Provide detailed preventative maintenance schedule for system components as described in Submittal article.

.2 Emergency Service Calls:

.1 Initiate service calls when EMCS is not functioning correctly.

.2 Qualified control personnel to be available during warranty period to provide service to "CRITICAL" components whenever required at no extra cost.

.3 Furnish Departmental Representative with telephone number where service personnel may be reached at any time.

.4 Service personnel to be on site ready to service EMCS within 2 hours after receiving request for service.

.5 Perform Work continuously until EMCS restored to reliable operating condition.

.3 Work requests: record each service call request, when received separately on approved form and include:

.1 Serial number identifying component involved.
.2 Location, date and time call received.
.3 Nature of trouble.
.4 Names of personnel assigned.
.5 Instructions of work to be done.
.6 Amount and nature of materials used.
.7 Time and date work started.
.8 Time and date of completion.

1.5 SERVICE CONTRACTS

.1 Provide in-depth technical expertise and assistance to Departmental Representative in preparation and implementation of service contracts and in-house preventive maintenance procedures.

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 System requirements for Local Area Network (LAN) for Building Energy Monitoring and Control System (EMCS).

.2 Related Sections:

.1 Section 25 05 00 - Common Work for Building Automation.

1.2 REFERENCES

.1 Canadian Standards Association (CSA International).

.1 CSA T529-95(R2000), Telecommunications Cabling Systems in Commercial Buildings (Adopted ANSI/TIA/EIA-568-A with modifications).

.2 CSA T530-99(R2004), Commercial Building Standard for Telecommunications Pathways and Spaces (Adopted ANSI/TIA/EIA-569-A with modifications).

.2 Institute of Electrical and Electronics Engineers (IEEE)/Standard for Information technology - Telecommunications and information exchange between systems - Local and metropolitan area networks - Specific requirements.

.1 IEEE Std 802.3™-2002, Part 3: Carrier sense multiple access with collision detection (CSMA/CD) access method and physical layer specifications.

.3 Telecommunications Industries Association (TIA)/Electronic Industries Alliance (EIA)

.1 TIA/EIA-568-March 2004, Commercial Building Telecommunications Cabling Standards Set, Part 1 General Requirements Part 2 Balanced Twisted-Pair Cabling Components Part 3 Optical Fiber Cabling Components Standard.

.2 TIA/EIA-569-A-December 2001, Commercial Building Standard for Telecommunications Pathways and Spaces.

.4 Treasury Board Information Technology Standard (TBITS).

.1 TBITS 6.9-2000, Profile for the Telecommunications Wiring System in Government Owned and Leased Buildings - Technical Specifications.

1.3 DEFINITIONS

.1 Acronyms and definitions: refer to Section 25 05 01 - EMCS - General Requirements.

1.4 SYSTEM DESCRIPTION

.1 Data communication network to link Operator Workstations and Master Control Units (MCU) in accordance with CSA T529 and CSA T530 and TBITS 6.9.

.1 Provide reliable and secure connectivity of adequate performance between different sections (segments) of network.

.2 Allow for future expansion of network, with selection of networking technology and communication protocols.

.2 Data communication network to include, but not limited to:

.1 EMCS-LAN.

.2 Network interface cards.

.3 Network management hardware and software.

.4 Network components necessary for complete network.

1.5 DESIGN REQUIREMENTS

.1 EMCS Local Area Network (EMCS-LAN).

.1 High speed, high performance, local area network over which MCUs and OWSs communicate with each other directly on peer to peer basis in accordance with IEEE 802.3/Ethernet Standard.

.2 Each EMCS-LAN to be capable of supporting at least 254 devices.

.3 Support of combination of MCUs and OWSs directly connected to EMCS-LAN.

.4 High speed data transfer rates for alarm reporting, quick report generation from multiple controllers, upload/download information between network devices. Bit rate to be 10 Megabits per second minimum.

.5 Detection and accommodation of single or multiple failures of either OWSs, MCUs or network media. Operational equipment to continue to perform designated functions effectively in event of single or multiple failures.

.6 Commonly available, multiple sourced, networking components and protocols to allow system to co-exist with other networking applications including office automation.

.2 Dynamic Data Access.

.1 LAN to provide capabilities for OWSs, either network resident or connected remotely, to access point status and application report data or execute control functions for other devices via LAN.

.2 Access to data to be based upon logical identification of building equipment.

.3 Network Medium.

.1 Network medium: CAT5 Cable or fibre optic cable compatible with network protocol to be used within buildings. [Fibre optic cable to be used between buildings.

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 Hardware and software requirements for an Operator Work Station (OWS) in a Building Energy Monitoring and Control System (EMCS), including primary, secondary, portable and remote OWS's. Labour, products, equipment and services necessary to complete the work of this Section.

.2 The BAS system is to be divided into two separate architectures, one with and one without a local front end.

.1 Those systems designated for general Building Services HVAC system applications and that support laboratory / research functional programs will NOT require a local work station end but rather be interconnected with the NRC campus wide network. These shall include Zones 20, 27 and 28.

.2 Those systems that are dedicated to process and laboratory / research functional programs will require a local front end that will be housed in the Flight Simulator Observation Room 26. These shall include all remaining Zones.

.3 Refer to the Points list tabulated in Section 25 95 00_01 for details.

.1 Related Sections:

.1 Section 25 05 00 – Common Work For Building Automation

.2 Section 25 05 01 - EMCS: General Requirements.

.3 Section 25 05 02 - EMCS: Shop Drawings, Product Data and Review Process.

.4 Section 25 05 03 - EMCS: Project Record Documents.

.5 Section 25 30 01 - EMCS: Building Controllers.

.6 Section 25 90 01 - EMCS: Site Requirements, Applications and Systems Sequences of Operation.

.7 Section 25 95 00 - Bldg Automation Control Sequences

1.2 DEFINITIONS

.1 BCU: Building Controller Unit

.2 ECU: Equipment Controller Unit

.3 PWS: Portable Work Station

.4 PC: commercially available Personal Computer

.5 OWS: Operator Work Station

PART - 2 PRODUCTS

2.1 OWS

.1 General

.1 Real time, ULC listed digital personnel computer.

.2 Acceptable Manufacturers

.1 Dell

.2 Hewlett Packard

.3 IBM

.2 PC Hardware

Chassis	3.6 GHz, XEON/533 Mini Tower
Connections	PS/2 – keyboard
	USB – mouse
	USB x 4 Rear
	USB x 1 Front
	8 x RS422
	2 x RS232
Processor	3.60 GHz 4th generation Intel® Core™ i7-4790
Hard Drive	1.0 TB, IDE (ATA_100), 1 inch, 7200 RPM, Precision
Memory	8 GB, Double Data Rate SDRAM, ECC, 2x512
Video	ATI, Fire GL Z1, 128 MB, 1-2 VGA/DVI, Graphics Card
CD Rom	16X DVD-ROM and 48X CDRW with Roxio and DVD Decode
Base Service	Next Business Day, On-Site Parts and Labour Service, 3 Years
Operating System	Windows 7, NTFS with Media
Accessories	700 VA Intelligent Line Inter
Monitor	19 Inch SVGA (17.90 inch Viewable Image Size), Energy Star compliant
Keyboard	Entry Level, PS/2, No Hot Keys
Mouse	Logitech, 2-button, with scroll, USB, Optical

.1 Laser Printer

.1 Black and White laser printer

.2 Printing of reports, graphics and trend logs

.3 600x300 dpi black text resolution on plain paper

.4 Replaceable print cartridges

.5 True type scalable fonts

.3 OWS Furniture

.1 Provide the following commercial grade computer desk furniture.

.1 Commercial grade computer furniture.

.2 Desk: suitably sized to hold the monitor, 1 printer beneath desk, underdesk support for CPU (CPU not to sit on the floor).

.3 Pull out keyboard tray with side space for mouse and mouse pad.

.4 Five roller leg office chair, padded seat and back support, adjustable height arm rests.

2.2 OPERATOR WORKSTATION - SOFTWARE

.1 General

.1 Data base

.1 Manages all data on an integrated, non-redundant basis.

.2 Allows additions and deletions to the data base without any detriment to existing data.

.3 Provides cross linkages such that no data that is required by a software program may be deleted by the operator.

.2 Error reporting

.1 Report execution and operating system errors to the dedicated programmer's terminal via an error message.

.2 Display error messages on the programmer's terminal and stored in a disk file.

.3 Store operator error acknowledgement in a disk file.

.4 Print the error file on demand based on date range, at any printer designated by the programmer.

.5 Error messages: full readable English and French.

.3 Error restart

.1 Automatic restart after an error occurs that halts operation, unless otherwise specified in the Sequence of Operation.

.2 During the restart procedure, store the contents of RAM memory in a disk file.

.3 Make this data available to be printed and analyzed to determine cause of failure.

.4 The OWS will return to full operation after restart.

.2 System Access

.1 Sign-on procedure:

.1 Masked system password

.2 Operator initials

.3 A unique 8 character (maximum), masked operator password.

.2 Sign-on action:

.1 Display a "signed-on" message containing the initials of the operator on pre-determined terminals.

.2 Print a "signed-on" message containing the initials of the operator on pre-

determined printers.

.3 Store the operator's initials and sign-on time in the event driven database.

.3 Unsuccessful sign-on attempts:

.1 Alarm and record unsuccessful sign-on attempts.

.2 Record the details of the sign-on attempt in the event driven database.

.3 Record the failed attempt after the third incorrect sign-on attempt.

.4 Provide a software mechanism to control operator access to various commands and to control access to specific points within commands.

.3 Automatic Sign-off

.1 Automatically sign-off colour graphic or monochromatic terminals on the BMS after a field-programmable period of no keyboard activity.

.1 Adjustable sign-off period from one minute to one day in one minute increments.

.2 Sign-off action:

.1 Display a "signed-off" message containing the initials of the operator on pre-determined terminals.

.2 Print a "signed-off" message containing the initials of the operator on pre-determined printers.

.3 Store the operator's initials and sign-off time in the event driven database.

.4 Operators Interface (OIS)

.1 Functions:

.1 Interactive operator interface

.2 Colour graphics

.3 Bar charts and curve plots

.4 Summary reports

.5 User definable reports and system security.

.2 OIS operates under human machine interface software control to provide self-prompting "top down" means of system penetration.

.1 Pop-up or pull-down menu driven at all levels initiates next step instructions.

.2 Functional grouping of system access menus:

.1 System

.2 Equipment

.3 Building

.4 Floor

.3 On-line Data Base Generator:

.1 Accomplish data file entry, application program modifications, group and point assignments, graphics generation and device assignments.

.2 Able to change programs or application package parameters, or modify points without interfering with HVAC control functions being performed by the BMS.

.3 Process and annunciate alarms, and execute control programs during all keyboard program modes.

.4 Command Functions:

.1 System security

.1 Sign on a terminal

.2 Sign off a terminal

.3 Reconfigure terminal to background console or operator console

.4 Set system and operator security parameters

.5 Set command security parameters

.6 Set point security parameters

.2 Point Information

.1 Point create/modify/read

.2 Point engineering unit read/modify

.3 System menu penetration create/modify

.4 Point display/command

.3 Historical Logging

.1 Historical capture parameters definition

.2 Historical report generation on captured data

.4 Report Initiation

.1 Alarm report

.2 All point report

.3 Status and Summary Report

.4 Trend Report

.5 Operator table report

.6 Event driven data base report

.5 Colour Graphics

.1 Graphic create/modify/delete

.2 Graphic for last Change of State (COS) point

.3 Graphic on for point

.4 Graphic index

.5 Graphic off

.6 Graphic on

.6 Change of State Message Text

.1 Alarm and trouble display/modify/create

.7 Historical Report (Curve Plot/Bar Chart)

.1 Historical report assignments

.2 Curve plot/bar chart display

.8 Report Scheduling

.1 Time scheduler (based on frequency and time)

.9 Peripheral Devices

.1 Segregation/name/descriptor of devices in system

.10 Help Command

.1 Summarize available operator command functions

.11 Time Synchronize

.1 Set OWS and field panel time, and synchronize their operation

.12 Communications

.1 Status/enable/disable communications from OWS to field panels.

.13 Time & Event

.1 Initiator create/modify/read/initiated programs delete

.2 Time/event program create/modify/read/delete

.5 Error/Problem Messages

.1 Inform operators of all types of errors and problems with comprehensive error messages:

.1 Operator input error messages

.2 Data transmission error messages

.3 Device failure messages

.4 Software failure messages

.6 Point Access

.1 Limit each operator access to specific points (see Access Control Section).

.2 Operator override (subject to access control):

.1 Command digital output and pseudo points.

.2 Manually command point normally under BCU/ECU software control, and to subsequently return to software control.

.3 Command analog output and pseudo points.

.4 Manually command analog point normally under DCU/ECU software control, and to subsequently return the point to software control.

.5 Command analog or digital output point on a graphic while viewing the graphic.

.1 Dynamically update the point's status on the graphic.

.2 Able to command points that are not displayed on the graphic that is being viewed.

.3 Operator to access points by using:

.1 Keyname of up to l2 characters.

.2 A numerical system point address.

.3 By using menu penetration.

.4 Logical Groups and Menu Penetration

.1 Generate software groupings of all system points.

.2 The logical grouping will allow points in different field panels to appear in logs and CRT displays.

.3 Points able to appear in a minimum of four logical software groups.

.4 Each logical group: minimum of 30 points.

.5 Create or modify any point keyname, logical group, or the menu penetration scheme, through any workstation.

.7 Access Control

.1 Provide software to control operator access to various commands and to control access to specific points within commands.

.2 Command Access Groups:

.1 Minimum of fifteen possible command access groups.

.2 Operator to easily assign any command to any, all or none of these groups.

.3 Operator to easily assign any operator to any, all or none of these groups.

.3 Operator Command Access:

.1 Only if there is at least one match between the command access groups of an operator and the command access groups of a command.

.2 Make visible only the commands to which an operator has access.

.4 Point Access Groups:

.1 Minimum of sixteen possible point access groups.

.2 Operator to easily assign any point to any, all or none of these groups.

.3 Operator to easily assign any operator to any, all or none of these groups.

.5 Operator Point Access:

.1 Only if there is at least one match between the point access groups of an operator and the respective point access groups of a point.

.2 Make visible only the system points to which the operator has access.

.8 Change of State Alarm (COS) Handling

.1 Queue COS conditions at the OWS and processed in a predetermined priority basis.

.1 Present COS conditions in the form of formatted COS messages.

.2 COS Reporting:

.1 Highest Priority: Point COS messages due to a device transmission failure.

.2 Point COS priority levels:

.1 Alarm

.2 Trouble

.3 No response

.4 Command failed

.5 Return to normal

.3 COS Reporting Levels:

.1 Minimum of 8 levels.

.2 Level 0 does not report a COS alarm; level 7 has highest priority

.4 COS Message Displays and History Storage:

.1 A dedicated area on OWS monitor allocated for change of state displays.

.2 COS message contents:

.1 Point name

.2 Point descriptor

.3 Engineering unit and value

.4 Time of change of state occurrence

.5 System descriptor

.6 Graphic number associated with the point

.7 Alarm or trouble message

.3 COS system capacity: 999

.4 COS message length: 236 characters (3 lines)

.5 Display the most recent highest priority unacknowledged COS message.

.6 Only retain the latest data received from a point that produces multiple alarms in the prioritized queue for display.

.7 Print all alarms as they occur.

.8 Do not acknowledge an alarm from a terminal that is not signed on by an operator

.5 Print to file COS Conditions including as follows:

.1 Alarm conditions for all types of points.

.2 Return-to-normal condition for all alarms

.3 Trouble conditions to fire points

.4 Acknowledgement of alarm and trouble conditions

.5 No responses, including power failure of field panels

.6 Uniquely identify COS alarm printouts.

.7 Acknowledgement and return-to-normal printouts:

.1 Time of restoration or acknowledgement

.2 The condition of the point

.3 Initials of operator acknowledging the condition

.8 Store data in the event driven database for recall by the operator.

.9 Separate message facility for fire trouble conditions.

.1 Allow for the same point to have two independent action taking instructions, one each for fire alarm and fire trouble conditions.

.10 Generate an audible alarm as well as visual annunciation.

.1 Definable audible type.

.9 Segregation

.1 Twelve unique segregation groups in the system.

.1 Any point in the system can belong to any, all or none of these groups.

.2 Any specific COS message can also belong to any, all, or none of these groups.

.3 Monitor any subset of the twelve segregation groups from any operators terminal.

.2 COS

.1 Display the point only at those terminals which have at least one segregation group assignment in common with the point and the type of COS.

.10 Databases

.1 Time Driven Database

.1 Able to sample analog physical and analog pseudo points.

.2 Sampling interval: adjustable between l minute and 60 minutes.

.3 Analog point sample time span: adjustable.

.4 Time spans:

.1 1 to 24 hours

.2 1 to 365 days

.3 1 to 5 years

.5 Continue sampling the analog point values (recycling data) at the end of the time period, or stop sampling the analog point values.

.1 Operator selectable.

.2 Event Drive Database

.1 Store in the event driven database the following items.

.1 Change of state activity including alarms and returns-to-normal.

.2 Operator signs-on and operator signs-off with time, location and operator's initials.

.3 Invalid sign-on attempts.

.4 Manual commands issued by any operator including the point keyname and the initials of the operator.

.5 Acknowledgment of alarms, including point's keyname, time of acknowledgment and initials of the operator.

.6 Definable number of transactions stored in the event driven database. Provide a counter which shall indicate the current number of transactions stored in the event driven database. Up to 999,999 transactions may be stored online.

.11 Data Archiving

.1 Archive events stored in the event driven database onto a secondary storage device such as a floppy disk, hard disk and CD Writer unit. Password protected Operator features include:

.1 Ability to schedule the data archiving task in the scheduler.

.2 Initiate a new data archiving task

.3 Suspend current data archiving

.4 Resume current data archiving

.5 Terminate current data archiving

.2 When the data archiving process is activated and the data archiving volume is not mounted, generate a COS message.

.1 COS message requests the operator to mount the volume.

.3 If during a data archiving session, the current data archiving volume becomes full, then automatically terminate the session and generate a COS message.

.1 COS message informs the operator that the volume is full.

.12 Dynamic Colour Graphics

.1 Provided as interactive icon based software to permit operator to create, modify, delete, file and recall graphics.

.1 System colour graphics easily developed via the mouse and keyboard using a number of interactive construction programs

.2 Library of standard symbols representing devices such as coils, smoke detectors, temperature sensors, thermals, contacts, speakers, watch tour stations, pumps, fans, dampers, motors, relays among others.

.3 Graphic construct program places the desired line drawings or symbols in the appropriate place on the screen, assign point type, colours, and text.

.4 Diagnostic dynamic testing of diagrams for accuracy and validity.

.2 Create graphics to describe systems as outlined in Operating Sequences and shown in I/O summary.

.3 Colour graphics: dynamic updating of dispersed real-time data.

.4 General:

.1 Minimum storage: 10,000 graphics, each including up to 200 freely assigned points.

.2 Point information: displayed in point windows.

.3 Graphic point capacity: up to 80 point windows and up to 200 points.

.5 Point window types:

.1 Single point window: constantly display point information for a single point on the graphic.

.2 Common point window: report alarms for up to 80 points. If any point represented in the window goes into alarm, indicate the alarm in the common window.

.3 Blind or hidden point window: display point information for a single point only when the point goes into alarm.

.6 Display graphics by:

.1 Entering the graphic number

.2 Entering the keyname of any point in the graphic

.3 Entering a command that displays the graphic of the point that last underwent a COS.

.7 Select systems/equipment graphics to be displayed by the following means:

Written description list of system names

.1 Operator entered physical label code

.2 Building location, using building floor plan CAD files

.3 Digital photos of mechanical / electrical rooms

.4 Terminal box / occupant data base, based on search by occupant name or room number.

.8 Operator commandable points on the graphic while viewing the graphic.

.9 Operator commandable points which are not displayed on the graphic that is being viewed.

.13 Curve Plot/Bar Chart

.1 Capability to display curve plots and bar charts using information stored in the time driven database.

.1 Display these curve plots and bar charts on any workstation.

.2 General

.1 Create up to 90 different curve plots.

.2 Display a minimum of 6 points on the same curve plot or bar chart. Highlight the six curves/bars in different colours.

.3 Display the minimum, maximum, average or actual variable values, over the specified sampling period and time window of the data capture.

.4 Display up to two y-axis on each curve plot/bar chart. Printer controllable y-axis and x-axis scales.

.5 Able to print the curve plot/bar chart to the colour printer

.6 Able to print the numerical values and point keynames of the points used in a curve plot or bar chart to the alarm or log printers.

.3 Three types of curve plots:

.1 Dot pattern

.2 Linear pattern

.3 Step pattern

.14 Dynamic Curve Plots/Bar Charts

.1 Capability to display dynamic trends of analog or digital point values on a curve plot or bar chart.

.1 Display these curve plots and bar charts on any workstation.

.2 General

.1 No limit on the number of plots that can be constructed.

.2 Capable of dynamically trending a minimum of 6 points on the same curve plot or bar chart with a minimum sample interval of 6 seconds.

.3 Operator control over the type of plot that is dynamically constructed.

.1 A linear plot

.2 Step plot

.3 Bar chart

.4 Display up to four reference lines on a curve plot or bar chart. The reference lines could be used for target or reference values.

.5 Capable of displaying either one or two y-axis on a curve plot or bar chart.

.6 Display up to 2 independent dynamic curve plots on one screen.

.7 Selectable different characteristics for each plot/bar chart.

.8 Able to print the curve plot/bar chart to the colour printer.

.15 Reports and Logs

.1 Operator selectable report generator.

.1 Custom formatted reports

.2 Selectable printer designation

.3 User-supplied report identifier (1 to 6 characters) and report title (60 characters minimum).

.2 Initiate report by:

.1 Manual command.

.2 A change of state.

.3 Return to normal.

.4 Alarm.

.5 Alarm return to normal.

.6 Schedule at specified time(s)/date(s).

.7 Schedule at specified time intervals.

.3 Standard reports available:

.1 Event driven data report

.2 Archived data report

.3 Historical report

.4 Summary report

.5 All Point log report

.6 Trend report

.7 Operator report

.8 Command Information report

.4 Operator point access:

.1 Restrict an operator from viewing points in a report unless the operator has the appropriate point access levels. This restriction is on a point by point basis.

.5 Extract data in the form of reports and include:

Report Type	Event Driven Database Report	Archived Data Report	Summary Report	All Point Log Report
User Defined Report Title	√	√	√	√
Event dates and times	√	√		
Point keynames	√	√	√	√
COS descriptors	√	√		
Engineering units	√	√	√	√
Point status			√	√
Point current value			√	√
Point descriptors			√	√

.6 Provide parameter selection filters:

.1 Key names of points

.2 Types of events (e.g. alarm, high alarm, low alarm, no response, etc)

.3 Engineering units such as Celsius, kilowatt, degrees, etc.

.4 Time windows, i.e., start date and time and end date and time.

.7 Historical Report (time driven database)

.1 Produce a list of the numerical values and the point keynames of the points stored in the time driven database.

.8 Summary Report and All Point Log Reports

.1 Alarm summary report: list points that are currently still in alarm.

.2 Operator selectable points that will be checked for alarms using any of the following methods:

.1 By selecting any logical group of points

.2 By selecting any branch of the menu penetration scheme. A branch may contain many logical groups

.3 By manually selecting up to 30 points

.9 Trend Report

.1 Trend the values of one to thirty points.

.2 Operator selects whether to print the values of the points at each trend interval or defer the printing of the report until all the data has been collected.

.1 Able to select up to 30 different points to be trended.

.2 Able to select any trend interval from two minutes to years.

.3 Provide multiple trend reports; trend report able to run concurrently.

.10 Operator Report

.1 Display a report of all operators assigned to the BMS. Include:

.1 Operator's initials

.2 Four-character operator ID

.3 Access level assignments.

.4 Ability to modify any of these parameters on-line.

.2 Assignable level of security so that only authorized personnel may access and run the report.

.11 Command Information Report

.1 Produce an alphabetical summary of all system commands including a brief description.

.2 All the command mnemonics and descriptors: on-line modifiable by any operator with proper authorization.

.3 Only display the commands that the operator is authorized to use.

.12 Comprehensive Report Scheduler

.1 Any report that has been previously formatted must be assignable to the comprehensive report scheduler. Operator selectable output schedule:

.1 Predetermined calendar time

.2 Predetermined time interval

.2 At any time, the operator must be able to view the queue of reports submitted to comprehensive report scheduler to determine:

.1 The current status of a report (i.e. executing or awaiting execution).

.2 Next time of execution of a report.

.3 Remaining number of executions for a report.

.4 The type of scheduling for a report.

.3 Cancel report: operator able to cancel any outstanding scheduled report at any time.

.16 Time and Event Initiated Programs

.1 Initiator (alarms, point transitions, etc.) activates any global or local TEIP (transferring of data, commanding points etc.). Initiators:

.1 A manual command

.2 A time schedule

.3 Point events such as

.1 Alarms

.2 Return to normal

.3 Value exceeding or falling below predefined limits

.4 Transition from any status to any other status.

.2 Each initiator can activate up to 10 TEIP's.

.3 TEIP functions:

.1 Transferring of data between devices

.2 Transferring of data between any two subsystems (e.g., EMC to DCP)

.3 Commanding any digital analog or pseudo point

.4 Initiating the printing or displaying of any report

.5 Initiate another TEIP.

.4 Operator access control to create TEIP's.

.5 Store in the event driven database a trace message describing its success or failure after the execution of each TEIP item.

.17 BCU/ECU/OWS Interface

.1 General

.1 Able to downline load any BCU/ECU application program to any BCU/ECU device from the OWS

.2 Able to up-line load BCU/ECU application programs to the OWS.

.3 Operator access restricted editing rights to BCU/ECU application program and database.

.4 Update and synchronize the real time clock in each BCU/ECU with the CCF's real time clock.

2.3 NETWORK COMMUNICATIONS

.1 General

.1 BACnet TCP/IP, Ethernet 10baseT, bus topology

.2 Fire Alarm and Security system communications:

.1 U.L. 864 listed and approved supervised redundant transmission network.

PART - 3 EXECUTION

3.1 INSTALLATION

.1 Create and install control sequence graphics and review with the Owner. Revise graphics to suit Owners requirements.

.2 Create initial logs as requested by the Owner.

3.2 SYSTEM INTEGRATION

.1 Network Integration

.1 Configure BMS system to integrate with other equipment/systems connected to the BMS system at either the Building LAN or Field LAN levels.

.2 OWS Integration

.1 Configure the OWS, including installation of communication cards and software programming supplied under separate Divisions of the Work.

.3 Provide operator access, graphics, trend logs, etc as if these devices were supplied under this Section of the Work,

3.3 PROGRAM ARCHIVES

.1 Provide two permanent record of all programs on CDROM. Provide one copy to the Owner and retain one copy.

.2 Archive programs after completion of controls verification at a time agreed to with the Owner.

3.4 COMPUTER FURNITURE

.1 Set-up workstation on computer furniture. Provide power bars, etc, to suit power requirements.

END OF SECTION

PART - 1 GENERAL

1.1 SUMMARY

.1 Section includes:

.1 Labour, products, equipment and services necessary to complete the work of this Section.

.2 The requirements of this Section can be met by either a standalone server device, or incorporation into a BCU - Section 25 13 00.

1.2 REFERENCE STANDARDS

.1 BACnet

.1 ANSI/ASHRAE Standard 135-1995

1.3 SUBMITTALS

.1 Shop Drawings

.1 Submit shop drawings in accordance with Section 01 33 00.

.2 Submit Protocol Implementation Conformance Statements (PICS) for all BACnet compliant devices.

PART - 2 PRODUCTS

2.1 INTERNET/INTRANET WEB SERVER

.1 General

.1 Web Server to allow daily operations functions to be accomplished from any network connected web browser, utilizing any commercially available browser such as Google Chrome

.2 No additional software is to be installed or is required on the client PC for normal operation of the system.

.3 Web Server to be located on the owners Intranet or on the Internet.

.4 Automatically obtain an IP (Internet Protocol) address using DHCP, as well as supporting static IP addressing.

.5 Sufficient capacity to store and serve 4000 (minimum) user defined graphics.

.6 Accessibility: unlimited, with a minimum of 30 users accessing this device at the same time.

.7 Web Browser Client supports Sun Microsystems JAVA 2 (JRE 1.4.0 or higher) plug-in.

.2 Communications

.1 BACnet: support the BACnet Interoperable Building Blocks (BIBBS) for Read (Initiate) and Write (Execute) Services, for the following data sharing BIBBS:

9.	DS-RP-A,B
10.	DS-RPM-A
11.	DS-WP-A
12.	DS-WPM-A

.3 Communications Security

.1 128 bit SSL encryption.

.4 Functionality

.1 Operators enter a valid user name and password to enter system. The view (access level) of the system provided will be customized based on user identity.

.2 Operator Security : assign an unique user name and password to each operator.

.3 Operator Access: based on security level – View, View and Edit, Administrator.

.1 Operators with proper security level can override setpoints and equipment operation, revise operating schedules, acknowledge alarms. These changes to be made graphically within the browser.

.4 Graphics Display : same as those generated at the Operators Workstation (OWS).

.1 Includes static information: floor plans, equipment schematics, etc.

.2 Includes dynamic information: space temperature, setpoints, equipment status, etc.

.3 Refresh rate: dynamic information every 10 seconds, without requiring a refresh of the static display.

.4 Display of system schedules.

.5 Alarms and Events: displayed through browser.

.6 Trending: displayed graphically through browser, with proper axis scaling automatically selected.

.5 Hardware

.1 Solid state type server. No moving parts, including but not limited to cooling fans, disk drives, CD-Rom drives, etc.

.2 Wall mounted in EEMAC 1 enclosure.

.3 All user entered information (web pages, security, etc) stored in non-volatile memory.

.4 Back-up system operational information and clock functions by battery or other device for a minimum of 72 hours.

PART - 3 EXECUTION

3.1 INSTALLATION

.1 Wiring

.1 Refer to Sections 25 13 00 and 25 14 00 for selection of communications medium.

END OF SECTION

PART - 1 GENERAL

1.1 SUMMARY

.1 Section includes:

.1 Labour, products, equipment and services necessary to complete the work of this Section.

1.2 DEFINITIONS

.1 ECU: Equipment Controller Unit

.2 BCU: Building Controller Unit

.3 OWS: Operators Work Station (desktop personnel computer)

.4 EMS: Energy Management System programs

1.3 SUBMITTALS

.1 Shop Drawings:

.1 Submit shop drawings in accordance with Section 01 33 00.

PART - 2 PRODUCTS

2.1 BUILDING CONTROLLER UNITS (BCU)

.1 General

.1 BCU used for:

.1 Global energy management control strategies

.2 Communications router/gateway between field bus and building network bus

.3 Storage of field data for Trend and History logs

.4 Capable of providing Direct Digital Control through use of integral or expansion module I/O boards, or I/O ECU units.

2.2 BCU - HARDWARE

.1 General

.1 Microprocessor based Direct Digital Control stand-alone units capable of performing control routines independent of communications with OWS.

.1 16-bit microprocessor with EPROM for operating system (O.S.) and EMS programs

.2 72 hour battery backed RAM for DDC programs and data files

.3 Microprocessor and memory sockets for chip replacement

.4 Power supply

.5 A/D and D/A converters

.6 Memory

.7 Motherboard capacity to accommodate a maximum of 64 input/output (I/O) points

.8 Plug in expansion boards to the maximum 64 points

.9 Minimum two totalizer inputs to accommodate demand meter pulse counts and end of interval signal

.2 Time Clock

.1 A battery backed hardware real time clock to provide time of day, day of week, date, month, and year

.2 An integral one hundred year calendar with automatic leap year compensation

.3 Operating Environment:

.1 Outdoors and/or wet ambient: mounted in NEMA 4 rated enclosures, rated for operation at -40°C to +65°C (-40°F to +150°F)

.2 Indoors : mounted in NEMA 1 rated enclosures, rated for operation at 0°C to +50°C (32° F to 120°F)

.3 Power rating ; 90% to 110% nominal voltage rating, with orderly shut-down below 80% voltage rating.

.2 Input/Output Interface

.1 I/O Protection

.1 I/O from shorting the point to itself, another point, or to ground, and not cause damage to the controller.

.2 Protected from voltage up to 24 V, with no damage to the controller.

.2 I/O General

.1 Inputs: universal type capable of handling current, voltage, resistance or open and closed contacts in any mix

.2 I/O's integral to BCU or mounted on expansion modules

.3 Analogue input devices

.1 4-20 mA

.2 0-1 volt

.3 0-5 volt

.4 0-10 volt

.5 2-10 volts

.4 Digital input types

.1 Normally open contacts

.2 Normally closed contacts

.3 Current/no current

.4 Voltage/no voltage

.5 Analog output types

.1 Proportional current or voltage type with a minimum incremental resolution of 0.5 percent of the full operating range of the valve or damper actuating device

.2 Proportional range: matched to the full operating range of the actuating device

.3 Zero and maximum output voltage or current values: used for shutdown and close off modes

.4 For troubleshooting and load analysis, make available the value of each analog output in the data base for trending and display

.6 Digital output types

.1 Maintained outputs

.2 Pulsed outputs for momentary or magnetic latching circuits

.3 Configurable for 3 mode control (fast-slow-off) and 2 mode control (On-Off)

.7 Sensor linearization

.1 Programmable intermediate ranges and linearization tables for sensors

.2 For RTD type sensors of 1000 ohms or less, individually calibrate each input point via precision decade box to compensate for lead lengths errors

.8 Packaging

.1 Complete installation and check out of field wiring can be done prior to the installation of electronic boards

.2 All board terminations are to be made via plug in connectors to facilitate trouble shooting, repair, and replacement

.3 Factory mounted accessories, wired and housed in enclosure including relays, transducers, power supplies, etc.

.4 Pre-wired connector for insertion of a portable operators terminal (POT) or portable programmers terminal (PPT). Attachment of POT or PPT shall not interrupt or disable normal panel operation or bus communications.

.9 Diagnostic indication

.1 Transmit

.2 Receive

.3 Power Up Test

.4 Power Up Fail

.5 Power Up Test Ok

2.3 **BCU - SOFTWARE**

.1 General

.1 Store Energy Management application programs and associated data files in non-volatile or 72 hour battery backed RAM memory.

.2 Access individual programs from the central operators terminal or portable operators terminal for enabling/disabling and program parameter modification.

.3 BCU programs written at OWS and downloaded to BCU.

.4 Self test diagnostics to run automatically and allow BCU to report malfunctions to OWS.

.5 DDC control sequences implemented in a high level programming language such as Pascal. Both PID and adaptive control algorithms are to be utilized as appropriate to the sequence of operation paragraphs of this specification.

.2 Programs

.1 Provide the following global programs

.1 Time Programs

.2 Exception day programs

.3 Optimal Start

.4 Distributed Power Demand

.5 Optimum Start

.6 Night Cycle

.7 Night Purge

.8 Duty Cycle

.9 Enthalpy Control

.10 Load Reset

.11 Heavy Equipment Starting

.12 Emergency/Normal Power program

.2 Assignment of points and systems to these programs to be under operator control.

.3 Time Programs

.1 Independent start and stop program time provided for each system identified in the Input/Output summary.

.2 It shall be possible to assign two independent start and stop times per day to any equipment connected to a controller. Outputs from this program are start/stop command signals to air handling, heating or cooling systems, etc.

.3 Downloadable to ECU units.

.4 Exception Day Scheduling

.1 Provided to accommodate Holiday and other planned exceptions to the normal time programs.

.1 Definition of up to 32 exception time spans. Each span to be defined as to calendar start day and calendar stop day.

.2 The exception day program applies to all time scheduled energy management programs like Optimum Start and Stop and Duty Cycle.

.3 Downloadable to ECU units.

.5 Temporary Scheduler

.1 Provided to allow the operator to modify present time program control of equipment.

.2 Minimum feature set required:

.1 Ability to alter time schedule changes as much as six days in advance.

.2 Ability to alter either start time, stop time or both for each day.

.3 Temporary schedule to be in effect for all days specified.

.4 Automatically delete the temporary schedule and restore program to normal schedule after execution.

.5 Ability to alter the stop time for the current day.

.6 Ability to assign schedule changes as permanent as well as temporary.

.3 Downloadable to ECU units.

.6 Distributed Power Demand Program (Load Shedding)

.1 Based on a sliding window instantaneous demand algorithm.

.2 Calculates the demand, forecasts the demand trend, compares it to established demand limits, and initiates load shedding action or reestablishment of loads as required.

.3 Sequential basis load-shedding with least important loads shed first and restored last.

.4 Restoration cycle: adds the most important loads first.

.5 Prioritization tier: four-tier system.

.1 When a tier request is issued to the bus, each ECU controller will shed Tier 4-3-2-1 loads, etc. until the shed requirement is met.

.7 Optimum Start, Night Cycling and Night Purge for Free Cooling

.1 Integrated into a single coordinated software package addressing the unique requirement of the building's Unoccupied Period. Each air handler is to be assigned an independent Unoccupied Period program which may include one or more of the following:

.2 Optimum Start Program

.1 Delay equipment startup based on outdoor temperature, space temperature, and system response to assure that comfort conditions are reached at scheduled occupancy time.

.2 The program operates in both heating and cooling cycles.

.3 Employ an adaptive algorithm which automatically adjusts according to the previous day's actual start time and whether comfort conditions were reached prior to or after scheduled occupancy time.

.4 The program automatically assigns longer lead times for weekend and holiday shutdowns.

.5 Space temperature input: For those zones that a Thermostat only is specified a single representative sample shall be applied. For those zones that a Thermostat and Space Temperature Sensors are specified, an average of zones served shall be applied.

.6 Assignable occupancy start times on a per air handler unit basis.

.7 Optimum Stop program to utilize stored energy (flywheel effect) to carry the heating or cooling load on a short term basis.

.8 Applicable to any primary or secondary system which supplies heating or cooling medium to the space (air handlers or water systems).

.9 employ an adoptive algorithm to automatically accelerate the stop time as much as one hour based on external load conditions and the rate of temperature change of the occupied space with the energy source off (Drift Rate).

.10 Independent Drift Rate calculations are required for heating and cooling. Calculate drift rate for heating on the basis of the zone having the greatest cooling load.

.11 Multi-zone applications: provide a subroutine that compares several zone temperatures, then selects the lowest or highest for the Drift Rate calculation depending on whether heating or cooling energy is being supplied.

.12 Historical Drift Rates for both heating and cooling are to be stored and adjusted daily for the current heating and cooling load. The lead time for stopping equipment shall not cause space conditions to exceed either the heating or cooling comfort limits.

.3 Night Cycle Program

.1 Applies to both heating and cooling cycle.

.2 Heating cycle: the average space temperature of the zones served determines the "fan on" or "supply heat" command. Assign a low limit of (15.5-18.3°C) as the minimum night temperature. During night cycle operation outdoor air dampers are to remain closed.

.3 Cooling cycle: the highest space temperature of the zones served or the highest relative humidity of the zones served determines the "fan on" or supply cooling command. Assign a high limit of 27.7°C (65% RH) as the upper limit for night cycle operation.

.4 Duty Cycle Program

.1 Periodically cycles lead duty standby pumps.

.2 Assign each load a cycle period, a maximum off time and a minimum off time.

.3 Do not cycle when either pump is in alarm or reports a failure to run status.

.4 The program applies to heating only, cooling only and heating/cooling units.

.5 Enthalpy Program

.1 Automatically selects the air source, outdoor air, or return air, or mix of both, that presents the least total heat load to the cooling coil.

.2 Base the control algorithm decision on measurement of outside air drybulb, outside air dewpoint or RH and return air drybulb, return dewpoint or RH. Make calculations of total heat content for each source and compare to determine if minimum outdoor air is to be used or a mix of outdoor and return air.

.6 Load Reset Program:

.1 Provided to assure that only the minimum amount of heating and cooling energy is supplied to satisfy zone temperature requirements.

.2 Applicable to multi-zone units and the chilled water supply to individual air handlers of all types.

.3 Provide individual programs, each sensing the worst case zone requirements and providing only the minimum temperature source media to satisfy the need.

.7 Heavy Equipment Starting Program:

.1 Prevent simultaneous starting of heavy equipment such as fans, pumps and chillers.

.2 Invoked on return to normal power from a power failure, or on return to normal after fire alarm condition and any other time when more than one piece of heavy equipment could be started at a time.

.8 Emergency/Normal Power Program:

.1 Initiated when normal power is off and diesels are running at proper voltage and frequency and when normal power is restored.

.2 Sense failure of primary power and automatically restore any preselected group of loads to running mode.

.3 Record time at which primary power failed and list loads turned on under emergency power condition.

.4 Turn on loads in an orderly fashion with programmable delay between starts.

.5 Sense restoration of primary power and automatically restore preselected group of loads to running mode.

.6 Record time at which primary power was restored and list loads turned on with the restoration of normal power.

.7 Turn on loads in an orderly fashion with programmable delay between starts.

.8 Alarm if equipment turned on fails to start on either emergency power or power restoration sequence.

2.4 OEM INTEGRATION CONTROLLERS

RESERVED

.1 Type

.1 Two way data communications/integration between BAS system and Original Equipment Manufacturers (OEM) controller units.

.2 Integration:

.1 Programmable protocol converters at the BMS Building Network Level or the Field LAN level.

.3 OEM manufacturers will provide communications device and application software for communications connections and data transfer:

.4 Applicable systems:

.1 Chillers

.2 22-AHU-03

.3 Variable speed drives

.4 Air compressors

.5 Compressed air dryers

.6 Chemical water treatment

.7 Fire Alarm System

.8 Lighting Control System

.9 Electrical Power Metering System

.10 Security System

.11 Other equipment

2.5 **BUILDING LAN COMMUNICATIONS**

.1 Type

.1 Manufacturer selectable communication protocol from the following:

.1 BACnet TCP/IP - Ethernet/Internet

.2 Wiring:

.1 Less than 100 m between network nodes without repeaters: Category 5 cable.

.2 Greater than 100 m between network nodes: optical fibre

.3 Between buildings, regardless of distance: optical fibre in 50 mm conduit directly buried in 20 MPa concrete.

PART - 3 EXECUTION

3.1 **INSTALLATION**

.1 Provide Energy Management Controllers for control and instrumentation strategies as detailed in sequence of operation, and mechanical drawings and specifications.

.2 Building LAN Wiring:

.1 Provide BMS Building LAN Ethernet wiring system in a Bus or Star topology.

.3 Equipment mounting:

.1 Install equipment in accordance with manufacturer's recommendations.

.2 Mount units on channel frames adjacent to equipment being controlled.

.3 Install piping securely anchored to structure or equipment.

.4 Make power connections to controller units and sensors.

.4 Configuration:

.1 Total number of devices on each Building LAN Bus not to exceed 80% of maximum device limitations (with the use of repeater devices).

.5 Labeling:

.1 Provide labeling in accordance with Section 25 05 00.End of Section

PART - 1 GENERAL

1.1 SUMMARY

.1 Section includes:

.1 Labour, products, equipment and services necessary to complete the work of this Section.

1.2 DEFINITIONS

.1 ECU: Equipment Controller Unit

.2 BCU: Building Controller Unit

.3 POT: Portable Operators Terminal

.4 OWS: Operators Work Station (desktop personal computer)

.5 EMS: Energy Management System programs

PART - 2 PRODUCTS

2.1 ECU - GENERAL

.1 Microprocessor based Direct Digital Control stand-alone units capable of performing control routines independent of communications with BCU units.

.2 ECU's divided into two controller classifications:

.1 Programmable: universal type, suitable for custom air handling units and large equipment systems - ECUP

.2 Configurable: pre-programmed units to serve terminal and unitary equipment. - ECUC

.3 I/O capacity: as required for control sequence requirements, plus a minimum of 10% allocation for future point additions without the addition of controllers or I/O expansion modules.

.4 I/O Protection:

.1 I/O from shorting the point to itself, another point, or to ground, and not cause damage to the controller.

.2 Protected from voltage up to 24 V, with no damage to the controller.

2.2 PROGRAMMABLE ECU - HARDWARE

.1 General

.1 Microprocessor based Direct Digital Control stand-alone units capable of performing custom control routines independent of communications with BCU units.

.1 16-bit microprocessor with EPROM for operating system (O.S.) and

EMS programs

.2 72 hour battery backed RAM for DDC programs and data files

.3 Microprocessor and memory sockets for chip replacement

.4 Power supply

.5 A/D and D/A converters

.6 Memory

.7 Motherboard capacity not to exceed 64 input/output (I/O) points, with or without expansion boards

.8 Minimum two totalizer inputs to accommodate demand meter pulse counts and end of interval signal

.2 Time Clock

.1 A battery backed hardware real time clock to provide time of day, day of week, date, month, and year

.2 An integral one hundred year calendar with automatic leap year compensation

.3 Operating Environment:

.1 Outdoors and/or wet ambient: mounted in NEMA 4 rated enclosures, rated for operation at -40℃ to +65℃

.2 Indoors : mounted in NEMA 1 rated enclosures, rated for operation at 0℃ to +50℃

.3 Power rating ; 90% to 110% nominal voltage rating, with orderly shut-down below 80% voltage rating

.2 Input/Output (I/O) Interface

.1 Inputs: universal type capable of handling current, voltage, resistance or open and closed contacts in any mix.

.2 Analogue input devices

.1 4-20 mA

.2 0-1 volt

.3 0-5 volt

.4 0-10 volt

.5 2-10 volts

.3 Binary input types

.1 Normally open contacts

.2 Normally closed contacts

.3 Current/no current

.4 Voltage/no voltage

.4 Analog output types

.1 Proportional current or voltage type with a minimum incremental resolution of .5 percent of the full operating range of the valve or damper actuating device

.2 Proportional range: matched to the full operating range of the actuating device

.3 Zero and maximum output voltage or current values: used for shutdown and closeoff modes

.4 For troubleshooting and load analysis, make available the value of each analog output in the data base for trending and display

.5 Binary output types

.1 Maintained outputs

.2 Pulsed outputs for momentary or magnetic latching circuits

.3 Configurable for 3 mode control (fast-slow-off) and 2 mode control

.6 Sensor linearization

.1 Programmable intermediate ranges and linearization tables for sensors

.2 For RTD type sensors of 1000 ohms or less, individually calibrate each input point via precision decade box to compensate for lead lengths errors

.7 Packaging

.1 Complete installation and check out of field wiring can be done prior to the installation of electronic boards

.2 All board terminations are to be made via plug in connectors to facilitate trouble shooting, repair, and replacement

.3 Factory mounted accessories, wired and housed in enclosure including relays, transducers, power supplies, etc.

.4 Pre-wired connector for insertion of a portable operators terminal (POT) or portable programmers terminal (PPT). Attachment of POT or PPT shall not interrupt or disable normal panel operation or bus communications

.8 LED Diagnostic indication

.1 Transmit

.2 Receive

.3 Power Up Test

.4 Power Up Fail

.5 Power Up Test Ok

.9 Operator Interface:

.1 LCD display and keypad, with scroll menu options

.2 Multi level security password access

2.3 PROGRAMMABLE ECU - SOFTWARE

.1 General

.1 DDC control sequences are to be ECU resident and implemented in a high level programming language such as Pascal. Both PID and adaptive control algorithms are to be utilized as appropriate to the sequence of operation paragraphs of this specification.

.2 ECU resident EMS programs: adaptive and fully integrated with the DDC programs to avoid control contentions. Specific EMS programs to be provided are as called for in the software section of this specification and the sequences of operation.

.3 Software includes:

.1 Complete operating system (O.S.)

.2 Communications handler

.3 Point processing

.4 Standard control algorithms and specific control sequences (DDC)

.5 An Owner/User custom control and calculation package complete with interpreter. (Reference "Data Communications" for communications network requirements.)

.2 O.S. Software

.1 General:

.1 PROM resident

.2 Operate in real time

.3 Provide prioritized task scheduling

.4 Control time programs

.5 Monitor and manage ECU to ECU and ECU to central computer communications

.6 Scan inputs and outputs

.7 Built-in diagnostics

.3 Input/Output Point Processing Software

.1 General:

.1 Continuous update of input and output values and conditions

.2 All connected points are to be updated at a minimum of one second intervals

.3 Analog to digital conversion

.4 Scaling and offset

.5 Correction of sensor non-linearity

.6 Sensing no response or failed sensors

.7 Conversion of values to 32 bit floating point format

.2 Both the maximum and minimum values sensed for each analog input are to be retained in memory.

.3 Able to input subsets of standard sensor ranges to the A/D converter and assign gains to match the full scale 32 bit conversion to achieve high accuracy readout.

.4 A reasonability check on all analog inputs against the previously read value and discard those values falling outside preprogrammed reasonability limits.

.5 Assignment of proper engineering units and status condition identifiers to all analog and digital input and outputs.

.6 Analog input alarm comparison with the ability to assign two individual sets of high and low limits (warning and actual alarm) to an input or to assign a set of floating limits (alarm follows a reset schedule or DDC control point) to the input.

.1 Assign a unique differential to prevent a point from oscillating into and out of alarm

.2 Alarm comparisons are to be made each scan cycle

.7 Debounce of binary inputs to prevent nuisance alarms.

.1 Debounce timing: adjustable from two seconds to two minutes in one second increments

.4 Command Control Software

.1 Manages the receipt of commands from the central operators console, portable operators terminal, and from control programs.

.2 Command delay: provided to prevent simultaneous energizing of loads. Delay must be programmable from 0 to 30 seconds.

.3 Assign each command a command and residual priority to manage contentions created by multiple programs having access to the same command point:

.1 Execute only outputs with a higher command priority execute

.2 Whenever a command is allowed to execute, its assigned residual priority shall replace the existing residual priority

.4 Fixed mode" option: supported to allow inputs to, and outputs from, DDC control programs to set to a fixed state or value:

.1 In "fixed mode" inputs and outputs are to be assigned a high residual command priority to prevent override by application programs.

.5 Maintain a last user record to positively identify which program or manual command is in control of a given point.

.1 Display the last user information along with other point data on the CRT display of logical groups.

.5 Alarm Lockout

.1 Provided to prevent nuisance alarms

.1 On initial startup of air handler and other mechanical equipment assign a "timed lockout" period to analog points to allow them to reach a stable condition before activating alarm comparison logic

.2 Lockout period: programmable on a per point basis from 0 to 90 minutes in one minute increments

.2 Provide a "hard lockout" to positively lock out alarms when equipment is turned off or when a true alarm is dependent on the condition of an associated point.

.1 Hard lockout points and lockout initiators: operator programmable.

.6 Run Time

.1 Accumulated Run time based on the status of a digital input point.

.1 Totalize either on time or off time up to 10,000 hours with one minute resolution.

.2 Run time counts reside in non volatile memory and have ECU resident run time limits assignable through the operators terminal.

.7 Transition Counter

.1 Provided to accumulate the number of times a device has been cycled on or off.

.1 Non-volatile and be capable of accumulating 600,000 switching cycles

.2 Assignable limits to counts to provide maintenance alarm printouts

.8 Custom DDC Programs

.1 Provide custom programming to meet the control strategies as called for in the sequence of operation sections.

.2 Memory resident and available to the programs a full library of DDC algorithms, intrinsic control operators, arithmetic, logic, and relational operators for implementation of control sequences.

.3 Proportional Control, Proportional plus Integral (PI), Proportional plus Integral plus Derivative (PID), and Adaptive Control (self learning).

.1 Adaptive Control algorithm used on control loops, as indicated in the I/O summary, where the controlled medium flow rate is variable (such as VAV units and variable flow pumping loops).

.2 Adaptive control algorithm monitor the loop response characteristics in accordance with the time constant changes imposed by variable flow rates. The algorithm operates in a continuous self learning manner and retains in memory a stored record of the system dynamics so that on system shutdown and restart, the learning process starts from where it left off and not from ground zero.

.3 Standard PID algorithms are not acceptable substitutes for variable flow applications since they will provide satisfactory control at only one flow rate and will require continued manual fine tuning.

.4 Make available DDC setpoints, gains and time constants associated with DDC programs to the operator for display and modification via the central operator interface and portable operators terminal.

.5 Adjustable execution interval of each DDC loop from two to 120 seconds in one second increments.

.6 Assignment of initialization values to all outputs to assure that controlled devices assume a fail safe position on initial system start up.

.9 Time and Event Programming

.1 Initiates a controlled sequence of events for execution at a specific time or upon the occurrence of an event.

.2 Program features required as a minimum are:

.1 Analog points to be commandable to a specific value

.2 Digital points commandable to a specific state; i.e., on or off; fast, slow or off

.3 Initiator to be a specific day and time or a specific event; i.e., either analog or digital alarm occurrence

.4 Manual initiation via operator's command

.5 Commands must honour command delays to prevent current surges and assigned minimum ON and OFF times

.6 Commands must honour command and residual priority structures allowing higher priority commands (like smoke control) to override lower priority commands (like duty cycle) and residual priority.

.7 Ability to chain TEP's

.8 Ability to enable and disable TEP's individually

.9 Ability to enable/disable TEP initiators

2.4 CONFIGURABLE ECU - HARDWARE

.1 General

.1 Pre-programmed, configurable packaged controller unit for:

.1 Variable volume terminal units

.2 Fan powered terminal units

.3 Unit heaters

.4 Fan coils

.5 Heat pumps

.6 Local reheat zones

.7 Perimeter heating control

.8 Free-standing fans

.2 Integral damper electronic actuator on terminal unit controllers.

.3 Optically isolated from other controllers on communication loop.

.4 Wired to wall mounted temperature sensor with jack-style communications wiring.

.5 Auxiliary universal I/O points for control of reheat coil hot water control valve and a second zone heating control valve.

.6 Factory calibrated velocity pressure sensor.

.7 Calibration data stored in EEPROM memory for at least 15 velocity/pressure points within terminal unit range.

.8 Memory: maintain all BIOS and programming information in the event of a power loss for at least 90 days.

.2 Operating Environment:

.1 Outdoors and/or wet ambient: mounted in NEMA 4 rated enclosures, rated for operation at -40°C to +65°C.

.2 Indoors: mounted in NEMA 1 rated enclosures, rated for operation at 0°C to +50°C.

.3 Power rating: 90% to 110% nominal voltage rating, with orderly shut-down below 80% voltage rating.

.4 Power:

.1 120 VAC, 60 Hz

.2 Provide control transformers as required to suit equipment

2.5 CONFIGURABLE ECU - SOFTWARE

.1 Programming

.1 Series of user selectable and configurable pre-programmed control functions.

.2 Control parameters field adjustable during balancing to compensate for variations in terminal unit installation, type and size.

.2 Data Input

.1 Entry of data through BCU, OWS or field interface unit through communications jack on room temperature sensor.

.2 Store and manipulate data including:

.1 Box type

.2 Box size

.3 Minimum and maximum air flows

.4 Reheat air flow: minimum turndown air flow prior to use of reheat

.5 Current air flow

.6 Calibration factor: for field calibration determines by air balancing

.7 Room temperature setpoint

.8 Maximum room temperature setpoint: occupant selectable

.9 Minimum room temperature setpoint: occupant selectable

.10 Cooling setpoint

.11 Heating setpoint

.12 Unoccupied cooling setpoint

.13 Unoccupied heating setpoint

.14 Afterhours Maximum Timer: maximum time occupant may override unoccupied cycle

.15 Internal Cooling Signal: used to reset supply air temperature if more cooling is required

.16 Internal Heating Signal: used to reset supply air temperature is less cooling is required

.3 Retain control of above listed variables in event of communication loss to Building Controller Units.

2.6 **FIELD BUS COMMUNICATIONS**

.1 General

.1 Communications between individual ECU's: single pair of twisted wires with a minimum transmission speed of 28,800 baud.

.2 Acoustically coupled to the bus to assure that single or multiple ECU failures will not cause loss of communications with other bus connected devices.

.2 Type:

.1 Polling from ECM.

.2 Manufacturer selectable communication protocol from the following:

.1 LonTalk standard network variable types - SNVTs

.2 (BACnet MS/TP)

.3 (Optimux)

2.7 PORTABLE OPERATORS TERMINAL

.1 Type

.1 Portable operator's terminal capable of direct plug-in to individual ECU's is to be provided for operator read out of:

.1 Temperatures

.2 Control values

.3 DDC parameters

.4 Manual commands, overrides and set point adjustment

.2 The POT is to be hand held, weigh less than [500 g][16 ounces], and plug directly into individual ECU's for power and data.

.2 Functionality

.1 Functionality to include ability to:

.1 Set points to a fixed value/state

.2 Display diagnostic results

.3 Display sequential all point summary and sequential alarm summary

.4 Display/change digital point state, analog point value

.5 Display/change time and date

.6 Display/change application and DDC parameters

.7 Display/change analog limits

.8 Display/change time schedules

.9 Display/change runtime counts and runtime limits

.10 Display/change daylight savings time changeover

.11 Display/change time/event initiation

.12 Display/change programmable offset values

.13 Access ECU initialization routines and diagnostics

.14 Enable/disable points, initiators and programs

.15 Display/change minimum on/off, maximum off time

.3 Interface

.1 Complete with:

.1 Command keys

.2 Data entry keys

.3 Cursor control keys

.4 24 character liquid crystal alpha-numeric display

.2 Access: via self prompting menu selection with arrow key control of next menu/previous menu and step forward/step backward within a given menu.

.4 Interconnection

.1 Connection of a POT to a ECU shall not interrupt nor interfere with normal peer network operation in any way, prevent alarms from being transmitted, or preclude central initiated commands and system modification.

.5 Alternative

.1 As an alternative to the POT, a fixed liquid crystal or LED display and entry keyboard may be provided per programmable-type ECUP controller. Functional capability must be equal to that described for the POT as a minimum. The fixed display and keyboard must be under lock and key control to prevent tampering.

PART - 3 EXECUTION

3.1 INSTALLATION

.1 Provide Equipment Controller Units for control and instrumentation strategies as detailed in sequence of operation, and mechanical drawings and specifications.

.2 Equipment mounting:

.1 Install equipment in accordance with manufacturer's recommendations.

.2 Mount units on channel frames adjacent to equipment being controlled.

.3 Install piping securely anchored to structure or equipment.

.4 Make power connections to controller units and sensors.

.3 Configuration:

.1 Total number of devices on each Field Bus not to exceed 80% of maximum device limitations (with the use of repeater devices).

.4 Labeling

.1 Provide labeling in accordance with Section 25 05 00.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Materials and installation for building automation controllers including:

.1 Master Control Unit (MCU).

.2 Local Control Unit (LCU).

.3 Equipment Control Unit (ECU).

.4 Terminal Control Unit (TCU).

.5 Input Output Units (IOU)

.2 Related Sections:

.1 Section 25 05 00 - Common Work for Building Automation.

.2 Section 25 05 01 - EMCS: General Requirements.

.3 Section 25 05 02 - EMCS: Shop Drawings, Product Data and Review Process.

.4 Section 25 05 03 - EMCS: Project Record Documents.

.5 Section 25 30 02 - EMCS: Field Control Devices.

.6 Section 25 90 01 - EMCS: Site Requirements Applications and Systems Sequences of Operation.

.7 Section - 25 95 00 Bldg Automation Control Sequences

1.2 REFERENCES

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

.1 ASHRAE 2007, Applications Handbook, I-P Edition.

.2 Canadian Standards Association (CSA International).

.1 C22.2 No.205-M1983(R1999), Signal Equipment.

.3 Institute of Electrical and Electronics Engineers (IEEE).

.1 IEEE C37.90.1-02, Surge Withstand Capabilities (SWC) Tests for Relays and Relay Systems Associated with Electric Power Apparatus.

1.3 DEFINITIONS

.1 Acronyms and definitions: refer to Section 25 05 01 - EMCS: General Requirements.

1.4 SYSTEM DESCRIPTION

.1 General: Network of controllers comprising of MCU('s), LCU('s), ECU('s) or TCU('s) to be provided as indicated in System Architecture Diagram to support building systems and associated sequence(s) of operations as detailed in these specifications.

.1 Provide sufficient controllers to meet intents and requirements of this section.

.2 Controller quantity, and point contents to be approved by Departmental Representative at time of preliminary design review.

.2 Controllers: stand-alone intelligent Control Units.

.1 Incorporate programmable microprocessor, non-volatile program memory, RAM, power supplies, as required to perform specified functions.

.2 Incorporate communication interface ports for communication to LANs to exchange information with other Controllers.

.3 Capable of interfacing with operator interface device.

.4 Execute its logic and control using primary inputs and outputs connected directly to its onboard input/output field terminations or slave devices, and without need to interact with other controller. Secondary input used for reset such as outdoor air temperature may be located in other Controller(s).

.1 Secondary input used for reset such as outdoor air temperature may be located in other Controller(s).

1.5 DESIGN REQUIREMENTS

.1 To include:

.1 Scanning of AI and DI connected inputs for detection of change of value and processing detection of alarm conditions.

.2 Perform On-Off digital control of connected points, including resulting required states generated through programmable logic output.

.3 Perform Analog control using programmable logic, (including PID) with adjustable dead bands and deviation alarms.

.4 Control of systems as described in sequence of operations.

.5 Execution of optimization routines as listed in this section.

.2 Total spare capacity for MCUs and LCUs: at least 20 % of each point type distributed throughout the MCUs and LCUs.

.3 Field Termination and Interface Devices:

.1 To: CSA C22.2 No.205.

.2 Electronically interface sensors and control devices to processor unit.

.3 Include, but not be limited to, following:

.1 Programmed firmware or logic circuits to meet functional and technical requirements.

.2 Power supplies for operation of logics devices and associated field equipment.

.3 Required communications equipment and wiring (if remote units).

.4 Leave controlled system in "fail-safe" mode in event of loss of communication with, or failure of, processor unit.

.5 Input Output interface to accept as minimum AI, AO, DI, DO, BI, BO functions as specified.

.6 Wiring terminations: use conveniently located screw type.

.4 AI interface equipment to:

.1 Convert analog signals to digital format with 10 bit analog-to-digital resolution.

.2 Provide for following input signal types and ranges. Installation of additional resistors for conversion purposes is acceptable:

.1 4 - 20 mA;

.2 0 - 10 V DC;

.3 100/1000 ohm RTD input;

.3 Meet IEEE C37.90.1 surge withstand capability.

.4 Have common mode signal rejection greater than 60 dB to 60 Hz.

.5 Where required, dropping resistors to be certified precision devices which complement accuracy of sensor and transmitter range specified.

.5 AO interface equipment:

.1 Convert digital data from controller processor to acceptable analog output signals using 8 bit digital-to-analog resolution.

.2 Provide for following output signal types and ranges:

.1 4 - 20 mA.

.2 0 - 10 V DC.

.3 Meet IEEE C37.90.1 surge withstand capability.

.6 DI interface equipment:

.1 Able to reliably detect contact change of sensed field contact and transmit condition to controller.

.2 Meet IEEE C37.90.1 surge withstand capability.

.3 Accept pulsed inputs up to 2 kHz.

.7 DO interface equipment:

.1 Respond to controller processor output, switch respective outputs. Each DO hardware to be capable of switching up to 0.5 amps at 24 V AC.

.2 Switch up to 5 amps at 220 V AC using optional interface relay.

.4 Controllers and associated hardware and software: operate in conditions of 0 degrees C to 44 degrees C and 20 % to 90 % non-condensing RH.

.5 Controllers (MCU, LCU): mount in wall mounted cabinet with hinged, keyed-alike locked door to match existing NRC standard.

.1 Provide for conduit entrance from top, bottom or sides of panel.

.2 ECUs to be mounted in equipment enclosures or separate enclosures.

.3 TCUs to be mounted [in equipment or separate enclosures] [without enclosures]

.4 Mounting details as approved by Departmental Representative for ceiling mounting.

.6 Cabinets to provide protection from water dripping from above, while allowing sufficient airflow to prevent internal overheating.

.7 When existing cabinets are re-used, the front panel is to be painted fluorescent orange to match existing EMCS NRC campus colour code. Any openings are to be closed with matching orange blank-plates.

.8 Provide surge and low voltage protection for interconnecting wiring connections.

1.6 SUBMITTALS

.1 Make submittals in accordance with Section 01 33 00 - Submittal Procedures and Section 25 05 02 - EMCS: Shop Drawings, Product Data and Review Process.

.1 Submit product data sheets for each product item proposed for this project.

Part 2 Products

.1 MASTER CONTROL UNIT (MCU)

.1 General:

.1 Master Control Units shall be microprocessor based, multi-tasking, multi-user, and employ a real time operating system. Each NCU control panel shall consist of modular hardware including power supply, CPU board, and input/output modules. A sufficient number of MCUs shall be supplied to fully meet the requirements of this specification and the attached point list.

.2 Hardware Specifications

.1 Memory:

.1 A minimum of 4MB of RAM shall be provided for MCUs with expansion up to 8MB. The 8MB versions shall include a floating-point math co-processor.

.2 Communication Ports:

.1 Each NCU shall provide communication to both the Workstation(s) and the field buses. In addition, each NCU must have at least 3 other communications ports that support a telephone modem, portable service tool, serial printer and connection to third party controllers such as a chiller control panel. On a LAN/WAN system the NCU shall be provided with a 10Mbps plug-in Ethernet TCP/IP network interface card (NIC).

.3 Input/Output (I/O):

.1 Each MCU shall support the addition of the following types of inputs and outputs:

.1 Digital Inputs for status/alarm contacts.

.2 Counter Inputs for summing pulses from meters.

.3 Thermistor inputs for measuring temperatures in space, ducts and thermowells.

.4 Analog inputs for pressure, humidity, flow and position measurements.

.5 Digital Outputs for on/off equipment control.

.6 Outs for valve and damper position control, and capacity control of primary equipment.

.4 Modular Expandability:

.1 The system shall employ a modular I/O design to allow easy expansion. Input and output capacity is to be provided through plug-in modules of various types or DIN-mountable IOU

modules. It shall be possible to combine I/O modules as desired to meet the I/O requirements for individual control applications.

.5 Hardware Override Switches:

.1 All digital output units shall include three position manual override switches to allow selection of the ON, OFF, or AUTO output state. These switches shall be built into the unit and shall provide feedback to the controller so that the position of the override switch can be obtained through software. In addition each analog output shall be equipped with an override potentiometer to allow manual adjustment of the analog output signal over its full range, when the 3 position manual override switch is placed in the ON position.

.6 Local Status Indicator Lamps:

.1 Provide as a minimum LED indication of CPU status, Ethernet LAN status, and field bus status. For each output, provide LED indication of the value of the output (On/Off). For each output module provide an LED which gives a visual indication of whether any outputs on the module are manually overridden.

.7 Real Time Clock (RTC):

.1 Each MCU shall include a battery-backed, real time clock, accurate to 10 seconds per day. The RTC shall provide the following: time of day, day, month, year, and day of week. In normal operation the system clock will be based on the frequency of the AC power. The system shall automatically correct for daylight savings time and leap years and be Year 2000 compliant.

.8 Power Supply:

.1 The power supply for the NCUs shall be auto sensing, 120-220VAC, 60/50 Hz power, with a tolerance of +/- 20%. Line voltage below the operating range of the system shall be considered outages. The controller shall contain over voltage surge protection, and require no additional AC power signal conditioning. Optionally, if indicated on the drawings, the power supply shall accept an input voltage of (–48 VDC).

.9 Automatic Restart After Power Failure:

.1 Upon restoration of power after an outage, the ECU shall automatically and without human intervention: update all monitored functions; resume operation based on current, synchronized time and status, and implement special start-up strategies as required.

.10 Battery backup:

.1 Each NCU with the standard 120-220VAC power supply shall include a programmable DC power backup system rated for a minimum of 72 hours of battery backup to maintain all volatile memory or, a minimum of 2 hours of full UPS including modem power. This power backup system shall be configurable such that at the end of a settable timeframe (such as 1 hour) of running on full UPS, the unit will shut off full UPS and switch to memory retention-only mode for the remainder of the battery power. The

system shall allow the simple addition of more batteries to extend the above minimum battery backup times.

.3 Software Specifications

.1 General.

.1 The MCU shall contain flash ROM as the resident operating system. Application software will be RAM resident. Application software will only be limited by the amount of RAM memory. There will be no restrictions placed on the type of application programs in the system. Each NCU shall be capable of parallel processing, executing all control programs simultaneously. Any program may affect the operation of any other program. Each program shall have the full access of all I/O facilities of the processor. This execution of control function shall not be interrupted due to normal user communications including interrogation, program entry, printout of the program for storage, etc.

.2 User Programming Language:

.1 The application software shall be user programmable. This includes all strategies, sequences of operation, control algorithms, parameters, and setpoints. The source program shall be English language-based and programmable by the user. The language shall be structured to allow for the easy configuration of control programs, schedules, alarms, reports, telecommunications, local displays, mathematical calculations, passwords, and histories. The language shall be self-documenting. Users shall be able to place comments anywhere in the body of a program. Program listings shall be configurable by the user in logical groupings.

.4 Control Software:

.1 The NCU shall have the ability to perform the following pre-tested control algorithms:

.1 Proportional, Integral plus Derivative Control (PID)

.2 Self Tuning PID

.3 Two Position Control

.4 Digital Filter

.5 Ratio Calculator

.6 Equipment Cycling Protection

.2 Mathematical Functions:

.1 Each controller shall be capable of performing basic mathematical functions (+, -, *, /), squares, square roots, exponential, logarithms, Boolean logic statements, or combinations of both. The controllers shall be capable of performing complex logical statements including operators such as >, <, =, and, or, exclusive or, etc. These must be able to be used in the same equations with the mathematical operators and nested up to five parentheses deep.

.5 Energy Management Applications:

.1 MCUs shall have the ability to perform any or all of the following energy management routines:

.1 Time of Day Scheduling
.2 Calendar Based Scheduling
.3 Holiday Scheduling
.4 Temporary Schedule Overrides
.5 Optimal Start
.6 Optimal Stop
.7 Night Setback Control
.8 Enthalpy Switchover (Economizer)
.9 Peak Demand Limiting
.10 Temperature Compensated Duty Cycling
.11 CFM Tracking
.12 Heating/Cooling Interlock
.13 Hot/Cold Deck Reset
.14 Free Cooling
.15 Hot Water Reset
.16 Chilled Water Reset
.17 Condenser Water Reset
.18 Chiller Sequencing

.6 History Logging:

.1 Each controller shall be capable of logging any system variable over user defined time intervals ranging from 1 second to 1440 minutes. Any system variables (inputs, outputs, math calculations, flags, etc.) can be logged in history. A maximum of 32767 values can be stored in each log. Each log can record either the instantaneous, average, minimum or maximum value of the point. Logs can be automatic or manual. Logged data shall be downloadable to the Operator Workstation for long term archiving based upon user-defined time intervals, or manual command.

.7 Alarm Management:

.1 For each system point, alarms can be created based on high/low limits or conditional expressions. All alarms will be tested each scan of the MCU and can result in the display of one or more alarm messages or reports.

.2 Up to 8 alarms can be configured for each point in the controller.

.3 Messages and reports can be sent to a local terminal, to the front-end workstation(s), or via modem to a remote-computing device.

.4 Alarms will be generated based on their priority. A minimum of 255 priority levels shall be provided.

.5 If communication with the Operator Workstation is temporarily interrupted, the alarm will be buffered in the MCU. When communications return, the alarm will be transmitted to the Operator Workstation if the point is still in the alarm condition.

.8 Reporting.

.1 The MCU shall be able to generate user-definable reports to a locally connected printer or terminal. The reports shall contain any combination

of text and system variables. Report templates shall be able to be created by users in a word processing environment. Reports can be displayed based on any logical condition or through a user command.

.9 Use uninterruptible Power Supply (UPS) and emergency power when equipment must operate in emergency and co-ordinating mode.

2.2 Standalone Digital Control Units (SDCU's): (LCU's), (TCU's), (ECU's)

.1 General:

.1 Standalone Digital Control Units shall provide control of HVAC and lighting. Each controller shall have its own control programs and will continue to operate in the event of a failure or communication loss to its associated MCU.

.2 Memory:

.1 Control programs shall be stored in battery backed-up RAM and EPROM. Each controller shall have a minimum of 32K bytes of user RAM memory and 128K bytes of EPROM.

.3 Communication Ports:

.1 SDCUs shall provide a communication port to the field bus. In addition, a port shall be provided for connection of a portable service tool to support local commissioning and parameter changes with or without the MCU online. It shall be possible from a service port on any SDCU to view, enable/disable, and modify values of any point or program on any controller on the local field bus, any MCU or any SDCU on a different field bus.

.4 Input/Output:

.1 Each SDCU shall support the addition of the following types of inputs and outputs:

.1 Digital Inputs for status/alarm contacts.

.2 Counter Inputs for summing pulses from meters.

.3 Thermistor Inputs for measuring temperatures in space, ducts and thermowells.

.4 Analog inputs for pressure, humidity, flow and position measurements.

.5 Digital Outputs for on/off equipment control.

.6 Analog Outputs for valve and damper position control, and capacity control of primary equipment.

.5 Expandability:

.1 Input and output capacity shall be expandable through the use of plug-in modules. A minimum of two modules shall be added to the base SDCU before additional power is required.

.6 Networking:

.1 Each SDCU will be able to exchange information on a peer to peer basis with other Standalone Digital Control Units during each field bus scan. Each SDCU shall be capable of storing and referencing global variables (on the LAN) with or without any workstations online. Each SDCU shall be able to have its program

viewed and/or enabled/disabled either locally through a portable service tool or through a workstation connected to an MCU.

.7 Indicator Lamps:

.1 SDCUs will have as a minimum, LED indication of CPU status, and field bus status.

.8 Real Time Clock (RTC):

.1 An SDCU shall have a real time clock in either hardware or software. The accuracy shall be within 10 seconds per day. The RTC shall provide the following information: time of day, day, month, year, and day of week. Each SDCU shall receive a signal, every hour, over the network from the NCU which synchronizes all SDCU real time clocks.

.9 Automatic Restart After Power Failure:

.1 Upon restoration of power, the SDCU shall automatically and without human intervention, update all monitored functions, resume operation based on current, synchronized time and status, and implement special start-up strategies as required.

.10 Battery Back Up:

.1 Each SDCU shall have at least 3 years of battery back up to maintain all volatile memory.

.11 Alarm Management:

.1 For each system point, alarms can be created based on high/low limits or conditional expressions. All alarms will be tested each scan of the SDCU and can result in the display of one or more alarm messages or reports.

.2 Up to 8 alarms can be configured for each point in the controller enabling the escalation of the alarm priority (urgency) based upon which alarm(s) is/are triggered.

.3 Alarm messages can be sent to a local display or to the Operator's Workstation(s).

.4 Alarms will be generated based on their priority. A minimum of 255 priority levels shall be provided.

.5 If communication with the MCU is temporarily interrupted, the alarm will be buffered in the SDCU. When communications return, the alarm will be transmitted to the NCU if the point is still in the alarm condition.

.12 Local Control Units (LCU's):

.1 LCU's shall be capable of meeting the requirements of the sequence of operation found in the Execution portion of this specification and for future expansion.

.2 LCU's shall support all the necessary point inputs and outputs as required by the sequence and operate in a standalone fashion.

.3 LCU's shall be fully user programmable to allow for modification of the application software.

.4 An LCD display shall be optionally available for readout of point values and to allow operators to change setpoints and system parameters.

.5 A manual override switch shall be provided for all digital and analog outputs on the LCU. The position of the switch shall be monitored in software and available for operator displays and alarm notification.

.13 Lighting Controller:

.1 Lighting controllers shall provide direct control of 20 Amp, 277 VAC lighting circuits using mechanically held, latching relays. Controllers will contain from 8 to 48 circuits per enclosure. Each controller shall also contain inputs for direct connection to light switches and motion detectors.

.2 Each controller shall have the capability for time of day scheduling, occupancy mode control, after hour operation, alarming, and trending.

.14 Provide multiple control functions for typical built-up and package HVAC systems, hydronic systems and electrical systems.

.15 Minimum of 16 I/O points of which minimum be 4 AOs, 4 AIs, 4 DIs, 4 DOs.

.16 Points integral to one Building System to be resident on only one controller.

.17 Microprocessor capable of supporting necessary software and hardware to meet specified requirements as listed in previous MCU article with following additions:

.1 Include minimum 2 interface ports for connection of local computer terminal.

.2 Design so that shorts, opens or grounds on input or output will not interfere with other input or output signals.

.3 Physically separate line voltage (70V and over) circuits from DC logic circuits to permit maintenance on either circuit with minimum hazards to technician and equipment.

.4 Include power supplies for operation of LCU and associated field equipment.

.5 In event of loss of communications with, or failure of, MCU, LCU to continue to perform control. Controllers that use defaults or fail to open or close positions not acceptable.

.6 Provide conveniently located screw type or spade lug terminals for field wiring.

.18 TERMINAL/EQUIPMENT CONTROL UNIT (TCU/ECU)

.1 Microprocessor capable of supporting necessary software and hardware to meet TCU/ECU functional specifications.T

.2 TCU/ECU definition to be consistent with those defined in ASHRAE HVAC Applications Handbook section 45.

.3 Controller to communicate directly with EMCS through EMCS LAN and provide access from EMCS OWS for setting occupied and unoccupied space temperature setpoints, flow setpoints, and associated alarm values, permit reading of sensor values, field control values (% open) and transmit alarm conditions to EMCS OWS.

.4 TCU's shall support, but not be limited to the control of the following configurations of VAV boxes to address current requirements as described in the Execution portion of this specification, and for future expansion:

.1 Single Duct Cooling Only

.2 Single Duct Cooling with Reheat (Electric or Hot Water)

.3 Fan Powered (Parallel or Series)

.4 Dual Duct (Constant or Variable Volume)

.5 Supply/Exhaust

.5 TCUs for single duct applications will come equipped with a built-in actuator for modulation of the air damper. The actuator shall have a minimum torque rating of 35 in.-lb., and contain an override mechanism for manual positioning of the damper during startup and service.

.6 TCU's shall contain an integral velocity sensor accurate to +/- 5% of the full range of the box's CFM rating.

.7 Each controller shall perform the sequence of operation described in Part 3 of this specification, and have the capability for time of day scheduling, occupancy mode control, after hours operation, lighting control, alarming, and trending.

.8 TCU's shall be able to communicate with any other Standalone Digital Control Unit on the same field bus with or without communication to the MCU managing the field bus. Systems that fail to provide this (true peer-to-peer) capability will be limited to a maximum of 32 TCU's per field bus.

.9 ECU's shall support, but not be limited to, the control of the following systems as described in the Execution portion of this specification, and for future expansion:

.1 Unit Ventilators

.2 Heat Pumps (Air to Air, Water to Water)

.3 Packaged Rooftops

.4 Fan Coils (2 or 4 Pipe)

.10 The I/O of each ECU shall contain the sufficient quantity and types as required to meet the sequence of operation found in the Execution portion of this specification. In addition, each controller shall have the capability for time of day scheduling, occupancy mode control, after hour operation, lighting control, alarming, and trending.

2.3 SOFTWARE

.1 General Description

.1 The software architecture must be object-oriented in design, a true 32-bit application suite utilizing Microsoft's OLE, COM, DCOM and ODBC technologies. These technologies make it easy to fully utilize the power of the operating system to share, among applications (and therefore to the users of those applications), the wealth of data available from the EMCS.

.2 The workstation functions shall include monitoring and programming of all DDC controllers. Monitoring consists of alarming, reporting, graphic displays, long term data storage, automatic data collection, and operator-initiated control actions such as schedule and setpoint adjustments.

.3 Programming of controllers shall be capable of being done either off-line or on-line from any operator workstation. All information will be available in graphic or text displays. Graphic displays will feature animation effects to enhance the presentation of the data, to alert operators of problems, and to facilitate location of information throughout the DDC system. All operator functions shall be selectable through a mouse.

.2 System Database

.1 The files server database engine must be Microsoft SQL Server, or another ODBC-compliant, relational database program. This ODBC (**O**pen **D**ata**b**ase **C**onnectivity)-compliant database engine allows for an owner to utilize "their" choice of database and due to it's "open" architecture, allows an owner to write custom applications and/or reports which communicate directly with the database avoiding data transfer routines to update other applications. The system database shall contain all point configurations and programs in each of the controllers that have been assigned to the network. In addition, the database will contain all workstation files including color graphic, alarm reports, text reports, historical data logs, schedules, and polling records.

.3 User Interface

.1 The EMCS workstation software shall allow the creation of a custom, browser-style interface linked to the user that has logged into the workstation software. This interface shall support the creation of "hot-spots" that the user may link to view/edit any object in the system or run any object editor or configuration tool contained in the software. Furthermore, this interface must be able to be configured to become a user's "PC Desktop" – with all the links that a user needs to run other applications. This, along with the Windows operating system user security capabilities, will enable a system administrator to setup workstation accounts that not only limit the capabilities of the user within the EMCS software but may also limit what a user can do on the PC and/or LAN/WAN. This might be used to ensure, for example, that the user of an alarm monitoring workstation is unable to shutdown the active alarm viewer and/or unable to load software onto the PC.

.4 User Security

.1 The software shall be designed so that each user of the software can have a unique username and password. This username/password combination shall be linked to a set of capabilities within the software, set by and editable only by, a system administrator. The sets of capabilities shall range from View only, Acknowledge alarms, Enable/disable and change values, Program, and Administer. The system shall allow the above capabilities to be applied independently to each and every class of object in the system. The system must allow a minimum of 256 users to be configured per workstation. There shall be an inactivity timer adjustable in software that automatically logs off the current operator after the timer has expired.

.5 Configuration Interface

.1 The workstation software shall use a familiar Windows Explorer™-style interface for an operator or programmer to view and/or edit any object (controller, point, alarm, report, schedule, etc.) in the entire system. In addition, this interface shall present a "network map" of all controllers and their associated points, programs, graphics, alarms, and reports in an easy to understand structure. All object names shall be alphanumeric and use Windows long filename conventions. Object names shall not be required to be unique throughout the system. This allows consistency in point naming. For example, each VAV controller can have an input called Space Temperature and a setpoint called CFM Setpoint. The VAV

controller name shall be unique such as VAV for LAB101. Systems requiring unique object names throughout the system will not be acceptable.

.2 The configuration interface shall also include support for template objects. These template objects shall be used as building blocks for the creation of the EMCS database. The types of template objects supported shall include all data point types (input, output, string variables, setpoints, etc.), alarm algorithms, alarm notification objects, reports, graphics displays, schedules, and programs. Groups of template object types shall be able to be set up as template subsystems and systems. The template system shall prompt for data entry if necessary. The template system shall maintain a link to all "child" objects created by each template. If a user wishes to make a change to a template object, the software shall ask the user if he/she wants to update all of child objects with the change. This template system shall facilitate configuration and programming consistency and afford the user a fast and simple method to make global changes to the EMCS.

.6 Color Graphic Displays

.1 The system shall allow for the creation of user defined, color graphic displays for the viewing of mechanical and electrical systems, or building schematics. These graphics shall contain point information from the database including any attributes associated with the point (engineering units, etc.). In addition operators shall be able to command equipment or change setpoints from a graphic through the use of the mouse.

.2 Requirements of the color graphic subsystem include:

.1 SVGA, bit-mapped displays. The user shall have the ability to import AutoCAD generated picture files as background displays.

.2 A built-in library of animated objects such as dampers, fans, pumps, buttons, knobs, gauges, ad graphs which can be "dropped" on a graphic through the use of a software configuration "wizard". These objects shall enable operators to interact with the graphic displays in a manner that mimics their mechanical equivalents found on field installed control panels. Using the mouse, operators shall be able to adjust setpoints, start or stop equipment, modify PID loop parameters, or change schedules.

.3 Status changes or alarm conditions must be able to be highlighted by objects changing screen location, size, color, text, blinking or changing from one display to another.

.4 Graphic panel objects shall be able to be configured with multiple "tabbed" pages allowing an operator to quickly view individual graphics of equipment, which make up a subsystem or system.

.5 Ability to link graphic displays through user defined objects, alarm testing, or the result of a mathematical expression. Operators must be able to change from one graphic to another by selecting an object with a mouse - no menus will be required.

.7 Automatic monitoring

.1 The software shall allow for the automatic collection of data and reports from any controller through either a hardwire or modem communication

link. The frequency of data collection shall be completely user-configurable.

.8 Alarm Management

.1 The software shall be capable of accepting alarms directly from controllers, or generating alarms based on evaluation of data in controllers and comparing to limits or conditional equations configured through the software. Any alarm (regardless of its origination) will be integrated into the overall alarm management system and will appear in all standard alarm reports, be available for operator acknowledgment, and have the option for displaying graphics, or reports.

.2 Alarm management features shall include the ability to have:

.1 A minimum of 255 alarm notification levels. Each notification level will establish a unique set of parameters for controlling alarm display, acknowledgment, keyboard annunciation, alarm printout and record keeping.

.2 Automatic logging in the database of the alarm message, point name, point value, connected controller, timestamp, username and time of acknowledgement, username and time of alarm silence (soft acknowledgement).

.3 Automatic printing of the alarm information or alarm report to an alarm printer or report printer.

.4 Playing an audible beep or audio (wav) file on alarm initiation or return to normal.

.5 Sending an email or alphanumeric page to anyone listed in a workstation's email account address list on either the initial occurrence of an alarm and/or if the alarm is repeated because an operator has not acknowledged the alarm within a user-configurable timeframe. The ability to utilize email and alphanumeric paging of alarms shall be a standard feature of the software integrated with the operating system's mail application interface (MAPI). No special software interfaces shall be required.

.6 Individual alarms shall be able to be re-routed to a workstation or workstations at user-specified times and dates. For example, a critical high temp alarm can be configured to be routed to a Facilities Dept. workstation during normal working hours (7am-6pm, Mon-Fri) and to a Central Alarming workstation at all other times.

.7 An active alarm viewer shall be included which can be customized for each user or user type to hide or display any alarm attributes.

.8 The font type and color, and background color for each alarm notification level as seen in the active alarm viewer shall be customizable to allow easy identification of certain alarm types or alarm states.

.9 The active alarm viewer can be configured such that an operator must type in text in an alarm entry and/or pick from a drop-down list of user actions for certain alarms. This ensures accountability (audit trail) for the response to critical alarms.

.9 Custom Report Generation

.1 The software will contain a built-in custom report generator, featuring word processing tools for the creation of custom reports. These custom reports shall be able to be set up to automatically run or be generated on demand. Each workstation shall be able to associate reports with any word processing or spreadsheet program loaded on the machine. When the report is displayed, it will automatically spawn the associated report editor such as MS Word™.

.1 Reports can be of any length and contain any point attributes from any controller on the network.

.2 The report generator will have access to the user programming language in order to perform mathematical calculations inside the body of the report, control the display output of the report, or prompt the user for additional information needed by the report.

.3 It shall be possible to run other executable programs whenever a report is initiated.

.4 Report Generator activity can be tied to the alarm management system, so that any of the configured reports can be displayed in response to an alarm condition.

.5 Standard reports shall include:

.1 Points in each controller.

.2 Points in alarm.

.3 Disabled points.

.4 Overridden points.

.5 Operator activity report.

.6 Alarm history log.

.7 Program listing by controller with status.

.8 Network status of each controller

.2 Spreadsheet-style reports

.1 The software shall allow the simple configuration of row/column (spreadsheet-style) reports on any class of object in the system. These reports shall be user-configurable and shall be able to extract live (controller) data and/or data from the database. The user shall be able to set up each report to display in any text font, color and background color. In addition the report shall be able to be configured to filter data, sort data and highlight data which meets user-defined criteria.

.2 HTML Reporting

.1 The above spreadsheet-style reports shall be able to be run to an HTML template file. This feature will create an HTML “results” file in the directory of the HTML template. This directory can be shared with other computer users, which will allow those users with access to the directory to “point” their web browser at the file and view the report.

.10 Scheduling

.1 It shall be possible to configure and download from the workstation schedules for any of the controllers on the network:

.1 Time of day schedules shall be in a calendar style and shall be programmable for a minimum of one year in advance. Each standard day of the week and user-defined day types shall be able to be associated with a color so that when the schedule is viewed it is very easy, at-a-glance, to determine the schedule for a particular day even from the yearly view. To change the schedule for a particular day, a user shall simply click on the day and then click on the day type.

.2 Each schedule will appear on the screen viewable as the entire year, monthly, week and day. A simple mouse click shall allow switching between views. It shall also be possible to scroll from one month to the next and view or alter any of the schedule times.

.3 Schedules will be assigned to specific controllers and stored in their local RAM memory. Any changes made at the workstation will be automatically updated to the corresponding schedule in the controller.

.11 Programmer's Environment

.1 The programmer's environment will include access to a superset of the same programming language supported in the controllers. Here the programmer will be able to configure application software off-line (if desired) for custom program development, write global control programs, system reports, wide area networking data collection routines, and custom alarm management software. On the same screen as the program editor, the programming environment shall include dockable debug and watch bars for program debugging and viewing updated values and point attributes during programming. In addition a wizard tool shall be available for loading programs from a library file in the program editor.

.2 Saving/Reloading

.1 The workstation software shall have an application to save and restore field controller memory files. This application shall not be limited to saving and reloading an entire controller – it must also be able to save/reload individual objects in the controller. This allows off-line debugging of control programs, for example, and then reloading of just the modified information.

.3 Data Logging

.1 The workstation software shall have the capability to easily configure groups of data points with trend logs and display the trend log data. A group of data points shall be created by drag-and-drop method of the points into a folder. The trend log data shall be displayed through a simply menu selection. This data shall be able to be saved to file and/or printed.

.4 Audit Trail

.1 The workstation software shall automatically log and timestamp every operation that a user performs at a workstation, from logging on and off a workstation to changing a point value, modifying a program, enabling/disabling an object, viewing a graphic display, running a report, modifying a schedule, etc.

2.4 LEVELS OF ADDRESS

.1 Upon operator's request, EMCS to present status of any single 'point', 'system' or point group, entire 'area', or entire network on printer or OWS as selected by operator.

.1 Display analog values digitally to 1 place of decimals with negative sign as required.

.2 Update displayed analog values and status when new values received.

.3 Flag points in alarm by blinking, reverse video, different colour, bracketed or other means to differentiate from points not in alarm.

.4 Updates to be change-of-value (COV)-driven or if polled not exceeding 2 second intervals.

2.5 POINT NAME SUPPORT

.1 Controllers (MCU, LCU) to support NRC point naming convention as defined in Section 25 05 01 - EMCS: General Requirements.

2.6 ACCEPTABLE MANUFACTURER

.1 Andover Continuum series of controllers.

Part 3 Execution

3.1 LOCATION

.1 Location of Controllers to be approved by Departmental Representative.

3.2 INSTALLATION

.1 Install Controllers in secure locking enclosures [as indicated] [or] [as directed by] Departmental Representative.

.2 Provide necessary power from local 120V branch circuit panel for equipment.

.3 Install tamper locks on breakers of circuit breaker panel.

END OF SECTION

PART - 1 GENERAL

.1 Section includes:

.1 Labour, products, equipment and services necessary to complete the work of this Section.

PART - 2 PRODUCTS

2.1 CONTROL AIR DAMPERS

.1 Type

.1 Modulating control dampers

Opposed blades

.2 Two position control dampers

Parallel blades

.2 Construction

.1 Bearings

Thermal plastic resin copolymer, nylon or oil impregnated bronze,

At blade axles, linkage devices, etc.

.2 Damper blades and frames

Extruded aluminum

Maximum blade length: 1.2 m without internal frame support

Maximum blade length: 1.2 m without internal frame support

Blade edge seals: EPDM gaskets

Frame side seals: extruded TPE

Frame style: flanged to duct.

Jack shaft: extendable, combination of aluminum, and zinc/nickel coated steel

Damper leakage: [50 l/s per m^2][10 CFM per ft^2] damper face area at 1 kPa differential static pressure.

.3 Damper blades for outside air applications

As above

Operating temperature: -40°C to 100°C

Thermally broken and insulated blades; expanded polyurethane foam insulation

Damper leakage: 21 l/s per m^2 damper face area at 1 kPa differential static pressure.

.4 Acceptable Manufacturer:

Tamco - Series 1000

Tamco - Series 9000 (outside air applications)

2.2 AUTOMATIC CONTROL VALVES

.1 Body Construction and Selection

.1 Proportional Valves:

Ball valves in accordance with Section 23 05 23

Pressure independent balancing and control valves in accordance with Section 23 05 23 and as follows:

Danfoss AM-QM Self Balancing And Control Valves (13mm To 32mm)

Danfoss AM-QM Self Balancing And Control Valves (38mm To 50mm)

Danfoss AM-QM Self Balancing And Control Valves (65mm To 100mm)

Globe valves in accordance with Section 23 05 23 and as follows:

Bronze body with screwed ends in sizes NPS 2 and smaller.

Cast iron with flanged ends in sizes NPS 2½ and larger.

Forged steel with flanged ends in sizes NPS 2½ and larger for steam systems.

Two butterfly valves, operated in tandem, are not acceptable for 3-way valves.

.2 Two Position Valves:

Ball valves in accordance with Section 23 05 23

Butterfly valves in accordance with Section 23 05 23 and as follows:

Full lug-wafer style, drilled and tapped

Extended neck for flange and insulation clearance

Valve discs

Composition type with bronze trim

Steam service with supply pressures greater than 103 kPa: stainless steel trim

.3 Valve seat rings

Screw in type.

.4 Proportional (2 way and 3 way)

Ball, and Globe type in accordance with Section 23 05 23.

.5 Two Position

Ball and Butterfly type in accordance with Section 23 05 23.

.6 Pressure ratings for steam and water valves

Minimum one and a half times the maximum system pressure.

Close against a minimum differential pressure rating of 275 kPa.

.7 Selection:

Select control valves as follows unless otherwise shown:

Application	Proportional	Two Position
Central Air Handling Units	SB & FC Globe	---
Refrigeration Chillers, Boilers, Cooling Towers, etc	---	Butterfly
Steam Piping system pressure, temperature and flow control	Globe	---
3 Way Hydronic Piping system pressure, temperature and flow control	Globe	---
Hydronic Piping system pressure, temperature and flow control	SB & FC Globe	---
Piping system automatic drain-down, NPS 50mm and under	---	Ball
Piping System Isolation valves, NPS 50mm and under	---	Ball
Piping System Isolation valves, NPS 100mm and over	---	Butterfly
Terminal unit reheat coils and unit heaters, NPS 32mm and under	SB & FC Globe	Ball
Terminal unit reheat coils, NPS 39mm and over	SB & FC Globe	---
Radiant ceiling panels and wall fin convectors	SB & FC Globe	---

.2 Performance

.1 General

C_v values to be corrected with piping geometry factor (Fp).

Straight through water valves: single seated with equal percentage flow characteristics and minimum resolution of 40:1 or greater.

Three-way mixing water valves: linear for each port giving constant total flow.

Modulating steam valves: modified linear flow characteristics.

.2 Steam Valves, Pressure Drop, unless otherwise shown.

Modulating, 100 kPa or less steam supply pressure: maximum 80% of inlet gauge pressure.

Two position, 100 kPa or less steam supply pressure: maximum 15 kPa.

Modulating, greater than 100 kPa steam supply pressure: 42% of the inlet absolute pressure.

.3 Water Valves, Pressure Drop, unless otherwise shown.

Two position: maximum 10% of system pump head.

Modulating, two-way: maximum of 36 kPa pressure drop.

Modulating, three-way: maximum of 60 kPa pressure drop.

.4 Valve Flow Rates

Valves at air handling units: refer to Coil schedules

Valves at Terminal Units and Unit Heaters : refer to Terminal Unit schedule and Unit Heater schedule.

Valves at distributed heating units including wall fin convectors and radiant panels: refer to plan drawings for flow rate or related heat rate.

All other valves : refer to Control Valve schedule.

.5 Modulating steam loads greater than 900 kg/hr: provide two valves in parallel, controlled in sequence, with first valve in opening sequence sized for 1/3 and the second valve for 2/3 of steam load.

.6 Acceptable Manufacturers

Danfoss

Baumann

Fisher

Honeywell Industrial Series

2.3 VALVE AND DAMPER OPERATORS

.1 General:

.1 Provide valves and dampers with metal body operators sized to assure smooth, positive operation over the entire operating range, without chatter or slamming, and to give tight shutoff at end positions against the system pressures to be encountered.

.2 Failure position:

Spring return, normally open or normally closed sequence as required so that systems will "Fail-safe" in case of control air pressure or power failure.

On 2-way butterfly valves, provide double acting or reversible actuators.

.3 Sequencing by spring range will not be approved for valves or dampers.

.4 Furnish valves and dampers with operators and spring ranges designed to match as linearly as possible the full scale operating range of the control valve.

.5 Valves NPS6 and over: manual override to open and close valve and disable control signal.

.6 Adequately size operators and in sufficient quantity to ensure smooth damper operation

.2 Selection:

.1 Indoor

Pneumatic – Steam Pressure Regulating Valves

.3 Pneumatic Actuators

.1 Valves

Fabricated steel or cast aluminum

Corrosion resistant spray finish

Rolling diaphragm

Maximum air operating pressure: 170 kPa

Start point pressure: 10 to 90 kPa adjustable

.2 Ancillary devices

End switches as detailed

Pilot positioner relays

Interconnection piping

.4 Electronic Actuators

.1 General

Low torque, fully modulating or two position as indicated.

Time for full open to full close: two minutes nominal.

Current limiting, digital motor rotation sensing circuits, or adjustable end of travel switches to provide motor protection.

Tandem mounting of actuators for higher torque requirements are acceptable.

Spring return with manual override unless otherwise indicated or specified.

On loss of control signal, valve will fail to the designated normally open or closed position.

.2 Terminal equipment

Non-spring return type.

.3 Power and Communications

Positive positioning at 2-10 VDC or 4-20 mA signal

Visual valve position indicator

Built-in rotation reversing switch

Actuator generated 2-10 VDC electronic feedback signal

Capacity to add auxiliary switches when required

Power: 24 VAC or VDC for proportional control, 24 or 120 VAC for 2 position, maximum 15 VA.

.4 Valves NPS 6 and larger

Modulating motor resolution: 1%

Two 1 metre pigtails or terminal strips

Field changeable, printed circuit boards to provide either 2-position or modulating operation

Actuator resolution: 80:1

Run time, end-to-end: 15 to 45 seconds

Power: 24 or 120 VAC, 60 Hz

Auxiliary switches, 1 NO, 1 NC

Housing. NEMA 4

2.4 **SWITCHES**

.1 Electric Space Thermostats

.1 "On-Off" thermostats for 120 volt service: minimum contact rating of seven amperes.

.2 Thermostats for unit heaters: complete with a manual switching sub-base.

Switching action: "Heat-Off-Fan"

Minimum contact rating: seven amperes at 120 volts A.C.

.3 Modulating electric thermostats: compatible with the equipment they are to control.

.2 Electric Temperature Switches

.1 General application

Minimum contact rating of seven amperes at 120 volts A.C.

Switch setting: adjustable differential.

Switch to switch setting: adjustable differential.

.2 Outside air application

As above

Installed so as not to be affected by sunlight, exhaust air, or reverse warm air flow through air supply units should the supply be off.

.3 Thermowell

Complete with compression fitting for 20 mm well

Mounting length: 100 mm

Immersion wells: type 316 stainless steel

.4 Strap-on pipe

Complete with helical screw stainless steel clamps

.3 High Limit Controls

.1 For ducts under 1.5 sq m of cross sectional area or where the longest dimension is not over 760 mm:

Bi-metal operated control complete with manual reset

Switch contact: normally closed.

.2 Ducts of cross sectional area greater than 1.5 sq m:

Temperature sensitive heads connected to a pressure switch so that, should a high temperature occur, one of the heads will operate to open the pressure switch and stop the respective equipment.

Switch contact: normally closed.

.4 Low Limit Controls

.1 6 m of capillary, wired to stop the equipment should the temperature over any 300 mm one foot] length drop below its set point.

.2 Switch contact: normally closed with a manual reset.

.5 Fan Proof-of-Flow

.1 U.L. listed adjustable set point and differential pressure type:

Fan static greater than 250 Pa: piped to fan discharge

Fan static less than 250 Pa: piped across the fan

For fractional horsepower and non-ducted fans, use relays or auxiliary contacts.

.2 Pressure ratings

Adjustable set point: 0-2500 Pa

Adjustable differential: 10-250 Pa

.3 U.L. listed adjustable differential pressure or flow type as specified in the sequence of operation:

Chilled water flow switches: totally sealed vapour tight switch enclosure on 2060 kPa body

Differential pressure switches: valve manifold for servicing

.4 Pressure ratings

Chilled and condenser water systems: 860 k

Hot water systems:860 kPa

Steam system and control air systems: 1200 kPa

High temp water systems above 110°C: 2700 kPa, with a full operating range of 0

to 270 kPa with an accuracy of 25 kPa

.5 Pigtail siphon between sensor and fluid line: steam lines and high temperature water lines.

.6 Isolation valve and snubber installed between sensor and pressure source.

.6 Flow Switches

.1 McDonnell and Miller FS-7 Series for liquids and AF Series for air flow.

.7 Fire Stats

.1 57°C manual reset, line voltage type with bimetal actuated switches.

.2 Size switch with adequate rating for the applied load.

2.5 ELECTRICAL RELAYS

.1 Current sensing (switch)

.1 Metering transformer ranged to match load being metered

Plug-in base and shorting shunt to protect current transformer when relay is removed from socket

Current transformer for single or three phase metering into single relay

Adjustable latch level, adjustable delay on latch and minimum differential of 10% of latch setting between latch level and release level

Discrimination between phases in three phase applications to allow worst case selection

Mounted in motor starter cabinet and fed from starter control transformer

Rating: 10 amps at 240 VAC

.2 General relays

.1 Relays for control and status indication

Double voltage DPDT

.2 Relays for implementation of control strategy

Single voltage with appropriate number of contacts

2.6 ELECTRONIC SENSORS

.1 General Requirements

.1 Input/output sensors and devices: closely matched to the requirements of the DCP for accurate, responsive, noise free signal input/output.

.2 Control input response: high sensitivity and matched to the loop gain requirements for precise and responsive control.

.3 In no case shall computer inputs be derived from pneumatic sensors. In no case shall thermocouples or thermistors be used.

.2 Temperature Sensors

.1 Resistance Temperature Detector (RTD) type:

500 ohm balco

or, 100 or 3000 ohm platinum

Factory calibrated

Stem and tip construction: copper or type 304 stainless steel.

End-to-end accuracy: ±0.25°C (±0.5°C) over full range of variable

Transducing output circuit to suit DCP

.2 Thermistor for Terminal Box Control

As above, or 100,000 ohm thermistor

Accuracy: ± 0.5°C

.3 Air Temperature Sensors, Space Type 1

RTD type

Concealed single linear set-point adjustment

Tamper-resistant access door

Field Bus communications jack for portable POT connection

On/Off button to allow occupant override feature

(Plastic mono-chromatic) (brushed aluminum) cover and casing

.4 Air Temperature Sensors, Space Type 2 sensor:

Thermistor type

Stainless steel flat plate surface sensor; sensor epoxy-bonded to back of cover plate.

Field Bus communications jack for portable POT connection

.5 Outside air wall mounted sensors:

RTD type

Provided with a sun shield.

Inert section for passing through wall to unit.

.6 Duct temperature sensors:

Rigid stem or averaging type as specified in the sequence of operation.

Averaging element style for ducts greater than 0.4 m² cross-sectional area.

.7 Water temperature sensor:

RTD type

Immersion well: NPS 3/4 stainless steel spring loaded construction, with heat transfer compound compatible with sensor, minimum height of 50mm or to clear insulation thickness

Minimum insertion length: 100 mm

.3 Dewpoint sensor

.1 Type:

Non-reactive organic bobbin material to give precise dewpoint readings with accuracy of not more than +1°C

Integral draft shield as part of the instrument for air velocities in excess of 0.25 m/s

Operate over a minimum dewpoint temperature range suitable to the application.

Provide one additional bobbin assembly with each dewpoint sensor

.4 Humidity Sensors Relative Humidity Sensors

.1 Capacitance type with 5% to 90% range

.2 Operating temperature range: 0-60°C

.3 Absolute accuracy:

Duct sensors: ±5%

Room sensors: ±2%

.4 Duct mounted humidity sensors: provided with a stainless steel sampling chamber for operation up to 10 m/s.

.5 Wall mounted sensors: provided with covers identical to temperature sensors.

.6 Combination temperature and humidity sensor:

Combination temperature compensated humidity and temperature sensors, with remote transmitter and interconnecting cabling

Stainless steel sensor probe, length as identified on drawings

Cable length:[5000 mm

.5 Differential and Static Pressure Sensors

.1 Air flow and static pressure analog sensors

High accuracy suitable for the low velocity pressures to be encountered:

Selected for approximately 50% over-range

4 to 20 ma output

Adjustments for zero and span

Connect differential pressure sensors to the air flow measuring station with valved lines for testing and calibration.

.2 Space pressure

Flush mounted 10 gauge stainless steel welded casing with No. 4 finish

Shielded space probe unaffected by airflows up to 5 m/s from a 360° radial source

Accuracy: ±1% of actual space pressure

.3 Outdoor air pressure

Exposed 10 gauge anodized aluminum with NPT 2 connection

Shielded space probe unaffected by airflows up to 5 m/s from a 360° radial source

Accuracy: ±2% of actual outdoor air static pressure when subjected to a radial wind velocities up to 35 m/s with approach angles up to 30° from the horizontal

2.7 FLOW METERS

.1 Water

.1 Provided under Section 23 05 19.

.2 Steam Flow Measurement

.1 Measure steam flow by means of an inline vortex flow meter and separately installed pressure sensor and transmitter. Flow meter shall be suitable for wet steam mass flow integrated temperature detection and measurement for steam quality falling within the range of 80% and 100%.

.2 Approvals:

Approval: CSA C/US NI Cl.I Div.2 Gr. ABCD

.3 Output Signal:

Output; Input: 4-20mA HART, pulse/freq./switch;

.4 Input:

4-20mA input

.5 Display:

Display; Operation: SD03 4-line, illum.; touch control + data backup function

.6 Construction:

Housing: GT20 dual compartment, aluminium coated

.7 Sensor Version:

Mass flow (integrated temperature measurement)

.8 AAS Process Connection:

Cl.150 RF Sch.40, flange ASME B16.5

.9 Calibration Flow:

0.75% volume 3-point

.10 Operation Language Display:

English

.11 Application Package:

Wet steam detection

.12 Performance

Accuracy, measured mass flow to within ±2% of the full scale.

Velocity range: 20 to 50 m/s

Re > 20,000

Operating temperatures: 150 °C

.13 Acceptable Products:

Endress and Hauser (or equivalent)

.14 (Steam Flow Meter Companion) Pressure Sensor and Transmitter

Measure steam pressure with condensate temperature buffer installation arrangement as indicated on the drawings.

Approval:

CSA C/US IS Cl.I,II,III Div.1 Gr.A-G, Cl.I Div.2 Gr.A-D, Ex ia, C: zone 0,1,2/ US: zone 0,1,2,20,21,22

Output; Operating:

4-20mA HART; inside + LCD

Housing;

Cover Sealing; Cable Entry: T14 Aluminium IP66/67 NEMA6P; EPDM; NPT1/2 thread, T14 = side cover

Sensor Range;

Sensor Overload Limit: 10bar/1MPa/150psi gauge; 40bar/4MPa/600psi

Calibration;

Unit: Sensor range; psi

RA Process Connection:

Thread ANSI MNPT1/2 FNPT1/4, 316L

A Seal:

FKM Viton

Additional Option 1: Not selected

Additional Option 2: Mounting bracket, wall/pipe, 316L

Performance

Accuracy, measured pressure up to plus / minus 0.05 % of the set span.

Acceptable Products:

Endress and Hauser (or equivalent)

.3 Airflow Measuring Stations

.1 Measure airflow by means of a network of static and total pressure sensors factory positioned and connected in parallel to produce an averaged velocity pressure.

.2 Performance:

Accuracy, measured velocity pressure converted to airflow l/s: ±2% of the full scale

Velocity range: 3.5 to 20 m/s

Maximum airflow resistance: 0.6 times the velocity head

Maximum operating temperatures: 121°C

.3 Construction:

Casing: heavy gauge (galvanized steel) construction

Duct to duct mounting flanges

Aluminum pitot traverse tubes

Inlet honeycomb air straightening section minimum free area: 97%.

2.8 TRANSMITTERS

.1 Temperature Transmitters

.1 Standalone transmitter

Microprocessor based transmitter

Input circuit: 3 lead, 100 ohm at 0°C, platinum RTD type sensor.

Integral multi-line digital display

Combined non-linearity, repeatability, hyseterisis effects: ±0.5% of full scale range.

Integral zero and span adjustments

Outputs: 4-20 mA linear into maximum 500 Ohm load

Power: 24 VAC, or 24 VDC, or 120 VAC

Provide transformer and ac/dc converter for 24 V devices

.2 Humidity Transmitters

.1 Standalone transmitter

Microprocessor based transmitter

Input circuit: from RH sensor

Integral multi-line digital display

Combined non-linearity, repeatability, hyseterisis effects: ±1% of full scale range.

Integral zero and span adjustments

Outputs: 4-20 mA linear into maximum 500 Ohm load

Power: 24 VAC, or 24 VDC, or 120 VAC

Provide transformer and ac/dc converter for 24 V devices

.3 Pressure (Static and Airflow) Transmitters

.1 Standalone transmitters

Microprocessor based transmitter

Receive flow signals (total and static pressure) from an airflow station or pressure probe and produce dual output linear and scaled signals for air volume, velocity and differential pressure

Integral multi-line digital display

Natural full span: 0-125 Pa

Accuracy: ±0.25% of natural spans

Outputs

0-5 VDC

0-10VDC

or 4-20 mA linear into maximum 500 Ohm load

Power: 24 VAC, or 24 VDC, or 120 VAC

Provide transformer and ac/dc converter for 24 V devices

Outdoor static pressure reference

2.9 **TRANSDUCERS**

.1 Kilowatt Transducers

.1 Integrated electronic type with accuracy of .2% of scale.

For balanced (such as motors) three phase loads, provide two current transformers (CT's).

Provide two or three potential transformers (PT's) as recommended by the manufacturer for the application.

Output: 4 to 20 ma.

Provide suitable CT's and PT's unless specifically specified with other equipment.

.2 Current Transducers

.1 Integrated electronic type with accuracy of .2% of scale.

For balanced (such as motors) three phase loads, provide two current transformers (CT's).

Measure line current, with output proportional signal:

4-20 mA

0-1 VDC

0-10 VDC

0-20 VDC

2.10 **ANCILLIARY DEVICES**

.1 Smoke Detectors

.1 Ionization plug-in type device

Two ionization chambers

A comparator-switching circuit

An integral alarm light indicator

Solid state detector circuits

Alarm status indicating lights shall be visible on the front of the detector.

.2 Self compensating for the effects of:

Velocity 0-5 m/s

Changes in temperature 0-50°C

Humidity (5-95% RH)

Atmospheric pressure

.3 Wiring connections: colour coded leadwires located on the mounting base.

.4 Mounting base: standard four inch square electrical box.

.5 Single chamber detectors and photoelectric smoke detectors will not be acceptable.

.2 Duct Smoke Detectors

.1 As above

.2 Listed by Underwriters Laboratories, Inc. for use in air handling systems.

.3 Designed to provide detection of combustion gases and fire and smoke in air conditioning and ventilating duct systems in compliance with the National Fire Protection Association and Underwriters Laboratories, Inc. Standard UL l67.

.4 Air sampling chamber with sampling tubes extending through the width of the air duct.

.5 Key controller test and reset switches plus an easily accessible test jack.

.6 Alarm relay contacts (DPDT) capable of handling loads of up to five (5) amperes at 120 VAC or 28 VDC resistive.

.7 Power: self-contained power supply requiring 120/220/240V power.

.3 Carbon Monoxide Sensors

.1 Solid state, plug-in type with a minimum 3 year sensor life, calibration to be set at 50 to 100 ppm.

CSA approved

.2 Local sensors:

Complete with local LED indication for High and Low alarm as well as a green LED power “ON” light.

Power: low voltage control transformer mounted adjacent to sensor for sensing device

.3 Central control panel:

NEMA 12 lockable steel enclosure containing LED indicators for High, Low and power “ON” for each detection system

BAS interface: one auxiliary alarm contact

Power: 120 VAC, 60 Hz, single phase

.4 Calibration kit:

One canister each of 50 and 100 ppm CO, one adapter and one carrying case.

.5 System supplier to provide site inspection, operating and maintenance instructions and a trained technician to perform system start-up and calibration checks.

.4 Surface Water Detection

.1 Provide alarm on presence of water on floor.

Expendable cartridge sensor

Internal waterproof switch

One set of dry contacts: 2 A at 24 VAC or VDC

Unaffected by moisture in air

Self-powered.

PART - 3 EXECUTION

3.1 INSTALLATION

.1 General

.1 Provide instrumentation, control devices, (pneumatic system) and electrical wiring for control and monitoring strategies as detailed in sequences of operation.

.2 Install equipment in accordance with manufacturers instructions.

.3 Make sensors and elements accessible for replacement and servicing

.4 Install transmitters, transducers, receiver-controllers, solenoid air valves and relays in NEMA 12 enclosures with wiring and tubing within panels in trays or individually clipped to back of panel and clearly identified. Install in NEMA 4 enclosures for outdoor installation.

.5 Install outdoor sensors in NEMA 12 enclosure.

.6 Support field mounted transmitters on pipe stands or channel brackets. Pipe pneumatic sensing lines to transmitters, complete with dirt pockets at transmitter.

.7 Support wall mounted devices on plywood back board, supported from wall or floor. Paint plywood one coat of primer and two top coats, light grey colour.

.2 Thermowells

.1 Install for all piping installations.

.2 Where pipe diameter is less than well insertion length, locate well in elbow, or expand pipe size to be equal to insertion length plus 25 mm.

.3 Thermowell to restrict flow area by less than 30%.

.3 Identification

.1 Identify field devices in accordance with Section 23 05 01.

.4 Testing

.1 Calibrate and test all field devices for accuracy and performance.

.2 Submit report detailing tests performed, results obtained to Consultant for approval. Consultant will verify results at random. Provide all testing equipment and manpower necessary for this verification.

3.2 SENSORS AND SWITCHES

.1 General

.1 Install room type 1 sensors in all general areas.

.2 Install room type 2 sensors where indicated.

.3 Use combination temperature and humidity sensors only when shown on drawings, otherwise provide separate sensors.

.2 Duct Installation

.1 Do not mount in dead air space.

.2 Thermally isolate elements from brackets and supports so as to respond to air temperature only.

.3 Support sensor element independently from coils and filter racks.

.3 Averaging duct type sensor or switch

.1 Sensor length: not less than 1000 mm for each square meter of duct cross-sectional area.

.2 Wire multiple sensors in parallel for freeze protection applications.

.3 Wire multiple sensors separately for temperature measurement.

.4 High Limit Controls:

.1 Coverage

Provide a temperature sensitive head for approximately every 1.5 sq m of duct cross sectional area.

Install heads in a staggered arrangement to give complete coverage of the duct.

.5 Low Limit Controls

.1 Coverage:

String horizontally across the full width of duct or coil with runs at a maximum of 300 mm centres.

Where one control is insufficient to provide the specified coverage, provide two or more controls to be wired in series.

Coordinate with other trades so that the capillary does not obstruct access from access openings or doors to other duct mounted equipment.

Coordinate with other trades so that the capillary does not obstruct access from access openings or doors to other duct mounted equipment.

.6 Flow Switches

.1 Install flow switches upright in horizontal pipe lines with at least five pipe diameters of straight pipe (without fittings, restrictions etc.) on each side of the flow switch.

.7 Airflow Stations

.1 Locate airflow stations in accordance with manufacturer's guidelines so as to approach ideal laboratory conditions.

.2 Cap off manifold until cleaning of ducts is complete.

.8 Pressure and Differential Switches

.1 Install isolation valve and snubber between sensor and pressure source.

.2 Protect sensing elements on steam and high temperature greater than 98°C with pigtail syphon between valve and sensor.

.9 Pressure Gauges

.1 Provide air pressure gauges as follows:

All pneumatic devices

I/P transducers

Pilot positioners

Motor operators

Switches

Relays

Valves

Damper operators

Valve actuators

Controller outputs

END OF SECTION

PART - 1 GENERAL

1.1 SUMMARY

.1 Section includes:

.1 Sequence of Operations to be issued by Addendum. Controls schematics and I/O summary Tables only have been made available at this time.

.2 Labour, products, equipment and services necessary to complete the work of this Section.

1.2 DEFINITIONS

.1 General

.1 System Start: actions required at system start-up under schedule control or on re-start after power failure

.2 Normal Operation: normal control sequence after initial start-up requirements are satisfied.

.3 System Stop: shut-down of system under schedule control and fail-safe position of system in event of loss of normal power.

.4 Fire Alarm: action required in the event of a signal from the fire alarm system.

.5 Schedule: scheduled operation of system

.6 Alarm: minimum alarms required.

.7 Emergency Power: BMS control elements to be fed from emergency power

.8 Load Shedding Priority: load shedding category - 0" expendable to 5" essential

PART - 2 PRODUCTS (NOT USED)

PART - 3 EXECUTION

3.1 INSTALLATION

.1 Sequence of Operation

.1 Control schematics that follow described required I/O for the control and monitoring of the building systems.

.2 I/O Summary

.1 I/O Summary tables that follow identify the point types and requirements of the building systems.

.2 I/O requirements are shown on the system schematic drawings.

.3 Control Sequence - Table of Contents

CS 412	22 SP-03 Storm Sump Pump
CS 501	Hot Water (Glycol) Heating System
CS 502	VFD Glycol Secondary Chilled Water Pump Control
CS 601	22-CCH-04 Building Services Chilled Water (Glycol) System
CS 602	High Lift Chilled Water - Glycol Cooling System
CS 701	22- AHU-03 General Building Conditioning
CS 701a	Damper Control
CS 702	22-AHU-04 Labs Pre-Conditioning
CS 703	22-AHU-05 FLEXIBLE CABIN / FUSSELAGE LAB
CS 704	22-AHU-06 Airport Terminal Lab
CS 705	22-AHU-07 Vibration Lab
CS 801	Building Sanitary Exhaust
CS 802	Flexible Cabin Sanitary Exhaust
CS 823	VAV Terminal Units with Re-Heat
CS 824	VAV Terminal Units
CS 825	Flight Sim Lab Fan

END OF SECTION

CS 412 22-SVP-03 SUMP PUMP (Storm and Sanitary)

Control Diagram	Detail: 16 Drawing: M-09
System Start	Continuous operation
Normal Operation	*Sump Level Control* Pumps operate under OEM built-in float control and high level float and audible alarm. BAS to remotely enable or disable pumps to run. BAS to monitor high level float alarm. Alternating lead pump and start stop of pump float control provided within self-contained pump control panel
System Stop	BAS remote override control
Schedule	Continuous operation
Fire Alarm	N/A
Alarms	HLA High sump level alarm
Monitor	HLA Pump High Level Alarm
Trend Logs	N/A
Emergency Power	YES

Remarks: Sump pump control panel to be equipped with audible high level alarm and float control alarm dry contacts to be connected to BAS

End of Section

CS 501 HOT WATER (GLYCOL) HEATING SYSTEM

Control Diagram	37788-M07	Detail Drawing	3788-M07

System Start

Operator initiates start-up of system. Operator selects initial lead boiler designation. Designated lead circulating pump starts ESS1.

Boiler Warm-Up

Open return water control valve VC1(VC2). Set starting boiler firing demand limit AO-EC to maximum 20% for 15 minutes (time to be adjusted in accordance with manufacturer's requirements) for boiler warm-up. At completion of boiler warm-up, set boiler demand limit to 100%. This control operates every time a boiler starts.

Normal Operation

Boiler Control

Boiler supply water temperature sensor hard wired to boiler OEM control to maintain supply water temperature.

Boiler supply water aquastat hardwired to boiler OEM control.

Boiler supply water temperature AI-LT1(2) monitored on BMS.

Provide Serial Communication (SC) to boiler OEM control to monitor boiler status

Increasing Load

On increasing heating load, when lead boiler is operating at 90% of maximum firing rate (AI-ER), start lag circulating pump ESS2, then open boiler control valve VO1 (VO2), and then enable lag boiler.

When lag boiler warm-up cycle is complete, reduce lead boiler demand firing rate AO-EC at 10% / 5 minutes until lead boiler and lag boiler firing rates (AI-ER) are within 10% of each other, then reset both boiler demand limits to 100%.

Decreasing Load

On decreasing load, when the combined firing rate of both boilers AI-ER is 85% of one boiler capacity (sum(AI-ER1% + AI-ER2% < 85%), stop the lead boiler, wait 1 minute, then close boiler control valve VO1 (VO2) and then shut-off pump. Cycle boiler and pump "lead" and "lag" designations.

Supply Water Pressure Control

Differential pressure sensor located across heating mains at ground floor level modulates the Constant Pressure Differential Control Valve CV-AO-VC to maintain constant pressure AI-LPD at the end of the heating mains. Control valve is sized to handle the full flow of one circulating pump and a pressure drop of 35 kPag.

CS 501 HOT WATER (GLYCOL) HEATING SYSTEM

Steam to Hot water Heat Exchangers (HX-1, & 2)

Operator OR BAS master schedule enables the heating system to operate.

When the heating system is enabled, the Heat Exchangers to operate in a staged lead lag configuration. If the lag Heat Exchanger fails to generate heat, operate the lag Heat Exchanger.

Reassign the lead and lag heat exchanger once per week.

Stage the Heat Exchangers such that the lead heat exchanger steam control valve will modulate to maintain the system supply water temperature set-point. Should the steam control valve be fully open and the system supply water temperature be less than set-point for a period of 15 minutes, the BAS shall apply an equal control signal to the steam control valves serving both the lead and lag Heat Exchangers that shall modulate to maintain the system supply water set-point. Should both control valves modulate to less than 25% open, the BAS shall revert back to single heat exchanger control.

Whenever a steam control valve is closed, the heating water control valve shall also be closed.

BAS shall monitor outdoor air temperature.

BAS shall monitor system supply and return water temperatures.

The heating supply water temperature set-point shall be linearly scheduled to the outdoor air temperature as per the following table:

Outdoor Air Temperature	System Supply Water Temperature
Deg. F / Deg. C.	Deg. C / Deg. F.
-13 / -25	180 / 82.2
65 / 18.3	140 / 60

Primary Heating Pump Control

System Start

Primary heating pumps 22-HWP-1 & 2 shall operate in a lead lag configuration. Operator OR BAS master schedule initiates start-up of the lead pump. Whenever the heating system is enabled, the lead pump shall be enabled.

Normal Operation

BAS monitors the differential pressure sensor located across the supply and return heating water mains where indicated on the drawings. The BAS shall use a PID control loop to modulate the speed of the active primary circuit heating water pump 22HWP-01 or 22HWP-02 to maintain differential pressure set-point. The set-point is to be determined in cooperation with the TAB contractor through field testing when all control valves are commanded open.

The pumps are intended for lead lag operation. Whenever pumps are to operate they shall be duty cycled on a monthly basis. The pump speed set point shall have a minimum speed of 25%. The BAS shall sequentially cycle both the duty and standby pump on for a minimum run time of 5 minutes once per month, twelve months per year to prevent pump from seizing.

CS 501 HOT WATER (GLYCOL) HEATING SYSTEM

System Stop	Primary heating pumps 22-HWP-1 & 2 shall operate in a lead lag configuration. Operator OR BAS master schedule initiates start-up of the lead pump. Whenever the heating system is disabled, the heating pumps shall be disabled.	
Schedule	Continuous during heating season.	
Fire Alarm	Circulating pumps continue to operate.	
Alarms	HTA	High heating water supply temperature > 98℃
	LTA	Low system supply water temperature < 22℃
	VFDA	Variable Frequency Drive Alarm Contacts (x2)
Trend Logs	Supply, Return, and Outdoor Air Temperature	
Emergency Power	No	

Remarks:

1.

End of Section

CS 502 VFD Glycol Secondary Chilled Water Pump Control (22PCWP-05 & 06)

Control Diagram	Detail: Drawing: M-07
System Start	Operator OR BAS master schedule initiates start-up of 22AHU-03. Whenever 22AHU-03 and 22CCH-04 have a run status of "ON", BAS enables lead secondary chilled water pump 22CWP05 / 22CWP06 to starts.
Normal Operation	BAS monitors the differential pressure sensor located across chilled water mains at the branch connections to 22-AHU-03. The BAS shall use a PID control loop to modulate the speed of the active secondary chilled water pump 22CWP-05 or 22CWP-06 to maintain differential pressure set-point. The set-point is to be determined in cooperation with the TAB contractor through field testing when 22-AHU-03 cooling coil control valve is fully open. The pumps are intended for lead lag operation. Whenever pumps are to operate they shall be duty cycled on a monthly basis. The pump speed set point shall have a minimum speed of 25%. The BAS shall sequentially cycle both the duty and standby pump on for a minimum run time of 5 minutes once per month, twelve months per year to prevent pump from seizing. *Secondary Loop Supply Water Pressure Control* *Pump Failure* If lead glycol chilled water pump fails, start lag pump.
System Stop	On request from operator to shut-down system, shut-down duty glycol chilled water pump.
Schedule	Enable pumps to be scheduled to operate in accordance with 22AHU-03 and Chiller 22CCH-04 system scheduling.
Fire Alarm	N/A
Alarms	22CWP-05 Circulating pump fail to run (common flow switch) 22CWP-05 Circulating pump fail to run (common flow switch)
Trend Logs	LT1 Secondary chilled water supply temperature LT2 Secondary chilled water return temperature
Emergency Power	No

Remarks:

1.

End of Section

CS 601 22-CCH-04 BUILDING SERVICES CHILLED WATER (GLYCOL) SYSTEM

Chiller 22-CCH-04

Control Diagram — Detail: Drawing: 3788 - M-07

System Start — Operator OR BAS master schedule initiates start-up of system. The BAS shall monitor the Chiller Run Status. Enables Chiller CCH-4 to start. Associated chilled water pump 22CWP03 / 22CWP04 starts. The chilled water flow switch shall be provided and hard wired to the chiller control panel by Division 25 in accordance with manufacturer's recommendations. Upon proof of flow, the chiller shall be allowed to start.

Normal Operation

Chilled Water Temperature Control

Chiller OEM controller operates machine to maintain chilled water temperature in OEM panel at 6.5℃. OEM temperature set-point can be reset remotely through the BMS to a maximum temperature of 10℃ through a 4 to 20 ma signal from BAS to Chiller terminal strip or via a Serial Communications link.

Chilled Water Temperature Reset

If outdoor air temperature is <20℃, set chilled water temperature at 9℃. If outdoor air temperature is ≥20℃, initially set chilled water temperature at 6.5C. If all control valves are < 80% open, increase chilled water supply temperature setpoint 0.5℃ / 15 minutes until at least one chilled water valve is 90% open, as long as all AHU return air humidity values are less than 60% RH.

Chiller / BMS Serial Communications

All chiller control panel operating data is made available to the BMS through the interface module with the BACnet MSTP protocol.

Primary Chilled Water Pumps 22-CWP09 and 22-CWP10

System Start — Primary chiller pumps 22-CWP09 and 22-CWP10 shall operate in a lead lag configuration. Operator OR BAS master schedule initiates start-up of the lead pump. Whenever the chiller plant enabled, the lead pump shall start.

Normal Operation — BAS starts lead chilled water pump whenever the Chiller is enabled to start. The BAS shall monitor each chilled water pump for run status. The pumps are intended for lead lag operation. Whenever pumps are to operate they shall be duty cycled on a monthly basis. The BAS shall sequentially cycle both the duty and standby pump on for a minimum run time of 5 minutes once per month, twelve months per year to prevent pump from seizing.

Pump Failure

Should the lead pump fail to start, following a five minute time delay, the BAS shall command the primary pump off, generate an alarm condition and automatically start the secondary pump.

CS 601 22-CCH-04 BUILDING SERVICES CHILLED WATER (GLYCOL) SYSTEM

System Stop — Operator OR BAS master schedule initiates stop of the lead pump. Whenever the chiller plant disabled, the lead pump shall stop.

Chiller OR BMS Serial Communications

All chiller control panel operating data is made available to the BMS through the interface module with the BACnet MSTP protocol.

Schedule — Enable pumps to be scheduled to operate in accordance with 22AHU-03 and Chiller 22CCH-04 system scheduling.

Secondary Chilled Water Pumps 22-CWP11 and 22-CWP12

System Start — Secondary chiller pumps 22-CWP11 and 22-CWP12 shall operate in a lead lag configuration. Operator OR BAS master schedule initiates start-up of the lead pump. Whenever the chiller plant is enabled, the lead pump shall start. The pumps are intended for lead lag operation. Whenever pumps are to operate they shall be duty cycled on a monthly basis. The pump speed set point shall have a minimum speed of 25%. The BAS shall sequentially cycle both the duty and standby pump on for a minimum run time of 5 minutes once per month, twelve months per year to prevent pump from seizing.

Secondary Loop Supply Water Pressure Control

Normal Operation — BAS monitors the differential pressure sensor located across chilled water mains at the branch connections to 22-AHU-03. The BAS shall use a PID control loop to modulate the speed of the active secondary chilled water pump 22CWP-05 or 22CWP-06 to maintain differential pressure set-point. The set-point is to be determined in cooperation with the TAB contractor through field testing when 22-AHU-03 cooling coil control valve is fully open.

Pump Failure

Should the lead pump fail to start, following a five minute time delay, the BAS shall command the primary pump off, generate an alarm condition and automatically start the secondary pump.

System Stop — Operator OR BAS master schedule initiates stop of the lead pump. Whenever the chiller plant is disabled, the lead pump shall stop.

Schedule — Enable pumps to be scheduled to operate in accordance with 22AHU-03 and Chiller 22CCH-04 system scheduling.

System Stop — Operator OR BAS master schedule initiates stop of the lead pump. Whenever the chiller plant disabled, the lead pump shall stop.

Chiller OR BMS Serial Communications

All chiller control panel operating data is made available to the BMS through the interface module with the BACnet MSTP protocol.

Schedule — To match main air handling system schedule and when 22-AHU-03 economizer cycle is unable to meet the building cooling demand or by operator selection.

Fire Alarm — N/A

CS 601 22-CCH-04 BUILDING SERVICES CHILLED WATER (GLYCOL) SYSTEM

Alarms	CHAS	Chiller alarm status
	CHWPS	Primary Chilled Water Pump Status – current sensor (x2)
	CHWPS	Secondary Chilled Water Pump Status – current sensor (x2)
	VFDALM	Secondary Chilled Water Pump VFD Alarm Status (x2)
	CHLWT	Chiller leaving water low temperature alarm
	CHWWT	Chiller entering water high temperature alarm
Trend Logs	LT1	Primary chilled water supply temperature
	LT2	Primary chilled water return temperature
	LT3	Secondary chilled water supply temperature
	LT4	Secondary chilled water return temperature
Emergency Power	No	

Remarks:

1.

End of Section

CS 602 High Lift Low Temp Chilled Water (Glycol) System 22-CCH-05 and 22-CCH-06

Chiller 22-CCH05

Control Diagram — Detail: Drawing: 3788 - M-07

System Start — Operator OR BAS master schedule initiates start-up of system. The BAS shall monitor the Chiller Run Status. When the chiller is enabled, the BAS shall enable primary chilled water pump 22-CWP-09 or 22-CWP-10 and primary condenser water pump 22-CWP-07 or 22-CWP-08 start and Dry Cooler 22-dry-01 to start. Chilled and condenser water flow switches shall be provided and hard wired to the chiller control panel by Division 25 in accordance with manufacturer's recommendations.

The following conditions must be met in before the chiller is allowed to start:

1. Air handling unit 22-AHU-3 must have a run status of "On"
2. Air handling unit 22-AHU-3 must be in mechanical cooling mode with a demand for cooling (not operating in economizer cycle).
3. Chilled water lead pump 22-CWP-09 or 22-CWP-10 and primary condenser water lead pump 22-CWP-07 or 22-CWP-08 and Dry Cooler 22-dry-01 commanded to start.
4. Chilled and Condenser water flow switches must return a Proof of Flow back to the chiller control panel.
5. The outdoor air temperature is greater than set-point to permit Fluid Cooler Free Cooling.
6. Control valves CV-FC1 and CV-FC2 are in the Non-Bypass position.

Normal Operation

Chilled Water Temperature Control

Chiller OEM controller operates machine to maintain chilled water temperature in OEM panel at 1.1℃. OEM temperature set-point can be reset remotely through the BMS to a maximum temperature of 6.7℃ through a 4 to 20 ma signal from BAS to Chiller terminal strip or via a Serial Communications link.

Chilled Water Temperature Reset

The BAS shall allow operator override control of chilled water supply temperature set-point within the specified high and low chilled water temperature limits.

Chiller / BMS Serial Communications

All chiller control panel operating data is made available to the BMS through the interface module with the BACnet MSTP protocol.

Chiller Failure — Should the chiller stop or fail to start, the chiller shall be disabled and the plant go into Plant Shutdown Mode

CS 602 High Lift Low Temp Chilled Water (Glycol) System 22-CCH-05 and 22-CCH-06

Plant Shutdown

Operator OR BAS master schedule initiates chiller plant shut down mode according to the following sequence of operations:

1. Chiller shall be disabled and if stopped under an alarm condition a "Chiller Stop" alarm condition be reported through the BAS.
2. After a five minute time delay, chilled water lead pump 22-CWP-09 or 22-CWP-10 and primary condenser water lead pump 22-CWP-07 or 22-CWP-08 and Dry Cooler 22-dry-01 commanded to stop.

Schedule

Enable pumps and dry cooler to be scheduled to operate in accordance with 22AHU-03 and Chiller 22CCH-04 system scheduling.

Primary Chilled Water Pumps 22-CWP09 and 22-CWP10

Normal Operation

BAS starts lead chilled water pump whenever the Chiller is enabled to start. The BAS shall monitor each chilled water pump for run status. The pumps are intended for lead lag operation. Whenever pumps are to operate they shall be duty cycled on a monthly basis. The BAS shall sequentially cycle both the duty and standby pump on for a minimum run time of 5 minutes once per month, twelve months per year to prevent pump from seizing.

Pump Failure

Should the lead pump fail to start, following a five minute time delay, the BAS shall command the primary pump off, generate an alarm condition and automatically start the secondary pump.

System Stop

Operator OR BAS master schedule initiates stop of the lead pump. Whenever the chiller plant is disabled, the lead pump shall stop

Secondary Chilled Water Pumps 22-CWP11 and 22-CWP12

System Start

Secondary chiller pumps 22-CWP-11 and 22-CWP-12 shall operate in a lead lag configuration. Operator OR BAS master schedule initiates start-up of the lead pump whenever the chiller plant has a run status of "ON".

Normal Operation

Secondary chiller pumps 22-CWP11 and 22-CWP12 shall operate in a lead lag configuration. Operator OR BAS master schedule initiates start-up of the lead pump. Whenever the chiller plant is enabled, the lead pump shall start. The pumps are intended for lead lag operation. Whenever pumps are to operate they shall be duty cycled on a monthly basis. The pump speed set point shall have a minimum speed of 25%. The BAS shall sequentially cycle both the duty and standby pump on for a minimum run time of 5 minutes once per month, twelve months per year to prevent pump from seizing.

System Stop

Secondary chiller pumps 22-CWP-11 and 22-CWP-12 shall operate in a lead lag configuration. Operator OR BAS master schedule initiates shut down of the lead pump whenever the chiller plant has a run status of "OFF".

Pump Failure

Should the lead pump VFD fail to operate, following a five (5) minute time delay, the BAS shall command the primary pump off, generate an alarm condition and automatically command the secondary pump VFD to commence operation.

Secondary Chilled Loop Water Pumps Speed Control

CS 602 High Lift Low Temp Chilled Water (Glycol) System 22-CCH-05 and 22-CCH-06

Normal Operation

BAS monitors the differential pressure sensor located across chilled water mains at the branch connections to the Flexible Cabin Lab. The BAS shall use a PID control loop to modulate the speed of the active secondary chilled water pump 22CWP-11 or 22CWP-12 to maintain differential pressure set-point. The set-point is to be determined in cooperation with the TAB contractor through field testing when the chilled water system is under maximum flow demand.

System Stop

Operator OR BAS master schedule initiates stop of the lead pump. Whenever the chiller plant is disabled, the lead pump shall stop.

Schedule

To match main air handling system schedule and when 22-AHU-03 economizer cycle is unable to meet the building cooling demand or by operator selection Enable pumps to be scheduled to operate in accordance with 22AHU-04 and Chiller 22CCH-05 system scheduling.

Primary Condenser Water Pumps 22-CWP07 and 22-CWP08

Normal Operation

BAS starts lead condenser water pump whenever the Chiller is enabled to start. The BAS shall monitor each condenser water pump for run status. The pumps are intended for lead lag operation. Whenever pumps are to operate they shall be duty cycled on a monthly basis. The BAS shall sequentially cycle both the duty and standby pump on for a minimum run time of 5 minutes once per month, twelve months per year to prevent pump from seizing.

Pump Failure

Should the lead pump fail to start, following a five minute time delay, the BAS shall command the primary pump off, generate an alarm condition and automatically start the secondary pump.

System Stop

Operator OR BAS master schedule initiates stop of the lead pump. Whenever the chiller plant is disabled, the lead pump shall stop

Fluid Cooler Condenser Water Temperature Control

System Start

Fluid Cooler is equipped with a standalone temperature control panel and set of dry contacts to enable the unit to run. Division 25 provided control wiring shall intercom the BAS to the Fluid Cooler control panel. Operator OR BAS master schedule enables or disables Fluid Cooler. Fluid cooler shall be commanded to start under one or both of the following conditions:

1. Chiller plant 22-CCH-05 is enabled and there is a system demand for mechanical cooling.
2. Chiller 22-CCH-06 is enabled and there is a system demand for mechanical cooling.

Normal Operation Summer

Fluid Cooler is equipped with a standalone temperature control panel, remote leaving water temperatures sensor to be installed by Division 23 contractor and set of dry contacts to switch the unit between Summer and Winter operating modes. Division 25 provided all control wiring shall intercom the BAS and remote sensor to the Fluid Cooler control panel for both temperature control and Summer Winter change over. The Fluid Cooler condenser water temperature set-points are to be set within the Fluid Cooler control panel. The operating set-points are tabulated as follows:

CS 602 High Lift Low Temp Chilled Water (Glycol) System 22-CCH-05 and 22-CCH-06

Entering D.B. Temp.	35ºC
Entering Liquid Temp.	46.1ºC
Leaving Liquid Temp.	40.6ºC
Heat Rejection Capacity	248 kW

Winter Free Cooling Change Over

Fluid Cooler is equipped with a standalone temperature control panel, remote leaving water temperatures sensor to be installed by Division 23 contractor and set of dry contacts to switch the unit between Summer and Winter operating modes. Division 25 provided all control wiring shall intercom the BAS and remote sensor to the Fluid Cooler control panel for both temperature control and Summer Winter change over.

The Chiller 22-CCH-05 primary chilled and condenser water circuits are equipped with three way bypass valves CV-FC1 and CV-FC2. These valves are provided to bypass the chiller and utilize Fluid Cooler 22-DRY-01 as the source of chilled water for **Process System** cooling coils. When the outdoor air temperature is less than 0.0 ºC (adjustable) Chiller 22-CCH-05 is to be disabled. After a five (5) minute time delay, the BAS shall actuate CV-FC1 and CV-FC2 to the Bypass position and change the Fluid Cooler operation over from Summer to Winter operation.

The condenser water temperature set-points are to be set within the Fluid Cooler control panel. The operating set-points are tabulated as follows:

Entering D.B. Temp.	- 6.2ºC
Entering Liquid Temp.	4.4ºC
Leaving Liquid Temp.	1.2ºC
Heat Rejection Capacity	141 kW

Winter to Summer Mech Cooling Change Over

When the outdoor air temperature is greater than 1.0 ºC (adjustable) the BAS shall actuate CV-FC1 and CV-FC2 to the NON-Bypass position and change the Fluid Cooler operation over from Winter to Summer operation. After a five (5) minute time delay Chiller 22-CCH-05 is to be enabled.

System Stop

Operator OR BAS master schedule initiates stop of the Fluid Cooler. Whenever the chiller plant is disabled, the fluid cooler shall be commanded to stop under one or both of the following conditions:

1. Chiller plant 22-CCH-05 is disabled and there is no system demand for mechanical cooling.
2. Chiller 22-CCH-06 is disabled and there is no system demand for mechanical cooling.

Chiller 22-CCH06

CS 602 High Lift Low Temp Chilled Water (Glycol) System 22-CCH-05 and 22-CCH-06

System Start

Operator ***Process*** BAS master controller initiates start-up of system. The BAS shall monitor the Chiller Run Status. When the chiller is enabled, the BAS shall enable ***Process*** chilled water pump 22-CWP-XX and primary condenser water pump 22-CWP-13A or 22-CWP-13B and 22-CWP-15 condenser water pumps and Dry Cooler 22-dry-01 to start. Chilled and condenser water flow switches shall be provided and hard wired to the chiller control panel by Division 25 in accordance with manufacturer's recommendations.

The following conditions must be met in before the chiller is allowed to start:

1. Process Operator has enabled the chiller to Start.
2. Chilled water lead pump 22-CWP-XX and primary condenser water pump 22-CWP-13A or 22-CWP-13B and condenser water pump 22-CWP-015 commanded to start.
3. Chilled and both Condenser water flow switches must return a Proof of Flow back to the chiller control panel.

Condenser Water Temperature Control

Process BAS shall monitor the condenser water entering and leaving primary condenser water temperature and modulate three way mixing control valve CV-MV1 to maintain condenser entering water 40.6 ºC (adjustable) temperature set-point.

Normal Operation

Chilled Water Temperature Control

Chiller controller operates machine to maintain chilled water temperature in control panel at 2.2℃. temperature set-point can be reset remotely through the BMS through the AER485P1 MODBUS system accessory.

Chiller / BMS MODBUS Communications

All chiller control panel operating data is made available to the BMS through the AER485P1 MODBUS interface module.

Chiller Failure

Should the chiller stop or fail to start, the chiller shall be disabled and the plant go into Plant Shutdown Mode

Plant Shutdown

Operator initiates chiller plant shut down mode according to the following sequence of operations:

4. Process Operator has disabled the chiller.
5. Following a five (5) minute time delay after the chiller is disabled, Chilled water lead pump 22-CWP-XX and primary condenser water pump 22-CWP-13A or 22-CWP-13B and condenser water pump 22-CWP-015 are commanded OFF.

Schedule

Enable pumps and dry cooler to be scheduled to operate in accordance with Process Operator command.

Primary Condenser Water Pumps 22-CWP13A and 22-CWP13B

CS 602 High Lift Low Temp Chilled Water (Glycol) System 22-CCH-05 and 22-CCH-06

Normal Operation	BAS starts lead condenser water pump whenever the Chiller is enabled to start. The BAS shall monitor each condenser water pump for run status. The pumps are intended for lead lag operation. Whenever pumps are to operate they shall be duty cycled on a monthly basis. The BAS shall sequentially cycle both the duty and standby pump on for a minimum run time of 5 minutes once per month, twelve months per year to prevent pump from seizing.
Pump Failure	Should the lead pump fail to start, following a five minute time delay, the BAS shall command the primary pump off, generate an alarm condition and automatically start the secondary pump.
System Stop	Operator initiates stop of the lead pump. Whenever the chiller plant is disabled, the lead pump shall stop
Alarms	CHAS Chiller alarm status CHWPS Primary Chilled Water Pump Status – current sensor (x2) CHWPS Secondary Chilled Water Pump Status – current sensor (x2) VFDALM Secondary Chilled Water Pump VFD Alarm Status (x2) CHLWT Chiller leaving water low temperature alarm CHWWT Chiller entering water high temperature alarm
Trend Logs	LT1 Primary chilled water supply temperature LT2 Primary chilled water return temperature LT3 Secondary chilled water supply temperature LT4 Secondary chilled water return temperature

Remarks:

1.

End of Section

CS 701 22- AHU-03 GENERAL BUILDING CONDITIONING

Control Diagram — Detail: 3788-M07 Drawing: 3788-M03

Overview — The unit will provide humidification, heating, cooling and ventilation. The unit will control to maintain the supply air temperature at set-point. The unit shall provide ehaust air energy recovery and outdoor air free cooling

Control Dampers — Configure dampers for Conditioned Air Mode as follows:

1. Command Normally Closed Dampers CD 21 and 22 to Open when 22-AHU-04 is to be enabled. Upon proof of dampers 21 and 22 open.
2. When 22-AHU-03 and 22-AHU-04 are commanded “OFF” or are both disabled, the BAS shall command Normally Closed Dampers CD15 and 14 to close and Normally Open Damper CF 13 to open. When Dampers CD 13, 14 and 15 have returned to their normal positions, 22-AHU-03 and 22-AHU-04 have a run status of “OFF”, allow Control Dampers CD 21 and 22 to Close

System Start — On operator or schedule start, the BAS shall sends a control signal via the network to energize the supply and exhaust fan VFDs and all other components of the system. The fan speed shall be provided with a soft start ramping the fan speeds up slowly to the minimum speed of 30% prior to being released to static pressure control.

Fan Speed Control — The air handling unit supply fan speed shall modulate to maintain duct static pressure set-point. The supply fan speed shall not drop below 30% (adjustable) to assure adequate fan motor cooling. The BAS shall vary fan speed to maintain the duct static pressure set-point of 250 Pa (1.0" w.g.) (adjustable). A high limit function shall reduce the supply fan speed to keep the supply duct pressure from exceeding 375 Pa (1.5 inches of water) regardless of the demand from the VAV boxes. The final duct static pressure set-points shall be determined in consultation with the balancing contractor. When the supply fan is de-energized the static set-point shall be zero.

Whenever the supply fan is energized, the return fan shall be energized. The return fan speed shall modulate to maintain a building positive differential pressure of 15 Pa (0.06 inch of water) (adjustable)

Modes of Operation — The occupied and unoccupied modes are determined by a time of day schedule.

OCCUPIED MODE

Supply Air Temperature Set-point Reset — The base supply air temperature set-point is automatically reset between 12 Deg C and 20 Deg C as the return air temperature varies from 26 DegC to 18 Deg C. The actual supply air temperature set-point is equal to the base supply air temperature set-point +/- an offset determined by the heating and cooling requests from the space. The maximum actual supply air temperature set-point is 20 Deg C and the minimum actual supply air temperature set-point is 12 Deg C. The set-point will be offset -1 Deg C every 10 minutes if a cooling request is received. The set-point will be offset +1 Deg C every 10 minutes if there are no cooling requests and a heating request is received. A cooling request is sent from a zone reheat controller when the space temperature is above set-point. A heating request is sent from a zone reheat controller when the heating valve is more than 25% open. A bias of +/- 0.5 Deg C will be applied to the actual supply air temperature set-point for heating and

CS 701 22- AHU-03 GENERAL BUILDING CONDITIONING

cooling purposes.

Humidifier Control

When the outdoor air temperature is below 10 Deg C the humidifier will be controlled to maintain the return air humidity at set point. The return air humidity set point is automatically reset between 30% RH and 40% RH as the outdoor air temperature varies from -20 Deg C to +10 Deg C. The humidifier's modulating signal will be limited to ensure the supply air humidity is kept below 85% RH. A manually adjustable High Humidity Limit Sensor shall be hardwire interlocked with the humidifier to disable the humidifier if the discharge air RH is greater than 85%. When the outdoor air temperature is above 10 Deg C the humidifier will be off.

Supply Fan

The supply fan runs continuously.

Power Exhaust Fan

The power exhaust fan is used to offset the amount of fresh air being introduced into the building. The building shall be maintained under slightly positive pressure 15 Pa (0.06 inch water) (adjustable). The Mixed Air Damper will modulate linearly with the fresh air damper as it opens above the minimum outdoor air damper setting (approximately 25% adjustable).

Mixed Air Dampers

The mixed air dampers will be positioned to provide minimum fresh air to the space. The minimum fresh air set-point is set by the balancer. The dampers will modulate above minimum set-point to provide free cooling when available and required. Free cooling will provide the first stage of temperature control for the unit. When free cooling is available the mixed air dampers will modulate to maintain the mixed air temperature at set-point. The mixed air temperature set-point will be equal to the supply air temperature set-point minus 1 Deg C. Free cooling will be available when both the outdoor air enthalpy is below the return air enthalpy and the outdoor air temperature is below the return air temperature.

Heat Wheel + Bypass Dampers

The control of the energy recovery wheel shall be by the Building Automation System. The rooftop unit with the energy recovery wheel shall incorporate the economizer operation. The energy recovery wheel shall have supply and exhaust bypass damper. When the unit is in the economizer mode of operation the energy recovery wheel shall stop and the bypass dampers shall be opened. The outdoor air shall be drawn through the bypass dampers to reduce the pressure drop of the outdoor airstream.

When the outdoor air temperature is below 12 Deg C the heat wheel will modulate to either maintain the heat wheel leaving temperature at set-point or to provide frost control. The heat wheel leaving temperature set-point will be equal to the supply air temperature set-point minus 1 Deg C. When the outdoor air temperature is more than 2 Deg C above the return air temperature the heat wheel will operate at maximum speed. Otherwise when the outdoor air temperature is above 12 Deg C and less than the exhaust air temperature the heat wheel will be off. When the heat wheel is rotating the bypass dampers will be positioned to allow The minimum outdoor air quantity through them (balancer to confirm). When the heat wheel is off the dampers will be fully open. The controller will provide frost protection for the heat wheel. The controller will slow the wheel down and stop it if necessary to maintain the frost temperature slightly above the frost set-point which varies with the exhaust air humidity and outdoor air temperature as shown in the table below:

OAT (C)	SETPTOINT	OAT (C)	SET-POINT	OAT (C)	SET-POINT

	RAH (20%)		RAH (30%)		RAH (40%)
-25	-15.6 C	-19.4	-11.1 C	-15.6	-8.2 C
-26.1	-11.7 C	-20.3	-7.8 C	-16.1	-4.9 C
-28.3	-8.3 C	-22.2	-4.4 C	-17.2	-1.9 C
-32.2	-5.6 C	-25	-1.9 C	-19.4	0.8 C
-35	-3.9 C	-27.2	-0.6 C	-20.6	2.3 C
-40	-3.3 C	-31.1	-0.3 C	-23.3	3.3 C

The BAS shall provide frost control for the energy recovery wheel. When the unit is equipped with the enthalpy wheel frost protection option, it has a variable speed enthalpy wheel. The speed of the wheel may be modulated as described below to prevent wheel frosting. When there is a threat of frost on the enthalpy wheel, the wheel is slowed down or stopped so that less enthalpy transfer occurs and frosting of the wheel is avoided. Frosting can occur on the enthalpy wheel when the exhaust air leaving the wheel is saturated. This condition occurs when two lines intersect on a psychrometric chart, and it does not occur when these two lines do not intersect (see Figure 8). One of these lines is the Humidity Ratio versus the dry bulb temperature for saturated air. The other line is the exhaust air process line. The exhaust air process is defined by two points on a psychrometric chart. The first point on this line is the outdoor air temperature at 95% relative humidity (point 1 in Figure 8) and the second point on the line is the return air temperature at the return air relative humidity (point 2 in Figure 8). One exhaust air process line showing frosting conditions and another showing no frost conditions is shown in Figure 8.

Cooling Coil

Cooling will be enabled based on the outdoor air temperature and return air temperature. The cooling coil valve will be modulated to maintain supply air temperature set point. At maximum cooling the Mixed Air Damper will open to Maximum position.

Heating Coil

Heating will be enabled based on the outdoor air temperature and return air temperature. The Heating coil valve will be modulated to maintain supply air temperature set point. At maximum heating the Mixed Air Damper will open to Maximum position.

Humidifier Control	BMS enables humidification generator HU- 1 on heating system enabled seasonal schedule and when 22-AHU-03 has a run status of "ON" and the duct mounted air proving switch contactors are closed indicating adequate airflow is present. Return air duct mounted humidity sensor/transmitter shall installed in the return duct. The BAS shall measure from 0% to 100% of RH range and provide an averaged linear output (10% RH to 90% RH) from 4 mA to 20 mA with accuracy ± 2% RH to the humidifier Vapor Logic controller. Operating temperature range: –4 °F to 140 °F (–20°C to 60 °C) modulates humidifier utilizing the standard modulating demand signal operating mode to maintain relative humidity set-point 35% (adjustable) to within plus or minus 3%. Provide an airflow proving switch, sail type to operate an electric switch that makes @ 1.3 m/s (250 fpm), breaks @ 0.4 m/s (75 fpm). Maximum operating temperature for sail: 170 °F (77 °C). Maximum operating temperature for switch: 125 °F (52 °C). Provide a duct mounted High Limit humidity sensor and limit switch (field adjustable set-point). Provide BAS interconnection to humidifier Modbus interface connection. BMS to disable humidifier generator when anyone of the following conditions exist; associated air handling system is shut-down, high limit switch is activated or when insufficient air flow is present. Provide all related low voltage control wiring between field devices and sensors BAS and humidifier unit. All 120 volt or less control / interlock wiring between field devices and sensors and humidifier unit shall be by Division 25.
	UN-OCCUPIED MODE
Overview	The unit is off.
Supply Fan	The supply fan is off.
Power Exhaust Fan	The exhaust fan is off.
Mixed Air Dampers	The fresh air damper is closed. The return air damper is open.
Cooling Coil	Cooling is off
Heating coil	Heating is off.
Humidification	Humidifier is off
Integration with Other Systems	The outside air temperature is shared over the network. Supply air heating and cooling requests are received from existing DDC system.
Heating Coil:	The heating coil valve, mixed air dampers, and cooling coil valve shall modulate in sequence to maintain supply air temperature set-point. Provide deadband between heating and economizer cooling.
Temperature Control	The supply air temperature set-point shall be reset from T-min (53°F) when the outside air temperature is 70°F and above, up to T-max when the outside air temperature is 65°F and below. T-max shall range from 55°F to 65°F. T-max shall vary such that the VAV box with the highest cooling demand is at 90% of its cooling max set-point. The supply air temperature set-point shall change slowly.

ERV Control

Defrost Control

The control of the energy recovery wheel shall be by the Building Automation System. The rooftop unit with the energy recovery wheel shall incorporate the economizer operation. The energy recovery wheel shall have supply and exhaust bypass damper. When the unit is in the economizer mode of operation the energy recovery wheel shall stop and the bypass dampers shall be opened. The outdoor air shall be drawn through the bypass dampers to reduce the pressure drop of the outdoor airstream.

The BAS shall provide frost control for the energy recovery wheel. When the unit is equipped with the enthalpy wheel frost protection option, it has a variable speed enthalpy wheel. The wheel is driven to maximum speed whenever the enthalpy wheel is on. The speed of the wheel may be modulated as described below to prevent wheel frosting.When there is a threat of frost on the enthalpy wheel, the wheel is slowed down or stopped so that less enthalpy transfer occurs and frosting of the wheel is avoided. Frosting can occur on the enthalpy wheel when the exhaust air leaving the wheel is saturated. This condition occurs when two lines intersect on a psychrometric chart, and it does not occur when these two lines do not intersect (see Figure 1). One of these lines is the Humidity Ratio versus the dry bulb temperature for saturated air. The other line is the exhaust air process line. The exhaust air process is defined by two points on a psychrometric chart. The first point on this line is the outdoor air temperature at 95% relative humidity (point 1 in Figure 1) and the second point on the line is the return air temperature at the return air relative humidity (point 2 in Figure 1). One exhaust air process line showing frosting conditions and another showing no frost conditions is shown in Figure 1.

Economizer Control

Economizer cooling is enabled whenever the outside air enthalpy is less than the return air enthalpy plus deadband. When the outside air enthalpy is greater than the return air enthalpy, economizer cooling is disabled. The outside air damper shall modulate in response to the greater of the economizer and CO2 control signals subject to a mixed air temperature low limit of 40°F (adjustable). When in economizer mode, the energy recovery wheel shall be off.

CO2 Control

Outdoor air temperature is less than the Economizer changeover temperature (18ºC) adjustable. If building / process Carbon Dioxide (CO2-1 or CO2-2 or CO2-3) selected sensor measures CO2 levels above 900 PPM, override and reduce mixed air temperature AT1 set-point at a rate of 1ºF/15 minutes (0.5ºC/15 minutes) until CO2 level drops below 800 PPM. If CO2 level drops below 700 PPM, disable override and reset Mixed Air Temperature Set-point = Supply Air Temperature set-point.

Outdoor air temperature > ECT : if building average Carbon Dioxide (CO2) sensor AA1 measures CO2 levels above 900 PPM, override economizer control and modulate open outdoor air control damper D15 and relief air control damper D14, and close recirculation control damper D13 at a rate of 5% actuator travel per 30 minutes, until space CO2 level drops below 800 ppm. If CO2 level drops below 700 PPM, disable override and release dampers D2, D3 and D4 to economizer control. The outside air damper shall modulate in response to the greater of the economizer and CO2 control signals subject to a mixed air temperature low limit of 40°F (adjustable).

UNOCCUPIED CONTROL

Temperature Control .

Unoccupied Off	The supply and return fans shall be de-energized except when operation is called for as described below. Outside air dampers and exhaust dampers shall be closed and return air damper open
Unoccupied Off Coil Protection	When the supply fan is de-energized and the outside air temperature is below the Outside Air Low Temperature Protection Set-point of 1.7°C (35°F) (adjustable) and the mixed air temperature is less than the Mixed Air Low Temperature Protection Set-point of 7.2°C (45°F) (adjustable), OR the Low Temperature Limit trips, then the heating coil valve shall cycle to maintain mixed air temperature of 7.2°C (45°F) (adjustable). When the outside air temperature is above the Outside Air Low Temperature Protection Set-point of 1.7°C (35°F) + differential (adjustable), or the mixed air temperature is greater than the Mixed Air Low Temperature Protection Set-point of 7.2°C (45°F)+ differential the heating coil valve shall be closed.
Unoccupied Setback:	When the lowest space temperature drops below the unoccupied heating space temperature set-point, the supply and return fans shall energize, the outside and exhaust dampers shall remain closed and return damper open. The heating coil valves shall modulate to maintain supply air temperature set-point of 95°F (adjustable) until the lowest space temperature is above the unoccupied set-point + differential. The supply and return fan speed shall be controlled as described in the occupied mode. When the unoccupied heating space temperature set-point + differential is reached, then the unit shall return to Unoccupied Off Mode.
Optimum Start Program	The optimum start program shall start the unit at the latest possible time to reach the desired occupied space temperature set-point at occupancy time. If the average space temperature is below the occupied space temperature set-point, the supply and return fans shall energize, the outside and exhaust dampers shall remain closed and return damper open. The heating coil valve shall modulate to maintain supply air temperature set-point of 35°C (95°F) (adjustable) until the average space temperature equals the occupied space temperature set-point. The supply and return fan speed shall be controlled as described in the occupied mode. The VAV boxes shall modulate to maintain the occupied space temperature while the unit is delivering warm air. When the occupied space temperature set-point is reached, the unit shall operate in the Occupied Mode. Morning warm-up shall occur only once in a day.
Morning Pre-Cooling	If the month is between May and October (adjustable), the outside air temperature is below 12.8°C (55°F) (adjustable) and the average of the three highest space temperatures exceeds Pre-Cool Space Temperature set-point, Morning Pre-cooling may begin. The unit shall start in the pre-cool mode as determined by an optimum start program at the latest possible time to have the space at the occupied set-point at occupancy time. The economizer cooling mode shall modulate the outside air and return air dampers to provide 55°F (adjustable) supply air. The heating and cooling valves shall be closed. The supply and return fan speed and the exhaust air damper shall be controlled as described in the occupied mode. When the average of the three highest space temperatures falls below the occupied space temperature set-point, the unit shall return to unoccupied mode. When the space has reached this set-point, the unit shall operate in the occupied mode. Morning cool-down shall occur only once in a day.

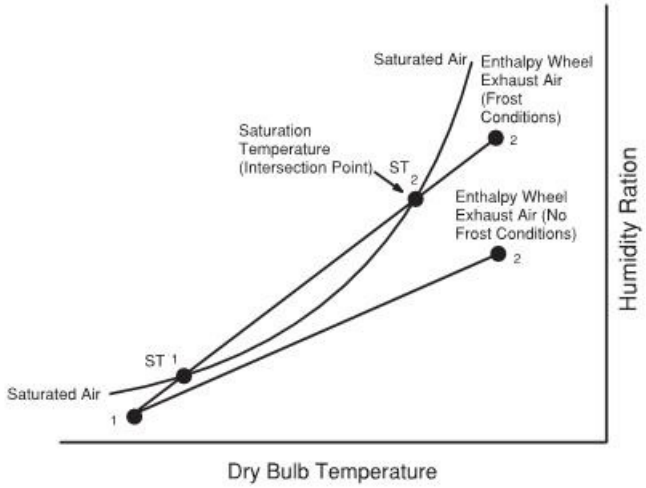
Response to Safeties

Duct smoke detection, space smoke detection, high pressure safeties, low pressure safeties and low temperature limit trips shall de-energize the air handling unit and close the outside air and exhaust air dampers. Manual reset of the tripped device shall be required to restart the system. When the outside air temperature is below 4.4°C (40°F) (adjustable) and the air-handling unit has shut down in alarm, the heating and cooling valves shall function as described in unoccupied mode.

BAS Operating Set-Points and Parameters		Parameter Name
Point Function	Point Set-Point	
Duct Pressure	Supply Duct Spt = 250 Pa	Set-Point
	BSP Db = 25 Pa	Dead Band
OA Damper	Min % OA = 22% (66 Lt/sec)	TAB Contractor Field Adjust Damper Position
Building Static P Setup	BSP Propbd= 15 Pa	Building Static Pressure Proportional Band
	BSP IntTime= 2.0 sec	BSP IntTime= 2.0 sec
	Building Static	Building Static

Figure 1

Figure 8: Variable Speed Enthalpy Wheel Frost Protection - Psychrometric Chart



Schedule

T.B.A.

Fire Alarm

NA.

Safeties and Limits

An averaging sensor freezestat is hardwired to shut down the fans and close the dampers when the sensed temperature drops below 1.7℃ (35℉) (adjustable). A five (5) minute time delay is provided on start-up to bypass the limit and allow time for the heating system to come under control. Once the timer has expired the unit will trip if it detects an air temperature of less than 1.7 Deg C. Once tripped the limit must be reset manually. Provide a reset button on the control panel. Protection will work when the fan is in either 'hand' or 'auto'. Fan is disabled until fan run status is received.

The maximum position for the Mixed Air Damper is 80% to allow a minimum fresh air.

Supply air temperature control is disabled until fan run status is received.

If the supply air temperature rises above 55 Deg C the controller will shut down the unit and issue an alarm. Manual reset though the BAS is required.

If the return air temperature rises above 55 Deg C the controller will shut down the unit and issue an alarm. Manual reset through the BAS is required.

Simultaneous heating and cooling is prohibited.

If the heat wheel is off for more than 1 day the controller will rotate the wheel at minimum speed for a minimum of five (5) minutes.

ALARMS

Critical Alarms

Fan is commanded on and status is not received (2 minute delay). Low temperature safety alarm is tripped.

General Alarms

The unit is running and the supply air temperature is below 8 Deg C or above 24 Deg C.

Maintenance Alarms

Fan is commanded off and status is received (10 minute delay).

Filter differential is above set-point.

Manual overrides are placed on the system.

Alarm Points	SAH-H3High supply dew point temperature -10ºC (-23.3ºF)
	FIL Dirty Pre-Filter
	FIL Dirty HEPA Filter
	APD1High filter pressure drop >500 Pa (2 in.W.C.)
	SFASupply fan status alarm
	EST2Return fan drive summary alarm
	AP1High supply static pressure >375 Pa (1.5 in.W.C.)
	AH2High building relative humidity >60% RH
	AH2Low building relative humidity <25% RH
	AT1Mixed air temperature > 1.5ºC above set-point
	AT1Mixed air temperature < 1.5ºC below set-point
Monitor	AT5Outdoor air temperature
	AH3Outdoor air humidity
Trend Logs	1.10.Trends
	1.10.1.All inputs and outputs will be trended at 30 minute intervals for 3 days.
	1.10.2.Additional trends will be added to:
	1.10.3.Supply air temperature set-point.
	1.10.4.Outside air temperature.AA1 Building CO2 levels at ±50 ppm from last reading
	AT4Building average return air temperature at ±1.5ºC from last reading
	AH2Building average return air humidity at ±5% RH from last reading
Emergency Power	No

Remarks:

End of Section

CS 701A GENERAL BUILDING HVAC DAMPER CONTROL

Control Diagram Detail: 3788-M07 Drawing: 3788-M03

Overview The outdoor Air intake and exhaust dampers CD-21 and 22 are Normally Closed and are only to open under the following conditions:

.1 22-AHU-03 is commanded to start.

.2 22-AHU-04 is commanded to start

.3 22-AHU-05 is commanded to start

.4 22-AHU-06 is commanded to start

.5 22-AHU-07 is commanded to start.

Should any of the above fans be commanded on or have a “SYSTEM ON” run status, CD-21 and 22 are to remain Open.

Should none of these fans have a “SYSTEM ON” run status, CD-21 and 22 are to be commended Closed.

Dampers CD-21 and 22 are to be provided with hard wired proving switches and be monitored by the BAS at all times.

Schedule T.B.A.

Fire Alarm NA.

ALARMS

General Alarms Damper position does not match command position.

Emergency Power No

Remarks:

End of Section

CS 702 22-AHU-04 LABS PRE-CONDITIONING

Control Diagram — Detail: 3788-M07 Drawing: 3788-M03

Flexible Cabin Lab Pre Conditioned Air Mode

Control Dampers — Configure dampers for Conditioned Air Mode as follows:

1. BAS to monitor position of control dampers CD 21 and 22.and if in the "Open" position command CD 25 to Open before enabling 22-AHU-04 to start. When Dampers CD 25 has a status of "Open", 22-AHU-04 will be enabled to start.
2. Modulate 22-AHU-04 Normally Closed bypass Dampers CD 05 open to relieve air should the duct static pressure increase 100 Pa greater than set-point.
3. By pass damper CD05 shall remain closed under normal operating condition. Should the operator elect to operate 22AHU-04 in the bypass mode, it shall be operator controlled.

System Start — BAS to monitor position of control dampers CD 21, 22.and 25 have an "Open" position status, 22-AHU-04 is enabled to start. On operator or schedule start, the BAS shall sends a control signal via the network to energize the supply fan VFD and enable the desiccant wheel and all other components.

System Stop — On operator or schedule stop, the BAS shall sends a control signal via the network to disable the supply fan VFD and the desiccant wheel and all other components. BAS Fan status and when there is a fan run status of "OFF", the BAS shall command control dampers CD 25 to the Closed position.

Fan Speed Control — Supply fan shall have a minimum speed of 25% or higher as per manufacturer's recommendations. Supply fan 22-AHU-06 shall start at minimum speed, and ramp up to the required capacity over 30 seconds. The BAS shall monitor the duct mounted supply static pressure sensor and modulate the fan speed of to maintain a minimum static pressure of 100 Pa (adjustable). SSP supply air static pressure and modulate supply fan VFD speed VSDCTL to maintain supply static pressure SSP set-point. Static pressure set-point to be determined by TAB contractor field measurements in cooperation with Division 25 and NORR engineers.

Humidifier Control — The use of humidification is intended for winter conditions when 22-AHU-04 Desiccant unit has a run status of "OFF" and the supply air dew point temperature set-point of 22-AHU-05 or 06 is greater than that of the outdoor air. Under these conditions humidifier HU-3 is to be enabled whenever 22AHU-05 or 22AHU-06 has a run status of "ON" and BT16 and BT17 are in the closed position.

When 22-AHU-05 has a run status of "ON", the BAS shall monitor the Supply Air Dew Point SAH located downstream of 22-AHU-05 and modulate the humidifier output to maintain the supply air dew point setpoint.

When 22-AHU-06 has a run status of "ON", the BAS shall monitor the Supply Air Dew Point SAH located downstream of 22-AHU-06 and modulate the humidifier output to maintain the supply air dew point setpoint.

CS 702 22-AHU-04 LABS PRE-CONDITIONING

Temperature and Dew Point Control

The BAS shall monitor SAT-TT-1 for monitoring purposes only.

The BAS shall monitor ST-TT-2 entering air temperatures. When SAT-TT-2 senses an air temperature lower than 7.22ºC (45ºF) the BAS shall use a PID control loop to modulate the steam control valve to maintain a heating coil leaving air temperature of 7.22ºC (45ºF) plus or minus 0.5ºC.

The BAS shall monitor SAT-TT-3. When SAT-TT-3 senses an air temperature greater than 7.22ºC (45ºF) plus 0.5ºC dead-band, the BAS shall use a PID control loop to modulate the chilled water control valve to maintain a cooling coil leaving air temperature of 7.22ºC (45ºF).

Desiccant Wheel Temperature Transmitter

The BAS shall monitor SAT-TT-4 for monitoring purposes only.

Post Cooling Coil Temperature Transmitter

The BAS shall monitor SAT-TT-5. When SAT-TT-4 senses an air temperature greater than 10ºC (50ºF), the BAS shall use a PID control loop to modulate the chilled water post cooling coil control valve to maintain a cooling coil leaving air temperature of 10ºC (50ºF) plus or minus 0.5ºC.

Entering Air Dew Point Transmitter

The BAS shall monitor SAH-H1 Dew Point for monitoring purposes only.

Supply Air Dew Point Transmitter

The BAS shall monitor SAH-H2. When SAH-H2 senses an dew point temperature greater than -11ºC (-23.9ºF), the BAS shall use a PID control loop and (0-10V) control signal to desiccant wheel supply air face damper CD-9A causing it to open and the bypass damper CD-9B to close to maintain a supply air dew point of -11ºC (-23.9ºF).

A PLC on board controller shall provide automatic energy modulation by means of a variable-position reactivation airflow damper and motor assembly, controlled by a proportioning temperature controller sensing the reactivation air stream as it leaves the dehumidifier. When there is no demand for dehumidification and the desiccant wheel supply air face damper is fully closed and by pass dampers is fully closed by the BAS. The end switch of the face damper CD-9A actuator is to be interlock wired with the PLC controller to stop the desiccant wheel rotation, regeneration fan and close the regeneration heaters steam valve. The supply fan will continue to operate. All field interlock wiring to be by Division 25. The supply and installation of the generator steam two position control valve shall be by Division 25 and be in accordance with the manufacturer's requirements.

CS 702 22-AHU-04 LABS PRE-CONDITIONING

System Stop	Operator initiated or by operating schedule.
	When 22-AHU-05, 06 or 07 have an "OFF" runs status, the BAS shall sends a control signal via the network to disable 22-AHU-04 and all other components of the system. The BAS shall monitor the VFD Supply Fan Amperage SFA and when 0 amps exist, the BAS shall disable humidifiers HUM-3 and allow intake and exhaust air damper CD-25 to close. If 22-AHU-03 has a run status of "OFF" the BAS shall also allow control dampers CD-21 and 22 to close.
Schedule	T.B.A.
Fire Alarm	NA.
Alarms	SAH-H3High supply dew point temperature -10ºC (-23.3ºF)
	FIL Dirty Pre-Filter
	FIL Dirty HEPA Filter
	APD1High filter pressure drop >2 in.W.C.
	SFASupply fan stus alarm
	EST2Return fan drive summary alarm
	AP1High supply static pressure >2.5 in.W.C.
	AH2High building relative humidity >60% RH
	AH2Low building relative humidity <25% RH
	AT1Mixed air temperature > 3ºF above setpoint
	AT1Mixed air temperature < 3ºF below setpoint
Monitor	AT5Outdoor air temperature
	AH3Outdoor air humidity
Trend Logs	AA1Building CO2 levels at ±50 ppm from last reading
	AT4Building average return air temperature at ±3ºF from last reading
	AH2Building average return air humidity at ±5% RH from last reading
1 Emergency Power	No

Remarks:

End of Section

CS 703 22-AHU-05 FLEXIBLE CABIN LAB / FUSSELAGE LAB

Control Diagram

Detail: 3788-M07 Drawing: 3788-M03

Flexible Cabin Lab 22-AHU05 and Return Fan 22-RAF-05

Control Dampers

Configure dampers for Conditioned Air Mode as follows:

1. Command Closed Air Valve AV04 and 11 to the Closed position.
2. Command Normally Open Air Valve AV 03 to the Open position.
3. The air valve positions shall remain in bypass mode under the following operating conditions:
   - .1 CD21 or 22 is closed.
   - .2 CD25 and 05 are closed.
4. BAS shall monitor air flow through air valves AV-11, 04 and 03. The BAS shall monitor room to cabin mock-up room static pressure and modulate Air Valve AV11 to maintain a room negative pressure of 25Pa (adjustable).

System Start

22-AHU05 shall be operator commanded to start. The BAS shall monitor Control Damper actuator contacts to ensure all air valves / dampers are in the required normal positions position before enabling 22-AHU05 and return fan 22-RAF-05 to start.

System Stop

22-AHU05 shall be operator commanded to stop. When commanded to stop, the fan speed of 22-AHU05 and return fan 22-RAF-05 will slowly modulate to minimum speed. When minimum speed is reached, the BAS shall fully open AV03 and upon proof of valve open, fully close AV11 and 04 returning the system to full bypass mode.

The system will go into Trouble Shutdown Mode under the flowing conditions:

- .1 The exhaust air static pressure exceeds 500 Pa (adjustable)
- .2 The supply static pressure exceeds 500 Pa (adjustable)

When in Trouble Shutdown Mode VFD 22-AHU05 and VFD 22-RAF-05 shall be disabled and the system shall modulate air valves to recirculation configuration.

Fan Speed Control

Supply fan shall have a minimum speed of 25% or higher as per manufacturer's recommendations. Supply fan 22-AHU-05 and return fan 22-RAF-05 to start at minimum speed, and ramp up to the required capacity over 30 seconds. The BAS shall monitor the duct mounted supply and exhaust fan static pressure sensors and modulate the fan speed of to maintain a minimum static pressure of 100 Pa (adjustable). SSP supply air static pressure and modulate supply fan VFD speed VSDCTL to maintain supply static pressure SSP set-point. Static pressure set-point to be determined by TAB contractor field measurements in cooperation with Division 25 and NORR engineers.

CS 703 22-AHU-05 FLEXIBLE CABIN LAB / FUSSELAGE LAB

Air Volume Flow Control

The air volume flow control shall be variable and Operator controlled. The BAS shall monitor in real time the air flow volume through Air Valves AV04, 11 and 03. AV11 shall be slaved to room static pressure sensor.AV03 shall be slaved to bypassing any positive difference in air flows between AV04 and AV11 such that the air flow exhausted always equals the air flow supplied. The air flow supplied through air valve AV04 shall be operator adjustable in 10% increments between a minimum of 10% to a maximum of 100%. Should the operator elect to override AV11 room static pressure control, AV11 will be slaved to AV04 exhausting an air flow volume equal to AV04.

Exhaust CO2:

The BAS shall monitor return air CO2 for information only.

Supply Air Temperature Control:

BAS shall monitor 22-AHU-04 entering air temperature EAT. Should the entering air temperature be greater than the supply air temperature SAT set-point, the BAS shall modulate the chilled water control valve CHW 2wayVLV to maintain the supply air temperature set-point minus 0.5 ºC.

The air flow FLOW proving switch shall be interlock wired with the duct heater by Division 25 such that on proof of flow, Electric Reheat Coil ERH-1 will be enabled. The BAS shall provide a control signal to the electric reheat coil SCR controller to modulate the heat output required to maintain the supply air temperature set-point plus or minus 0.1ºC

Humidity Control	Humidity control shall be through 22-AHU-04 system controls.
Flexible Cabin Lab Temperature Control	The air flow FLOW proving switch shall be interlock wired with the duct heater by Division 25 such that on proof of flow, Electric Reheat Coil ERH-1 will be enabled. The BAS shall provide a control signal to the electric reheat coil SCR controller to modulate the heat output required to maintain the supply air temperature set-point plus or minus 0.5 ºC
Flight Simulation Lab Temperature Control	The air flow FLOW proving switch shall be interlock wired with the duct heater by Division 25 such that on proof of flow, Electric Reheat Coil ERH-2 will be enabled. The BAS shall provide a control signal to the electric reheat coil SCR controller to modulate the heat output required to maintain the supply air temperature set-point plus or minus 0.5 ºC
Schedule	System Operator Determined
Fire Alarm	On signal from global Fire Alarm System MCA1, place system into System Stop mode.

CS 703 22-AHU-05 FLEXIBLE CABIN LAB / FUSSELAGE LAB

Alarms	SAH	High supply air humidity 75% RH
	FIL 1	High Pre-filter pressure drop >500 Pa.
	FIL 2	High HEPA filter pressure drop >1.0 KPa.
	RFA	Return fan drive summary alarm
	SFA	Supply fan drive summary alarm
	Trouble	Shutdown Mode
Monitor	AFMS	Supply air flow
	AFMS	Return air flow
	EAT	Entering air temperature
	RAT	Return air temperature
	SAT	Supply air temperature
	SAH	Supply air dew point
	SSP	Supply static pressure
	SFA	Supply fan amperage (run status)
	RFA	Return fan amperage (run status)
	MD	Motorized damper and air valve position (CD-21,22,25,05; AV11, 03, & 04)
Trend Logs	SAT	Supply air temperature
	SAH	Supply air dew point
Emergency Power	No	

Remarks:

1. Provide graphics that actively displays operating mode and air flow.

End of Section

CS 704 22-AHU-06 AIRPORT TERMINAL LAB

Control Diagram

Detail: 3788-M07 Drawing: 3788-M03

Airport Terminal 22-AHU06 and Return Fan 22-RAF-06

Control Dampers

Configure dampers for 22 AHU-04 Conditioned Air Mode as follows:

1. Command Closed Air Valve AV01 and 12 to the Closed position.
2. Command Normally Open Air Valve AV 02 to the Open position.
3. Air Valves ALT-AV1,2,3,4,5,6 & 7 shall remain operator controlled
4. Bubble Tight Dampers BT16 and BT17 shall be commanded Closed
5. The air valve positions shall remain in bypass mode under the following operating conditions:
   - .1 CD21 or 22 is closed.
   - .2 CD25 and 05 are closed.
6. BAS shall monitor air flow through air valves AV-12, 01 and 02. The BAS shall monitor room to cabin mock-up room static pressure and modulate Air Valve AV11 to maintain a room negative pressure of 25Pa (adjustable).

Control Dampers

Configure dampers for Building Services HVAC Mode as follows:

1. Dampers shall be low pressure shut-off type pressure independent flow control valves.
2. Command Closed Air Valve AV01 and 12 to the Closed position.
3. Command Normally Open Air Valve AV 02 to the Closed position.
4. Air Valves ALT-AV1,2,3,4,5,6 & 7 shall remain operator controlled
5. Bubble Tight Dampers BT16 and BT17 shall be commanded Open

System Start

22-AHU06 shall be operator commanded to start. The BAS shall monitor Control Damper actuator contacts to ensure all air valves / dampers are in the required normal positions position before enabling 22-AHU06 and return fan 22-RAF-06 to start.

CS 704 22-AHU-06 AIRPORT TERMINAL LAB

System Stop

22-AHU06 shall be operator commanded to stop. When commanded to stop, the fan speed of 22-AHU05 and return fan 22-RAF-05 will slowly modulate to minimum speed. When minimum speed is reached, the BAS shall fully open AV03 and upon proof of valve open, fully close AV11 and 04 returning the system to full bypass mode.

The system will go into Trouble Shutdown Mode under the flowing conditions:

.1 The exhaust air static pressure exceeds 500 Pa (adjustable)

.2 The supply static pressure exceeds 500 Pa (adjustable)

When in Trouble Shutdown Mode VFD 22-AHU06 and VFD 22-RAF-06 shall be disabled and the system shall modulate air valves to recirculation configuration.

Fan Speed Control:

Supply fan shall have a minimum speed of 25% or higher as per manufacturer's recommendations. Supply fan 22-AHU-06 and return fan 22-RAF-06 to start at minimum speed, and ramp up to the required capacity over 30 seconds. The BAS shall monitor the duct mounted supply and exhaust fan static pressure sensors and modulate the fan speed of to maintain a minimum static pressure of 100 Pa (adjustable). SSP supply air static pressure and modulate supply fan VFD speed VSDCTL to maintain supply static pressure SSP set-point. Static pressure set-point to be determined by TAB contractor field measurements in cooperation with Division 25 and NORR engineers.

Air Volume Flow Control

The air volume flow control shall be variable and Operator controlled. The BAS shall monitor in real time the air flow volume through Air Valves AV01, 12 and 02. AV12 shall be slaved to room static pressure sensor. AV02 shall be slaved to bypassing any positive difference in air flows between AV04 and AV11 such that the air flow exhausted always equals the air flow supplied. The air flow supplied through air valve AV01 shall be operator adjustable in 10% increments between a minimum of 10% to a maximum of 100%. Should the operator elect to override AV12 room static pressure control, AV12 will be slaved to AV01 exhausting an air flow volume equal to AV01.

Exhaust CO2:

The BAS shall monitor return air CO2 for information only.

Humidity Control

Humidity control shall be through 22-AHU-04 system controls.

CS 704 22-AHU-06 AIRPORT TERMINAL LAB

Airport Terminal Temperature Control

BAS shall monitor 22-AHU-06 entering air temperature EAT. Should the entering air temperature be greater than the supply air temperature SAT set-point, the BAS shall modulate the chilled water control valve CHW 2wayVLV to maintain the supply air temperature set-point minus 0.5 ºC.

The air flow FLOW proving switch shall be interlock wired with the duct heater by Division 25 such that on proof of flow, Electric Reheat Coil ERH-2 will be enabled. The BAS shall provide a control signal to the electric reheat coil SCR controller to modulate the heat output required to maintain the supply air temperature set-point plus or minus 0.1 ºC

Airport Terminal Temperature Control

Operator shall assign space temperature control to selected space temperature control apparatus and assigned control algorithm to maintain space temperature control set-point.

Radiant Heating Water Temperature Control

Pump Control – 22GLP-16 shall be operator commanded On and Off.

The BAS shall monitor the supply water temperature and modulate the three way mixing control valve to maintain supply water temperature set-point (52 ºC adjustable)

Radiant Chilled Water Temperature Control

Pump Control – 22GLP-12 shall be operator commanded On and Off.

The BAS shall monitor the supply water temperature and space dew point sensor and modulate the three way mixing control valve to maintain supply water temperature set-point below apparatus dew point temperature.

Schedule

System Operator Determined

Fire Alarm

On signal from global Fire Alarm System MCA1, place system into System Stop mode.

Alarms

SAH	High supply air humidity 75% RH
FIL 1	High Pre-filter pressure drop >500 Pa.
FIL 2	High HEPA filter pressure drop >1.0 KPa.
RFA	Return fan drive summary alarm
SFA	Supply fan drive summary alarm

Trouble Shutdown Mode

CS 704 22-AHU-06 AIRPORT TERMINAL LAB

Monitor	AFMS	Supply air flow
	AFMS	Return air flow
	EAT	Entering air temperature
	RAT	Return air temperature
	SAT	Supply air temperature
	SAH	Supply air dew point
	SSP	Supply static pressure
	SFA	Supply fan amperage (run status)
	RFA	Return fan amperage (run status)
	MD	Motorized damper and air valve position (CD-21,22,25,05; AV01, 02, & 12)
Trend Logs	SAT	Supply air temperature
Emergency Power	No	

Remarks:

1. Provide graphics that actively displays operating mode and air flow.

End of Section

CS 705 22-AHU-07 VIBRATION LAB

Control Diagram: Detail: 3788-M07 Drawing: 3788-M03

Vibration Lab Pre Conditioned Air Mode

Control Dampers: Configure dampers for Conditioned Air Mode as follows:

1. Command Closed Air Valve AV20 and 24 to the Closed position.
2. Command Normally Open Air Valve AV 23 to the Open position.
3. The air valve positions shall remain in bypass mode under the following operating conditions:
4. CD21 or 22 is closed.
5. CD25 and 05 are closed.

System Start: The BAS shall monitor Control Damper actuator contacts to ensure all dampers are in the required position, 22-AHU-04 and 22-RAF-1 system operating status ON, prior to enabling 22-AHU-07 VFD to start. Supply fan 22-AHU-07 and return fan 22-RAF-7 to start at minimum speed, and ramp up to the required capacity over 30 seconds.

System Stop: 22-AHU07 shall be operator commanded to stop. When commanded to stop, the fan speed of 22-AHU07 and return fan 22-RAF-07 will slowly modulate to minimum speed. When minimum speed is reached, the BAS shall fully open AV23 and upon proof of valve open, fully close AV20 and 24 returning the system to full bypass mode.

The system will go into Trouble Shutdown Mode under the flowing conditions:

.1 The exhaust air static pressure exceeds 500 Pa (adjustable)

.2 The supply static pressure exceeds 500 Pa (adjustable)

When in Trouble Shutdown Mode VFD 22-AHU07 and VFD 22-RAF-07 shall be disabled and the system shall modulate air valves to recirculation configuration.

CS 705 22-AHU-07 VIBRATION LAB

Fan Speed Control:

Supply fan shall have a minimum speed of 25% or higher as per manufacturer's recommendations. Supply fan 22-AHU-07 and return fan 22-RAF-07 to start at minimum speed, and ramp up to the required capacity over 30 seconds. The BAS shall monitor the duct mounted supply and exhaust fan static pressure sensors and modulate the fan speed of to maintain a minimum static pressure of 100 Pa (adjustable). SSP supply air static pressure and modulate supply fan VFD speed VSDCTL to maintain supply static pressure SSP set-point. Static pressure set-point to be determined by TAB contractor field measurements in cooperation with Division 25 and NORR engineers.

Air Volume Flow Control

The air volume flow control shall be variable and Operator controlled. The BAS shall monitor in real time the air flow volume through Air Valves AV20, 24 and 23. AV24 shall be slaved to AV20 exhausting an air flow volume equal to AV20 supply air. AV23 shall be slaved to bypassing any positive difference in air flows between AV20 and AV24 such that the air flow exhausted always equals the air flow supplied. The air flow supplied through air valve AV20 shall be operator adjustable in 10% increments between a minimum of 10% to a maximum of 100%.

Supply Air Temperature Control:

BAS shall monitor AHU entering air temperature EAT. Should the entering air temperature be greater than the supply air temperature SAT set-point, the BAS shall modulate the chilled water control valve CHW 2wayVLV to maintain the supply air temperature set-point minus 1.5 ºC.

The air flow FLOW proving switch shall be interlock wired with the duct heater by Division 25 such that on proof of flow, Electric Reheat Coil ERH-1 will be enabled. The BAS shall provide a control signal to the electric reheat coil SCR controller to modulate the heat output required to maintain the supply air temperature set-point plus or minus 0.5 ºC

Humidity Control	Humidity control shall be through 22-AHU-04 system controls.
Supply Air Temperature Control	BAS shall monitor 22-AHU-06 entering air temperature EAT. Should the entering air temperature be greater than the supply air temperature SAT set-point, the BAS shall modulate the chilled water control valve CHW 2wayVLV to maintain the supply air temperature set-point minus 0.5 ºC. The air flow FLOW proving switch shall be interlock wired with the duct heater by Division 25 such that on proof of flow, Electric Reheat Coil ERH-2 will be enabled. The BAS shall provide a control signal to the electric reheat coil SCR controller to modulate the heat output required to maintain the supply air temperature set-point plus or minus 0.1 ºC
Humidity Control	Not Available.
Schedule	T.B.A.

CS 705 22-AHU-07 VIBRATION LAB

Fire Alarm	On signal from global Fire Alarm System MCA1, place system into System Stop mode.	
Alarms	SAH	High supply air humidity 75% RH
	FIL 1	High Pre-filter pressure drop >500 Pa.
	FIL 2	High HEPA filter pressure drop >1.0 KPa.
	RFA	Return fan drive summary alarm
	SFA	Supply fan drive summary alarm
	Trouble	Shutdown Mode
Monitor	AFMS	Supply air flow
	AFMS	Return air flow
	EAT	Entering air temperature
	RAT	Return air temperature
	SAT	Supply air temperature
	SAH	Supply air dew point
	SSP	Supply static pressure
	SFA	Supply fan amperage (run status)
	RFA	Return fan amperage (run status)
	MD	Motorized damper and air valve position (CD-21,22,25,05; AV20, 23, & 24)
Trend Logs	SAT	Supply air temperature
Emergency Power	No	

Remarks:

1. Provide graphics that actively displays operating mode and air flow.

End of Section

CS 801 BUILDING SANITARY EXHAUST

Exhaust Fan 22XAF-09 building Sanitary Exhaust

Control Diagram	Detail: 1-M03 Drawing: 3788-M03
System Start	Exhaust Fan start by operator OR BAS master schedule. When main air handling 22-AHU-03 has a run status of ON (software interlock), open exhaust air damper CD19 and enable exhaust fan to start. When damper is proved open by hardwire MDNC, exhaust fan 22XAF-10 starts.
Normal Operation	Continuous operation
Building Flushing	N/A
System Stop	When main air handling unit 22-AHU-03 stop (software interlock), stop exhaust fan 22XAF-10 and close exhaust air damper CD19.
Schedule	Same as associated main building air handling system 22-AHU-03
Fire Alarm	Fan continuous to operate in current state (no FAS interlock)
Alarms	EFA Exhaust fan run failure.
Monitor	EFA Exhaust fan status (current switch)
Trend Logs	None
Emergency Power	No

Remarks:

1. Exhaust air damper prove-open switch is wired to the fan starter as a running interlock; single DO point required.

End of Section

CS 801 BUILDING SANITARY EXHAUST

Exhaust Fan 22XAF-09 building Sanitary Exhaust

Control Diagram	Detail: 1-M03 Drawing: 3788-M03
System Start	Exhaust Fan start by operator OR BAS master schedule. When main air handling 22-AHU-03 has a run status of ON (software interlock), open exhaust air damper CD19 and enable exhaust fan to start. When damper is proved open by hardwire MDNC, exhaust fan 22XAF-10 starts.
Normal Operation	Continuous operation
Building Flushing	N/A
System Stop	When main air handling unit 22-AHU-03 stop (software interlock), stop exhaust fan 22XAF-10 and close exhaust air damper CD19.
Schedule	Same as associated main building air handling system 22-AHU-03
Fire Alarm	Fan continuous to operate in current state (no FAS interlock)
Alarms	EFA Exhaust fan run failure.
Monitor	EFA Exhaust fan status (current switch)
Trend Logs	None
Emergency Power	No

Remarks:

1. Exhaust air damper prove-open switch is wired to the fan starter as a running interlock; single DO point required.

End of Section

CS 823 VAV TERMINAL UNITS WITH REHEAT

Control Diagram	Detail: Drawing: 3788-M03 37788-M07
System Start	Air damper normally open (NO). When air supply is detected on start-up of associated air handling system, terminal unit control starts When associated air handling unit is in Quick Warm-Up or Cool-Down mode, set air damper to 100% volume.
Normal Operation	*Temperature Control* Room temperature sensor RMTS modulates air damper to maintain space temperature setpoint at 22℃ winter, 23℉ summer. Where room thermostats are specified, RMTH modulates air damper to maintain space temperature set-point as operator controlled at local thermostat. On decreasing heating or cooling load, primary damper closes to minimum position as specified. When at minimum damper position should the space temperature continue to fall 0.5℃ below set point, the reheat coil control valve modulates open to maintain space temperature setpoint. Should the control valve reach fully open and the space temperature remain below setpoint, the airflow damper position increasing the air flow to maintain space temperature setpoint. When at maximum damper position and the heating control valve is fully open, should the space temperature rise 0.5℃ above setpoint, the air flow damper begins to close to maintain space temperature setpoint. Should the airflow damper reach minimum position and the space temperature continue to rise above setpoint, the heating control valve modulates closed to maintain space temperature setpoint. Should the heating control valve be fully closed and the space temperature continue to rise above set-point, the heating valve will remain closed and the airflow damper will modulate open to maintain space temperature setpoint. *Pressure Independent Control* Airflow sensor AF adjusts position of airflow damper to maintain current airflow value, independent of upstream system static pressure fluctuations.
Building Flushing	During building flushing operation of associated air handling unit, set air damper control to 100% open
System Stop	When associated air handling unit shuts-down, loss of supply air turns TU unit OFF.
Schedule	Continuous operation
Fire Alarm	N/A
Alarms	None
Trend Logs	None

CS 823 VAV TERMINAL UNITS WITH REHEAT

Monitor	Provide a summary data table for each room / space for the following:
	Terminal Unit location (room or nearest column, floor)
	Space setpoint temperature
	Current value space temperature
	Air supply volume maximum and minimum settings
	Current value air supply volume
Emergency Power	No.

Remarks:

1.

End Of Section

CS 824 VAV TERMINAL UNITS WITHOUT REHEAT

Control Diagram	Detail: Drawing: 3788-M03 37788-M07
System Start	Air damper normally open (NO). When air supply is detected on start-up of associated air handling system, terminal unit control starts When associated air handling unit is in Quick Warm-Up or Cool-Down mode, set air damper to 100% volume.
Normal Operation	*Temperature Control* Room temperature sensor RMTS modulates air damper to maintain space temperature setpoint at 22℃ winter, 23℉ summer. Where room thermostats are specified, RMTH modulates air damper to maintain space temperature set-point as operator controlled at local thermostat. On decreasing cooling load, primary damper closes to minimum position as specified. *Pressure Independent Control* Airflow sensor AF adjusts position of airflow damper to maintain current airflow value, independent of upstream system static pressure fluctuations.
Building Flushing	During building flushing operation of associated air handling unit, set air damper control to 100% open
System Stop	When associated air handling unit shuts-down, loss of supply air turns TU unit OFF.
Schedule	Continuous operation
Fire Alarm	N/A
Alarms	None
Trend Logs	None
Monitor	Provide a summary data table for each room / space for the following: Terminal Unit location (room or nearest column, floor) Space setpoint temperature Current value space temperature Air supply volume maximum and minimum settings Current value air supply volume
Emergency Power	No.

Remarks:

1.

End Of Section

CS 825 FLIGHT SIM LAB FAN 22SAF01

Control Diagram	Detail: Drawing: 3788-M03 37788-M07
System Start	SAF starts on BAS master schedule. Outdoor air damper CD10 opens to minimum position. Recirculation damper CD09 is normally open. Relief air damper CD08 is open to minimum position.
Normal Operation	*Temperature Control* Room thermostat modulates heating coil control valve maintain space temperature setpoint at 22℃ winter.
User Override	Low space temperature is achieved by closing heating coil valve. Outdoor air damper CD10 opens fully. Recirculation damper CD09 closes fully. Relief air damper CD08 opens fully. SAF01 runs.
System Stop	SAF is stopped by BAS operator signal or master schedule. Outdoor air damper CD10 closes. Relief air damper CD08 closes.
Schedule	Same as building occupancy schedule
Fire Alarm	N/A
Alarms	SFA Supply fan run failure
Trend Logs	Space temperature Space temperature setpoint
Monitor	SFA Supply fan run status Space setpoint temperature Current value space temperature HCV Heating coil valve position
Emergency Power	No.

Remarks:

1.

End Of Section

Input/Output Summary Table

NRC PROJECT NO:		IMC0140			CONSULTANT:	NORR			M&E Drawing Reference:						
AREA IDENTIFIER:		M22 - CCER, Zones [UTILITY FANS] Bld Services INPUTS & OUTPUTS			MCU NUMBER:				EMCS System Identifier:						
AREA EXPANSION:		Cabin Comfort and Environment Research Facility			LOCATION OF MCU:				EMCS System Expansion:						
1	2	3	4	5	6	7		8	9		10	11	12	13	
POINT IDENTIFICATION					AUXILIARY DEVICES			ALARMS			DI/DO	DI	DO		
POINT #	POINT IDENTIFIER	POINT EXPANSION	TYPE	ENG UNITS	CONTROLLED OR AUXILIARY SENSING DEVICE, TYPE OF SENSOR OR OUTPUT DEVICE (Supplied, Installed and Wired By Div. 25000)	FLOOR	ROOM	Priority 1 2 3	ANALOG LIMITS		CONTACT	ACTION	HVY MOTOR	Notes and Old SDC Reference Point if Applicable	
						LOCATION			L1	H1	NO NC	C/R O/R	DELAY		
		INPUTS BELOW													
		UTILITY FANS													
1.6B.XX.01.01	EF	Exhaust Fan Start / Stop	DO				133							Building Sanitary Exhaust Fan 22-XAF-09	
1.6B.XX.01.02	EFA	Exhaust Fan Srun Status	DI				133							Building SanitaryExhaust Fan 22-XAF-09	
1.6B.XX.01.03	MDNC	Motorized Exhaust Air Damper	DO				133							Wall Louver Motorized Damper CD-18 (NC)	
1.6B.XX.01.04	EF	Exhaust Fan Start / Stop	DO				140							Flexible Cabin Sanitary Exhaust Fan 22-XAF-10	
1.6B.XX.01.05	EFA	Exhaust Fan Srun Status	DI				140							Flexible Cabin Sanitary Exhaust Fan 22-XAF-10	
1.6B.XX.01.06	MDNC	Motorized Exhaust Air Damper	DO				140							Wall Louver Motorized Damper CD-19 (NC)	

Input/Output Summary Table

NRC PROJECT NO:		IMC0140			CONSULTANT:	Norr			M&E Drawing Reference:				
AREA IDENTIFIER:		M22 - CCER, Zone 10: Human Vibration Lab, HVAC INPUTS & OUTPUTS			MCU NUMBER:				EMCS System Identifier:				
AREA EXPANSION:		Cabin Comfort and Environment Research Facility			LOCATION OF MCU:				EMCS System Expansion:				
1	2	3	4	5	6	7		8	9		10	11	12	13
POINT IDENTIFICATION					AUXILIARY DEVICES			ALARMS			DI/DO	DI	DO	
POINT #	POINT IDENTIFIER	POINT EXPANSION	TYPE	ENG UNITS	CONTROLLED OR AUXILIARY SENSING DEVICE, TYPE OF SENSOR OR OUTPUT DEVICE (Supplied, Installed and Wired By Div. 25000)	FLOOR	ROOM	Priority 1 2 3	ANALOG LIMITS		CONTACT	ACTION	HVY MOTOR	Notes and Old SDC Reference Point if Applicable
						LOCATION			L1	H1	NO NC	C/R O/R	DELAY	
		INPUTS BELOW												
		VIBRATION LAB												
10.6B.13.01.01	AFMS	Airflow, Vibration, Main Supply from AHU1	AI											Ceiling level
10.6B.13.01.02	AFMS	Airflow, Vibration, Main Return, from AHU1	AI											Ceiling level
10.6B.13.01.03	RAT	Temperature, Air, Room	AI											East wall at mid-level
10.6B.13.01.04	VAVTU	Airflow, Vibration, Main Supply Valve	AO											Ceiling level
10.6B.13.01.05	HW 2wayVLV	VAV Supply Reheat	AO											

Input/Output Summary Table

NRC PROJECT NO:	IMC0140	CONSULTANT:	NORR	M&E Drawing Reference:	
AREA IDENTIFIER:	M22 - CCER, Zone 20: HVAC 22-AHU-03, Building, INPUTS & OUTPUTS	MCU NUMBER:		EMCS System Identifier:	
AREA EXPANSION:	Cabin Comfort and Environment Research Facility	LOCATION OF MCU:		EMCS System Expansion:	

1	2	3	4	5	6	7		8	9		10	11	12	13
POINT IDENTIFICATION					AUXILIARY DEVICES			ALARMS			DI/DO	DI	DO	
POINT #	POINT IDENTIFIER	POINT EXPANSION	TYPE	ENG UNITS	CONTROLLED OR AUXILIARY SENSING DEVICE, TYPE OF SENSOR OR OUTPUT DEVICE (Supplied, Installed and Wired By Div. 25000)	FLOOR	ROOM	Priority 1 2 3	ANALOG LIMITS		CONTACT	ACTION	HVY MOTOR	Notes and Old SDC Reference Point if Applicable
						LOCATION			L1	H1	NO NC	C/R O/R	DELAY	
		INPUTS BELOW												
		22-AHU-03 BUILDING VENTILATION												
	HHL	Supply Air HI Limit Humidity Switch	-											High Limit Hard Wire To Disable Humidifier
1.6A.13.01.01	SAH	Supply Air Humidity Sensor	AI											
1.6A.13.01.02	RAH	Return Air Humidity Sensor	AI											Control
1.6A.13.01.03	HUM	Humidifier Enable	DO											Humidifier HU-2
1.6A.13.01.04	HUMCS	Humidifier Control Signal	AO											
1.6A.13.01.05	OAT	Outdoor Air Entering Air Temperature (T-1)	AI											Entering ERV - Supply Side
1.6A.13.01.06	LAT	Energy Wheel Leaving Aitr Temperature Sensor (T-2)	AI											Leaving ERV - Supply Side
1.6A.13.01.07	RAT	Return Air Temperature Sensor (T-3)	AI											Entering ERV - Exhaust Side
1.6A.13.01.08	EAT	Mixed Air Temperature Sensor (T-4)	AI											Leaving ERV - Exhaust Side
1.6A.13.01.09	MAT	Mixed Air Temperature Sensor (T-5)	AI											
1.6A.13.01.10	SAT	Supply Air Temperature Sensor (T-6)	AI											Downstream of Heating Coil
1.6A.13.01.11	SAT	Supply Air Temperature Sensor (T-7)	AI											AHU discharge temperature
	FRZ	Freeze Stat	-											Hard Wire to Supply Fan
1.6A.13.01.12	ERWSC	Energy Recovery Wheel Speed Control	AO											
1.6A.13.01.13	ERWENA	Energy Recovery Wheel Enable - Disable	DO											
1.6A.13.01.14	FIL	Dirty Pre-Filter Alarm Pressure Switch	DI											
1.6A.13.01.15	SSP	Supply Static Pressure	AI											
1.6A.13.01.16	BSP	Building Static Pressure	AI											Mount Sensor Exterior Wall Room 124
1.6A.13.01.17	VSDENA	Supply Fan 22-AHU-05 Variable Speed Drive Enable	DO											
1.6A.13.01.18	VSDCTL	Supply Fan 22-AHU-05 Variable Speed Drive Control Signal	AO											
1.6A.13.01.19	SFA	Supply Fan 22-AHU-05 Amperage	AI											
1.6A.13.01.20	VSDENA	Return Fan 22-RFA-02 Variable Speed Drive Enable	DO											
1.6A.13.01.21	VSDCTL	Return Fan 22-RFA-02 Variable Speed Drive Control Signal	AO											
1.6A.13.01.22	RFA	Return Fan 22-RFA-02 Amperage	AI											
1.6A.13.01.23	CHW 2wayVLV	Cooling Coil Valve Control Signal	AO											
1.6A.13.01.24	HW 2wayVLV	Heating Coil Valve Control Signal	AO											
1.6A.13.01.25	OAD	Outside Air Damper CD-15	AO											Control and Status
1.6A.13.01.26	MAD	Mixed Air Damper CD-13	AO											Control and Status
1.6A.13.01.27	EAD	Exhaust Air Damper CD-14	AO											Control and Status

Input/Output Summary Table

NRC PROJECT NO:		IMC0140			CONSULTANT:	Nor			M&E Drawing Reference:							
AREA IDENTIFIER:		M22 - CCER, Zone 21: HVAC 22-AHU-4, Makeup, INPUTS & OUTPUTS			MCU NUMBER:				EMCS System Identifier:							
AREA EXPANSION:		Cabin Comfort and Environment Research Facility			LOCATION OF MCU:				EMCS System Expansion:							
1	2	3	4	5	6	7		8	9		10	11	12	13		
POINT IDENTIFICATION					AUXILIARY DEVICES			ALARMS			DI/DO	DI	DO			
POINT #	POINT IDENTIFIER	POINT EXPANSION	TYPE	ENG UNITS	CONTROLLED OR AUXILIARY SENSING DEVICE, TYPE OF SENSOR OR OUTPUT DEVICE (Supplied, Installed and Wired By Div. 25000)	FLOOR	ROOM	Priority 1 2 3	ANALOG LIMITS		CONTACT	ACTION	HVY MOTOR	Notes and Old SDC Reference Point if Applicable		
						LOCATION			L1	H1	NO NC	C/R O/R	DELAY			
		INPUTS BELOW														
		22-AHU04 DESICCANT AIR DRYER														
21.6B.13.20.01	VSDENA	Supply Fan 22-AHU-06 Variable Speed Drive Enable	DO													
21.6B.13.20.02	VSDCTL	Supply Fan 22-AHU-06 Variable Speed Drive Control Signal	AO													
21.6B.13.20.03	SFA	Supply Fan 22-AHU-06 Amperage	AI													
21.6B.13.20.04	MD	Bypass Damper Position	DO											CD-25		
21.6B.13.20.05	MD	Bypass Damper Position	DO											CD-05		
21.6B.13.20.06	SSP	Supply Air Static Pressure	AI													
21.6B.13.20.07	FIL	Filter Differential Pressure Switch	DI											Entering Air Filter		
21.6B.13.20.08	HCEAT	Heating Coil Entering Air Temperature	AI											TT-1		
21.6B.13.20.09	HCLAT	Heating Coil Leaving Air Temperature	AI											TT-2		
21.6B.13.20.10	HW 2wayVLV	Heating 2-way flow control valve	AO											entering air temperature control		
21.6B.13.20.11	EAT	Desiccant Entering Air Temperature	AI											TT-3		
21.6B.13.20.12	CCEAT	Pre-Cooling Coil Entering Air Temperature	AI											TT-4		
21.6B.13.20.13	CCLAT	Pre-Cooling Coil Leaving Air Temperature	AI											TT-5		
21.6B.13.20.14	CHW 2wayVLV	Pre-Cooling Coil Chilled Water 2-way Flow Control Valve	AO													
21.6B.13.20.15	SAH	Supply AirDew Point	AI											Air Entering Dew Point		
21.6B.13.20.16	HW 2wayVLV	Steam Heating 2-way 2 Position Control Valve	-											interlocked with PCL controller		
21.6B.13.20.17	DPS	Entering Air Dew Point	AI											H-1 (hard wire to Desiccant Controller as required)		
21.6B.13.20.18	DPS	Entering Air Dew Point	AI											H-2 (hard wire to Desiccant Controller as required)		
21.6B.13.20.19	DPS	Supply Air Dew Point	AI											H-3 (hard wire to Desiccant Controller as required)		
21.6B.13.20.20	SAT	Desiccant Leaving Regenerative Air Temperature	AI											T-6		
21.6B.13.20.21	FIL	Differential Pressure - HEPA filter	DI											HEPA Filter		
21.6B.13.20.22	RSP	Return Duct Static Pressure	AI											Duct Mounted		
21.6B.13.20.23	DWENA	Desiccant Wheel Alarm Point	DI											General Alarm		
	DWIAD	Desiccant Wheel Face Damper CD-09A	-											Hard Wired		
	DWBAD	Desiccant Wheel Bypass Damper CD-09B	-											Hard Wired		
	HW 2wayVLV	Desiccant Steam Valve Control	-											Hard Wired		
	MD	Desiccant Regenerator Fan Damper	-											Hard Wired		
21.6B.13.20.24	CHW 2wayVLV	Post-Cooling Coil Chilled Water 2-way Flow Control Valve	AO													
21.6B.13.20.25	HUM	Humidifier Enable	DO													
21.6B.13.20.26	SAH	Supply Air HI Limit Humidity Switch	DI											High Limit		

NRC PROJECT NO:	IMC0140	CONSULTANT:	NORR	M&E Drawing Reference:	
AREA IDENTIFIER:	M22 - CCER, Zone 22: HVAC AHU4, FCL & FSL, INPUTS & OUTPUTS	MCU NUMBER:		EMCS System Identifier:	
AREA EXPANSION:	Cabin Comfort and Environment Research Facility	LOCATION OF MCU:		EMCS System Expansion:	

1	2	3	4	5	6	7		8	9		10	11	12	13
POINT IDENTIFICATION					AUXILIARY DEVICES			ALARMS			DI/DO	DI	DO	
POINT #	POINT IDENTIFIER	POINT EXPANSION	TYPE	ENG UNITS	CONTROLLED OR AUXILIARY SENSING DEVICE, TYPE OF SENSOR OR OUTPUT DEVICE (Supplied, Installed and Wired By Div. 25000)	LOCATION		Priority 1 2 3	ANALOG LIMITS		CONTACT	ACTION	HVY MOTOR	Notes and Old SDC Reference Point if Applicable
						FLOOR	ROOM		L1	H1	NO NC	C/R O/R	DELAY	
		INPUTS BELOW												
		22-AHU05-22 / RAF-05 [FCL & FSL]												
1.6A.13.01.01	SAH	Supply Air Humidity Sensor	AI											sensor to measure Dew Point
1.6A.13.01.02	EAT	Entering Air Temperature Sensor	AI											
1.6A.13.01.03	SAT	Supply Air Temperature Sensor	AI											Leaving 22-AHU-05
1.6A.13.01.04	SAT	Supply Air Temperature Sensor	AI											Flexible Cabin Lab
1.6A.13.01.05	SAT	Supply Air Temperature Sensor	AI											Flight Simulation Lab
1.6A.13.01.06	RAT	Return Air Temperature Sensor	AI											Flexible Cabin Lab
1.6A.13.01.07	RAT	Return Air Temperature Sensor	AI											Flight Simulation Lab
1.6A.13.01.08	FIL	Dirty Pre-Filter Alarm Pressure Switch	DI											
1.6A.13.01.09	FIL	Dirty HEPA Filter Alarm Pressure Switch	DI											
1.6A.13.01.10	SSP	Supply Static Pressure	AI											and high limit
1.6A.13.01.11	RSP	Return Static Pressure	AI											and high limit
1.6A.13.01.12	VSDENA	Supply Fan 22-AHU-05 Variable Speed Drive Enable	DO											
1.6A.13.01.13	VSDCTL	Supply Fan 22-AHU-05 Variable Speed Drive Control Signal	AO											
1.6A.13.01.14	SFA	Supply Fan 22-AHU-05 Amperage	AI											
1.6A.13.01.15	VSDENA	Return Fan 22-RFA-02 Variable Speed Drive Enable	DO											
1.6A.13.01.16	VSDCTL	Return Fan 22-RFA-02 Variable Speed Drive Control Signal	AO											
1.6A.13.01.17	RFA	Return Fan 22-RFA-02 Amperage	AI											
1.6A.13.01.18	CHW_2wayVLV	Cooling Coil Valve Control Signal	AO											
1.6A.13.01.19	RMDP	Pressure, Room, Static	AI											East wall, mid-level
1.6A.13.01.20	AVFM	Air Valve Airflow Measurement	AI											AV 11 Exhaust
1.6A.13.01.21	AVFC	Air Valve Airflow Control	AO											AV 11 Exhaust
1.6A.13.01.22	AVFM	Air Valve Airflow Measurement	AI											AV 03 Recirculation
1.6A.13.01.23	AVFC	Air Valve Airflow Control	AO											AV 03 Recirculation
1.6A.13.01.24	AVFM	Air Valve Airflow Measurement	AI											AV 04 Supply
1.6A.13.01.25	AVFC	Air Valve Airflow Control	AO											AV 04 Supply
1.6A.13.01.26	EF	Exhaust Fan Start / Stop	AI											22-XAF-10
1.6A.13.01.27	EFA	Exhaust Fan Status	DI											22-XAF-10
1.6A.13.01.28	ECO2	Return Air CO2-2	AI											Common sensor to Flexible Cabin Lab and Flight Simulatio Lab - Operator Selected
1.6A.13.01.29	RAT	Room Air Temperature Sensor	AI											Flexible Cabin Lab
1.6A.13.01.30	ERHCS	Flex Cabin Electric Reheat Coil SCR Control Signal	AO											
1.6A.13.01.31	SAT	Flex Cabin Supply Air Temperature Sensor	AI											Duct Mounted
	FLOW	Flex Cabin Supply Air Flow Switch	_											Division 25 Hard Wired to Electric Reheat Coil
1.6A.13.01.32	ERHCS	Flight Simulation Lab Electric Reheat Coil SCR Control Signal	AO											
1.6A.13.01.33	SAT	Flight Simulation Lab Supply Air Temperature Sensor	AI											Duct Mounted
	ERHCS	Flight Simulation Lab Supply Air Flow Switch	_											Division 25 Hard Wired to Electric Reheat Coil

Input/Output Summary Table

NRC PROJECT NO:		IMC0140			CONSULTANT:	NORR			M&E Drawing Reference:							
AREA IDENTIFIER:		M22 - CCER, Zone 22: HVAC AHU06, Airport Terminal, INPUTS & OUTPUTS			MCU NUMBER:				EMCS System Identifier:							
AREA EXPANSION:		Cabin Comfort and Environment Research Facility			LOCATION OF MCU:				EMCS System Expansion:							
1	2	3	4	5	6	7		8	9		10	11	12	13		
POINT IDENTIFICATION					AUXILIARY DEVICES			ALARMS			DI/DO	DI	DO			
POINT #	POINT IDENTIFIER	POINT EXPANSION	TYPE	ENG UNITS	CONTROLLED OR AUXILIARY SENSING DEVICE, TYPE OF SENSOR OR OUTPUT DEVICE (Supplied, Installed and Wired By Div. 25000)	FLOOR	ROOM	Priority 1 2 3	ANALOG LIMITS		CONTACT	ACTION	HVY MOTOR	Notes and Old SDC Reference Point if Applicable		
						LOCATION			L1	H1	NO NC	C/R O/R	DELAY			
		INPUTS BELOW														
		22-AHU06-22 / RAF-06 [AT]														
1.6A.13.01.01	SAH	Supply Air Dew Point Sensor	AI											sensor to measure Dew Point		
1.6A.13.01.02	EAT	Entering Air Temperature Sensor	AI													
1.6A.13.01.03	SAT	Supply Air Temperature Sensor	AI											Leaving 22-AHU-06		
1.6A.13.01.04	SAT	Supply Air Temperature Sensor	AI											Downstream of Electric Re-Heat Coil		
1.6A.13.01.05	SAT	Supply Air Temperature Sensor	AI											Flight Simulation Lab		
1.6A.13.01.06	RAT	Return Air Temperature Sensor	AI											Airport Terminal Simulation Lab		
1.6A.13.01.07	FIL	Dirty Pre-Filter Alarm Pressure Switch	DI													
1.6A.13.01.08	FIL	Dirty HEPA Filter Alarm Pressure Switch	DI													
1.6A.13.01.09	SSP	Supply Static Pressure	AI											and high limit		
1.6A.13.01.10	RSP	Return Static Pressure	AI											and high limit		
1.6A.13.01.11	VSDENA	Supply Fan 22-AHU-06 Variable Speed Drive Enable	DO													
1.6A.13.01.12	VSDCTL	Supply Fan 22-AHU-06 Variable Speed Drive Control Signal	AO													
1.6A.13.01.13	SFA	Supply Fan 22-AHU-06 Amperage	AI													
1.6A.13.01.14	VSDENA	Return Fan 22-RFA-06 Variable Speed Drive Enable	DO													
1.6A.13.01.15	VSDCTL	Return Fan 22-RFA-06 Variable Speed Drive Control Signal	AO													
1.6A.13.01.16	RFA	Return Fan 22-RFA-06 Amperage	AI													
1.6A.13.01.17	CHW_2wayVLV	Cooling Coil Valve Control Signal	AO													
1.6A.13.01.18	AVFM	Air Valve Airflow Measurement	AI											AV 12 Exhaust		
1.6A.13.01.19	AVFC	Air Valve Airflow Control	AO											AV 12 Exhaust		
1.6A.13.01.20	AVFM	Air Valve Airflow Measurement	AI											AV 01 Recirculation		
1.6A.13.01.21	AVFC	Air Valve Airflow Control	AO											AV 01 Recirculation		
1.6A.13.01.22	AVFM	Air Valve Airflow Measurement	AI											AV 02 Supply		
1.6A.13.01.23	AVFC	Air Valve Airflow Control	AO											AV 02 Supply		
1.6A.13.01.24	BTD	Bubble Tight Damper	DO											HVAC System Supply		
1.6A.13.01.25	BTD	Bubble Tight Damper	DO											HVAC System Return		
1.6A.13.01.26	ECO2	Return Air CO2-3	AI													
1.6A.13.01.27	RAT	Room Air Temperature Sensor	AI											Airport Terminal		
1.6A.13.01.28	RDP	Room Dew Point Sensor	AI													
1.6A.13.01.29	ERHCS	Airport Terminal Electric Reheat Coil SCR Control Signal	AO													
1.6A.13.01.30	FLOW	Airport Terminal Supply Air Flow Switch	_											Division 25 Hard Wired to Electric Reheat Coil		
1.6A.13.01.31	PSS	Pump Start - Stop	DO											22GLP16		
1.6A.13.01.32	PRS	Pump Run Status	DI											22GLP16		
1.6A.13.01.33	HWST	Heating Water Supply Temperature	AI													
1.6A.13.01.34	CHW_3wayVLV	Mixing Valve Control	AO											Heating Mixing Valve Control		
1.6A.13.01.35	PSS	Pump Start - Stop	DO											22GLP12		
1.6A.13.01.36	PRS	Pump Run Status	DI											22GLP12		
1.6A.13.01.37	CHSWT	Cooling Water Supply Temperature	AI													
1.6A.13.01.38	CHW_3wayVLV	Mixing Valve Control	AO											Cooling Mixing Valve Control		

Input/Output Summary Table

NRC PROJECT NO:	IMC0140	CONSULTANT:	NORR	M&E Drawing Reference:	
AREA IDENTIFIER:	M22 - CCER, Zone 24: HVAC 22-AHU-7, HVL, INPUTS & OUTPUTS	MCU NUMBER:		EMCS System Identifier:	
AREA EXPANSION:	Cabin Comfort and Environment Research Facility	LOCATION OF MCU:		EMCS System Expansion:	

1	2	3	4	5	6	7		8	9		10	11	12	13
POINT IDENTIFICATION					AUXILIARY DEVICES			ALARMS			DI/DO	DI	DO	
POINT #	POINT IDENTIFIER	POINT EXPANSION	TYPE	ENG UNITS	CONTROLLED OR AUXILIARY SENSING DEVICE, TYPE OF SENSOR OR OUTPUT DEVICE (Supplied, Installed and Wired By Div. 25000)	FLOOR	ROOM	Priority 1 2 3	ANALOG LIMITS		CONTACT	ACTION	HVY MOTOR	Notes and Old SDC Reference Point if Applicable
						LOCATION			L1	H1	NO NC	C/R O/R	DELAY	
		INPUTS BELOW												
		22-AHU-07 [HVL]												
1.6A.13.01.01	AVFM	Air Valve Airflow Measurement	AI											AV 20 Exhaust
1.6A.13.01.02	AVFC	Air Valve Airflow Control	AO											AV 20 Exhaust
1.6A.13.01.03	AVFM	Air Valve Airflow Measurement	AI											AV 24 Recirculation
1.6A.13.01.04	AVFC	Air Valve Airflow Control	AO											AV 24 Recirculation
1.6A.13.01.05	AVFM	Air Valve Airflow Measurement	AI											AV 23 Supply
1.6A.13.01.06	AVFC	Air Valve Airflow Control	AO											AV 23 Supply
1.6A.13.01.07	EAT	Entering Air Temperature Sensor	AI											
1.6A.13.01.08	SAT	Cooling Coil Leaving Air Temperature	AI											
1.6A.13.01.09	SAT	Supply Air Temperature Sensor	AI											
1.6A.13.01.10	RAT	Return Air Temperature Sensor	AI											
1.6A.13.01.11	FIL	Dirty Pre-Filter Alarm Pressure Switch	DI											
1.6A.13.01.12	SSP	Supply Air Static Pressure Sensor	AI											
1.6A.13.01.13	RSP	Return Air Static Pressure Sensor	AI											
1.6A.13.01.14	VSDENA	Supply Fan 22-AHU-07 Variable Speed Drive Enable	DO											
1.6A.13.01.15	VSDCTL	Supply Fan 22-AHU-07 Variable Speed Drive Control Signal	AO											
1.6A.13.01.16	SFA	Supply Fan 22-AHU-07 Amperage	AI											
1.6A.13.01.17	VSDENA	Return Fan 22-RFA-07 Variable Speed Drive Enable	DO											
1.6A.13.01.18	VSDCTL	Return Fan 22-RFA-07 Variable Speed Drive Control Signal	AO											
1.6A.13.01.19	RFA	Return Fan 22-RFA-07 Amperage	AI											
1.6A.13.01.20	ERHCS	Vibration Lab Electric Reheat Coil Control Signal	AO											
1.6A.13.01.21	CHW 2wayVLV	Cooling Coil Valve Control Signal	AO											
	FLOW	Vibration Lab Supply Air Flow Switch	_											Division 25 Hard Wired to Electric Reheat Coil

Input/Output Summary Table

NRC PROJECT NO:	IMC0140	CONSULTANT:	NORR	M&E Drawing Reference:	
AREA IDENTIFIER:	M22 - CCER, Zone 27: HVAC HWS/R, Building, INPUTS & OUTPUTS	MCU NUMBER:		EMCS System Identifier:	
AREA EXPANSION:	Cabin Comfort and Environment Research Facility	LOCATION OF MCU:		EMCS System Expansion:	

1	2	3	4	5	6	7		8	9		10	11	12	13
POINT IDENTIFICATION					AUXILIARY DEVICES			ALARMS			DI/DO	DI	DO	
POINT #	POINT IDENTIFIER	POINT EXPANSION	TYPE	ENG UNITS	CONTROLLED OR AUXILIARY SENSING DEVICE, TYPE OF SENSOR OR OUTPUT DEVICE (Supplied, Installed and Wired By Div. 25000)	FLOOR	ROOM	Priority 1 2 3	ANALOG LIMITS		CONTACT	ACTION	HVY MOTOR	Notes and Old SDC Reference Point if Applicable
						LOCATION			L1	H1	NO NC	C/R O/R	DELAY	
		INPUTS BELOW												
		PRIMARY HEATING SYSTEM												
27.6B.13.09.01	HWST	Heating Supply Temperature	AI											
27.6B.13.09.02	HWRT	Heating Return Temperature	AI											
27.6B.13.09.03	VSDENA	Heating Distribution Pump #1 Variable Speed Drive Enable	DO											22-HWP-01
27.6B.13.09.04	VSDALM	Heating Distribution Pump #1 Variable Speed Drive Alarm	DI											22-HWP-01
27.6B.13.09.05	VSDCTL	Heating Distribution Pump #1 Variable Speed Drive Control Signal	AO											22-HWP-01
27.6B.13.09.06	VSDENA	Heating Distribution Pump #2 Variable Speed Drive Enable	DO											22-HWP-02
27.6B.13.09.07	VSDALM	Heating Distribution Pump #2 Variable Speed Drive Alarm	DI											22-HWP-02
27.6B.13.09.08	VSDCTL	Heating Distribution Pump #2 Variable Speed Drive Control Signal	AO											22-HWP-02
27.6B.13.09.09	VSDDPS	Variable Speed Drive Differential Pressure Sensor	AI											
27.6B.13.09.10	HW 2wayVLV	Heat Exchanger Control Valve Position	AO											Steam - HX-1
27.6B.13.09.11	HW 2wayVLV	Heat Exchanger Control Valve Position	AO											Steam - HX-2
27.6B.13.09.12	HW 2wayVLV	Heat Exchanger 2 Position Control Valve	DO											Heating Water - HX-1
27.6B.13.09.13	HW 2wayVLV	Heat Exchanger 2 Position Control Valve	DO											Heating Water - HX-2
27.6B.13.09.14	OAT	Outdoor Air Temperature	AI											Common Shared Outside, North wall M22
27.6B.13.09.15	OAH	Outdoor Air Humidity (temp next channel)	AI											Common Shared Outside, North wall M22

Input/Output Summary Table

NRC PROJECT NO:	IMC0140	CONSULTANT:	NORR	M&E Drawing Reference:	
AREA IDENTIFIER:	M22 - CCER, Zone 28A: HVAC CCH1 Building, INPUTS & OUTPUTS	MCU NUMBER:		EMCS System Identifier:	
AREA EXPANSION:	Cabin Comfort and Environment Research Facility	LOCATION OF MCU:		EMCS System Expansion:	

1	2	3	4	5	6	7		8	9		10	11	12	13
POINT IDENTIFICATION					AUXILIARY DEVICES			ALARMS			DI/DO	DI	DO	
POINT #	POINT IDENTIFIER	POINT EXPANSION	TYPE	ENG UNITS	CONTROLLED OR AUXILIARY SENSING DEVICE, TYPE OF SENSOR OR OUTPUT DEVICE (Supplied, Installed and Wired By Div. 25000)	LOCATION: FLOOR	LOCATION: ROOM	Priority 1 2 3	ANALOG LIMITS: L1	ANALOG LIMITS: H1	CONTACT: NO NC	ACTION: C/R O/R	HVY MOTOR: DELAY	Notes and Old SDC Reference Point if Applicable
		INPUTS BELOW												
		BLD SERVICES CHILLED WATER SYSTEM												
28A.6B.13.07.01	CHSWT	Chilled Water Distribution Supply Temperature	AI											
28A.6B.13.07.02	CHRWT	Chilled Water Distribution Return Temperature	AI											
28A.6B.13.07.03	CHLWT	Chiller Leaving Water Temperature	AI											
28A.6B.13.07.04	CHEWT	Chiller Entering Water Temperature	AI											
28A.6B.13.07.05	CHW_FLOW	Flow Switch	DI											
28A.6B.13.07.06	CHENA	Chiller Enable / Disable	DO											22-CCH-04
28A.6B.13.07.07	CHRS	Chiller Run Status	DI											22-CCH-04
28A.6B.13.07.08	CHAS	Chiller Alarm Status	DI											22-CCH-04
28A.6B.13.07.08	CHWTRC	Chiller Water Temperature Reset Control	AO											22-CCH-04
28A.6B.13.07.09	CHWPS	Chiller Pump #1 Status	DI											22-CWP-03
28A.6B.13.07.10	CHWPS	Chiller Pump #2 Status	DI											22-CWP-04
28A.6B.13.07.11	CHWPS	Chiller Distribution Pump #1 Status	DI											22-CWP-05
28A.6B.13.07.12	CHWPS	Chiller Distribution Pump #2 Status	DI											22-CWP-06
28A.6B.13.07.13	CHWPENA	Chiller Pump #1 Start/Stop	DO											22-CWP-03
28A.6B.13.07.14	CHWPENA	Chiller Pump #2 Start/Stop	DO											22-CWP-04
28A.6B.13.07.15	VSDENA	Chiller Distribution Pump #1 Variable Speed Drive Enable	DO											22-CWP-05
28A.6B.13.07.16	VSDALM	Chiller Distribution Pump #1 Variable Speed Drive Alarm	DI											22-CWP-05
28A.6B.13.07.17	VSDCTL	Chiller Distribution Pump #1 Variable Speed Drive Control Signal	AO											22-CWP-05
28A.6B.13.07.18	VSDENA	Chiller Distribution Pump #2 Variable Speed Drive Enable	DO											22-CWP-06
28A.6B.13.07.19	VSDALM	Chiller Distribution Pump #2 Variable Speed Drive Alarm	DI											22-CWP-06
28A.6B.13.07.20	VSDCTL	Chiller Distribution Pump #2 Variable Speed Drive Control Signal	AO											22-CWP-06
28A.6B.13.07.21	VSDDPS	Variable Speed Drive Differential Pressure Sensor	AI											

Input/Output Summary Table

NRC PROJECT NO:	IMC0140	CONSULTANT:	NORR	M&E Drawing Reference:	
AREA IDENTIFIER:	M22 - CCER, Zone 29A: ECS CCH2 Labs, INPUTS & OUTPUTS	MCU NUMBER:		EMCS System Identifier:	
AREA EXPANSION:	Cabin Comfort and Environment Research Facility	LOCATION OF MCU:		EMCS System Expansion:	

1	2	3	4	5	6	7		8	9		10	11	12	13
POINT IDENTIFICATION					AUXILIARY DEVICES			ALARMS			DI/DO	DI	DO	
POINT #	POINT IDENTIFIER	POINT EXPANSION	TYPE	ENG UNITS	CONTROLLED OR AUXILIARY SENSING DEVICE, TYPE OF SENSOR OR OUTPUT DEVICE (Supplied, Installed and Wired By Div. 25000)	FLOOR	ROOM	Priority 1 2 3	ANALOG LIMITS		CONTACT	ACTION	HVY MOTOR	Notes and Old SDC Reference Point if Applicable
						LOCATION			L1	H1	NO NC	C/R O/R	DELAY	
		INPUTS BELOW												
		LAB HIGH LIFT CHILLER SYSTEM												
28A.6B.13.07.01	CHSWT	Chilled Water Distribution Supply Temperature	AI											
28A.6B.13.07.02	CHRWT	Chilled Water Distribution Return Temperature	AI											
28A.6B.13.07.03	CHLWT	Chiller Leaving Water Temperature	AI											
28A.6B.13.07.04	CHEWT	Chiller Entering Water Temperature	AI											
28A.6B.13.07.05	CHW_FLOW	Flow Switch	DI											
28A.6B.13.07.06	CHENA	Chiller Enable / Disable	DO											22-CCH-05
28A.6B.13.07.07	CHRS	Chiller Run Status	DI											22-CCH-05
28A.6B.13.07.08	CHAS	Chiller Alarm Status	DI											22-CCH-05
28A.6B.13.07.09	CHWTRC	Chiller Water Temperature Reset Control	AO											22-CCH-05
28A.6B.13.07.10	CH_3wayVLV	Chiller 3 Way By-Pass Valve	DO											
28A.6B.13.07.11	EFA	Chiller Room Exhaust Fan (ERV)	DI											
28A.6B.13.07.12	RA	Chiller Room Refrigerant Monitor	DI											
28A.6B.13.07.13	CEWT	Condenser Entering Water Temperature	AI											
28A.6B.13.07.14	CLWT	Condenser Leaving Water Temperature	AI											
28A.6B.13.07.15	CWFS	Condenser Water Flow Switch	DI											
28A.6B.13.07.16	C_3wayVLV	Condenser 3-way By-Pass Valve	DO											
28A.6B.13.07.17	DCEWT	Dry Cooler Entering Water Temperature	AI											
28A.6B.13.07.18	DCLWT	Dry Cooler Leaving Water Temperature	AI											
28A.6B.13.07.19	DCENA	Dry Cooler Enable	DO											Dry Contacts
28A.6B.13.07.20	DCRS	Dry Cooler Run Status	DI											
28A.6B.13.07.21	DCS-W	Dry Cooler Summer / Winter	DO											Dry Contacts
28A.6B.13.07.22	CHWPENA	Chiller Primary Pump #1 Start/Stop	DO											Primary Pumps 22-CWP-09
28A.6B.13.07.23	CHWPENA	Chiller Primary Pump #2 Start/Stop	DO											Primary Pumps 22-CWP-10
28A.6B.13.07.24	CHWPS	Chiller Primary Pump #1 Status	DI											Primary Pumps 22-CWP-09
28A.6B.13.07.25	CHWPS	Chiller Primary Pump #2 Status	DI											Primary Pumps 22-CWP-10
28A.6B.13.07.26	VSDENA	Chiller Secondary Pump #1 Variable Speed Drive Enable	DO											Secondary Pump 22-CWP-11
28A.6B.13.07.27	VSDALM	Chiller Secondary Pump #1 Variable Speed Drive Alarm	DI											Secondary Pump 22-CWP-11
28A.6B.13.07.28	VSDCTL	Chiller Secondary Pump #1 Variable Speed Drive Control Signal	AO											Secondary Pump 22-CWP-11
28A.6B.13.07.29	VSDENA	Chiller Secondary Pump #2 Variable Speed Drive Enable	DO											Secondary Pump 22-CWP-12
28A.6B.13.07.30	VSDALM	Chiller Secondary Pump #2 Variable Speed Drive Alarm	DI											Secondary Pump 22-CWP-12
28A.6B.13.07.31	VSDCTL	Chiller Secondary Pump #2 Variable Speed Drive Control Signal	AO											Secondary Pump 22-CWP-12
28A.6B.13.07.32	VSDDPS	Variable Speed Drive Differential Pressure Sensor	AI											
28A.6B.13.07.33	CWPS	Condenser Primary Water Pump #1 Status	DI											Primary Pumps 22-CWP-07
28A.6B.13.07.34	CWPS	Condenser Primary Water #2 Status	DI											Primary Pumps 22-CWP-08
28A.6B.13.07.35	CWPENA	Condenser Primary Water Pump #1 Start / Stop	DO											Primary Pumps 22-CWP-07
28A.6B.13.07.36	CWPENA	Condenser Primary Water Pump #2 Start / Stop	DO											Primary Pumps 22-CWP-08
28A.6B.13.07.37	CWPS	Condenser Secondary Water Pump #1 Status	DI											Secondary Pumps 22-CWP-13A
28A.6B.13.07.38	CWPS	Condenser Secondary Water #2 Status	DI											Secondary Pumps 22-CWP-13B
28A.6B.13.07.39	CWPENA	Condenser Secondary Water Pump #1 Start / Stop	DO											Secondary Pumps 22-CWP-13A
28A.6B.13.07.40	CWPENA	Condenser Secondary Water Pump #2 Start / Stop	DO											Secondary Pumps 22-CWP-13B

Input/Output Summary Table

NRC PROJECT NO:	IMC0140	CONSULTANT:	Nor	M&E Drawing Reference:	
AREA IDENTIFIER:	M22 - CCER, Zone 8: Flight Simulation Lab, HVAC INPUTS & OUTPUTS	MCU NUMBER:		EMCS System Identifier:	
AREA EXPANSION:	Cabin Comfort and Environment Research Facility	LOCATION OF MCU:		EMCS System Expansion:	

1	2	3	4	5	6	7		8	9		10	11	12	13
POINT IDENTIFICATION					AUXILIARY DEVICES			ALARMS			DI/DO	DI	DO	
POINT #	POINT IDENTIFIER	POINT EXPANSION	TYPE	ENG UNITS	CONTROLLED OR AUXILIARY SENSING DEVICE, TYPE OF SENSOR OR OUTPUT DEVICE (Supplied, Installed and Wired By Div. 25000)	FLOOR	ROOM	Priority 1 2 3	ANALOG LIMITS		CONTACT	ACTION	HVY MOTOR	Notes and Old SDC Reference Point if Applicable
						LOCATION			L1	H1	NO NC	C/R O/R	DELAY	
		INPUTS BELOW												
		FLIGHT SIMULATION LAB												
8.6B.13.02.01	RMTS	Room Temperature Sensor, Air, High Bay 1	AI											Floor level
8.6B.13.02.02	RMH	Humidity, Air, High Bay 1 (temp next channel)	AI											Floor level
8.6B.13.02.03	RMSP	Pressure, Static, High Bay	AI											East wall at mid-level
8.6B.13.02.04	SFA	High Bay Supply Fan Status	DI											
8.6B.13.02.05	SFENA	High Bay Supply Fan Stop / Start	DO											
8.6B.13.02.06	FIL	Coil Filter Differential Pressure Switch	DI											
8.6B.13.02.07	HCV	Heating Coil Control Valve	AO											
8.6B.13.02.08	MATS	Mixed Air Temperature Sensor	AI											
8.6B.13.02.09	OAD	Supply Fan Intake Air Damper	AO											
8.6B.13.02.10	MAD	Supply Fan Mixed Air Damper	AO											
8.6B.13.02.11	EAD	Exhaust Louver Relief Air Damper	DO											

Input/Output Summary Table

NRC PROJECT NO:		IMC0140			CONSULTANT:	NORR			M&E Drawing Reference:						
AREA IDENTIFIER:		M22 - CCER, Zones [SUMP PUMPS] Bld Services INPUTS & OUTPUTS			MCU NUMBER:				EMCS System Identifier:						
AREA EXPANSION:		Cabin Comfort and Environment Research Facility			LOCATION OF MCU:				EMCS System Expansion:						
1	2	3	4	5	6	7		8	9		10	11	12	13	
POINT IDENTIFICATION					AUXILIARY DEVICES			ALARMS			DI/DO	DI	DO		
POINT #	POINT IDENTIFIER	POINT EXPANSION	TYPE	ENG UNITS	CONTROLLED OR AUXILIARY SENSING DEVICE, TYPE OF SENSOR OR OUTPUT DEVICE (Supplied, Installed and Wired By Div. 25000)	FLOOR	ROOM	Priority 1 2 3	ANALOG LIMITS		CONTACT	ACTION	HVY MOTOR	Notes and Old SDC Reference Point if Applicable	
						LOCATION			L1	H1	NO NC	C/R O/R	DELAY		
		INPUTS BELOW													
		SUMP AND SEWAGE PUMPS													
1.6A.XX.01.01	PRS	Sump Pump Run Status	DI				28							Sump Pump SVP-1	
1.6A.XX.01.02	HLA	High Level Alarm	DI				28							Critical Level Sump Pump SVP-1 High Level Alarm	
1.6A.XX.01.03	PRS	Sump Pump Run Status	DI				25							Sump Pump SVP-2	
1.6A.XX.01.04	HLA	High Level Alarm	DI				25							Critical Level Sump Pump SVP-2 High Level Alarm	
1.6A.XX.01.05	PRS	Sump Pump Run Status	DI				137							Sump Pump SVP-3	
1.6A.XX.01.06	HLA	High Level Alarm	DI				137							Critical Level Sump Pump SVP-3 High Level Alarm	

Input/Output Summary Table

NRC PROJECT NO:		IMC0140			CONSULTANT:	NORR			M&E Drawing Reference:							
AREA IDENTIFIER:		M22 - CCER, Multiple Zones TU With RH INPUTS & OUTPUTS			MCU NUMBER:				EMCS System Identifier:							
AREA EXPANSION:		Cabin Comfort and Environment Research Facility			LOCATION OF MCU:				EMCS System Expansion:							
1	2	3	4	5	6	7		8	9		10	11	12	13		
POINT IDENTIFICATION					AUXILIARY DEVICES			ALARMS			DI/DO	DI	DO			
POINT #	POINT IDENTIFIER	POINT EXPANSION	TYPE	ENG UNITS	CONTROLLED OR AUXILIARY SENSING DEVICE, TYPE OF SENSOR OR OUTPUT DEVICE (Supplied, Installed and Wired By Div. 25000)	FLOOR	ROOM	Priority 1 2 3	ANALOG LIMITS		CONTACT	ACTION	HVY MOTOR	Notes and Old SDC Reference Point if Applicable	Comments	
						LOCATION			L1	H1	NO NC	C/R O/R	DELAY			
		INPUTS BELOW														
		VAV BOX WITH REHEAT COIL														
1.6B.13.01.01	VAVTU	Variable Air Volume Terminal Unit Control Signal	AO				21							VAV Box 1.2	CORRIDOR	
1.6B.13.01.02	HW 2wayVLV	Heating Water Control Valve	AO											Terminal Unit Reheat Control Valve	CORRIDOR	
1.6B.13.01.03	RMTS	Room Temperature Sensor	DI				21							Wall Mounted	CORRIDOR	
1.6B.13.01.04	VAVTU	Variable Air Volume Terminal Unit Control Signal	AO				22,31,32							VAV Box 1.4	CORRIDOR / OFFICE	
1.6B.13.01.05	HW 2wayVLV	Heating Water Control Valve	AO											Terminal Unit Reheat Control Valve	CORRIDOR / OFFICE	
1.6B.13.01.06	RMTH	Room Thermostat	AI				32							Wall Mounted	CORRIDOR / OFFICE	
1.6B.13.01.07	VAVTU	Variable Air Volume Terminal Unit Control Signal	AO				33							VAV Box 1.5	WORKSHOP	
1.6B.13.01.08	HW 2wayVLV	Heating Water Control Valve	AO											Terminal Unit Reheat Control Valve	WORKSHOP	
1.6B.13.01.09	RMTH	Room Thermostat	AI				33							Wall Mounted	WORKSHOP	
1.6B.13.01.10	VAVTU	Variable Air Volume Terminal Unit Control Signal	AO				34							VAV Box 1.6	WORKSHOP	
1.6B.13.01.11	HW 2wayVLV	Heating Water Control Valve	AO											Terminal Unit Reheat Control Valve	WORKSHOP	
1.6B.13.01.12	RMTH	Room Thermostat	AI				34							Wall Mounted	WORKSHOP	
1.6B.13.01.13	VAVTU	Variable Air Volume Terminal Unit Control Signal	AO				22,31,32							VAV Box 1.7	OFFICE	
1.6B.13.01.14	HW 2wayVLV	Heating Water Control Valve	AO											Terminal Unit Reheat Control Valve	OFFICE	
1.6B.13.01.15	RMTH	Room Thermostat	AI				36							Wall Mounted	OFFICE	
1.6B.13.01.16	VAVTU	Variable Air Volume Terminal Unit Control Signal	AO				21							VAV Box 1.8	CORRIDOR	
1.6B.13.01.17	HW 2wayVLV	Heating Water Control Valve	AO											Terminal Unit Reheat Control Valve	CORRIDOR	
1.6B.13.01.18	RMTS	Room Temperature Sensor	DI				21							Wall Mounted	CORRIDOR	
1.6B.13.01.19	VAVTU	Variable Air Volume Terminal Unit Control Signal	AO				124							VAV Box 2.1	CORRIDOR	
1.6B.13.01.20	HW 2wayVLV	Heating Water Control Valve	AO											Terminal Unit Reheat Control Valve	CORRIDOR	
1.6B.13.01.21	RMTS	Room Temperature Sensor	DI				124							Wall Mounted	CORRIDOR	
1.6B.13.01.22	VAVTU	Variable Air Volume Terminal Unit Control Signal	AO				130,131,132							VAV Box 2.6	EXAM	
1.6B.13.01.23	HW 2wayVLV	Heating Water Control Valve	AO											Terminal Unit Reheat Control Valve	EXAM	
1.6B.13.01.24	RMTS	Room Temperature Sensor	DI				130							Wall Mounted	EXAM	
1.6B.13.01.25	RMTS	Room Temperature Sensor	DI				132							Wall Mounted	EXAM	
1.6B.13.01.26	RMTH	Room Thermostat	AI				131							Wall Mounted	EXAM	
1.6B.13.01.27	VAVTU	Variable Air Volume Terminal Unit Control Signal	AO				24							VAV Box 1.3	VIBRATION LAB	
1.6B.13.01.28	HW 2wayVLV	Heating Water Control Valve	AO											Terminal Unit Reheat Control Valve	VIBRATION LAB	
1.6B.13.01.29	RMTS	Room Temperature Sensor	DI				24							Wall Mounted	VIBRATION LAB	
1.6B.13.01.30	VAVTU	Variable Air Volume Terminal Unit Control Signal	AO				139							VAV Box 2.8	FLEXIBLE CABIN LAB	
1.6B.13.01.31	HW 2wayVLV	Heating Water Control Valve	AO											Terminal Unit Reheat Control Valve	FLEXIBLE CABIN LAB	
1.6B.13.01.32	RMTS	Room Temperature Sensor	DI				139							Wall Mounted	FLEXIBLE CABIN LAB	

Input/Output Summary Table

NRC PROJECT NO:		IMC0140			CONSULTANT:	NORR			M&E Drawing Reference:							
AREA IDENTIFIER:		M22 - CCER, Multiple Zones Terminal Units INPUTS & OUTPUTS			MCU NUMBER:				EMCS System Identifier:							
AREA EXPANSION:		Cabin Comfort and Environment Research Facility			LOCATION OF MCU:				EMCS System Expansion:							
1	2	3	4	5	6	7		8	9		10	11	12	13		
POINT IDENTIFICATION					AUXILIARY DEVICES			ALARMS			DI/DO	DI	DO			
POINT #	POINT IDENTIFIER	POINT EXPANSION	TYPE	ENG UNITS	CONTROLLED OR AUXILIARY SENSING DEVICE, TYPE OF SENSOR OR OUTPUT DEVICE (Supplied, Installed and Wired By Div. 25000)	FLOOR	ROOM	Priority 1 2 3	ANALOG LIMITS		CONTACT	ACTION	HVY MOTOR	Notes and Old SDC Reference Point if Applicable	Comments	
						LOCATION			L1	H1	NO NC	C/R O/R	DELAY			
		INPUTS BELOW														
		VAV BOX														
1.6B.13.02.01	VAVTU	Variable Air Volume Terminal Unit Control Signal	AO				26							VAV Box 1.1	FSL OBSERVATION	
1.6B.13.02.02	RMTS	Room Temperature Sensor	DI				26							Wall Mounted	FSL OBSERVATION	
1.6B.13.02.03	VAVTU	Variable Air Volume Terminal Unit Control Signal	AO				127							VAV Box 202	INTERVIEW ROOM	
1.6B.13.02.04	RMTH	Room Thermostat	AI				127							Wall Mounted	INTERVIEW ROOM	
1.6B.13.02.05	VAVTU	Variable Air Volume Terminal Unit Control Signal	AO				125							VAV Box 2.3	WAITING ROOM	
1.6B.13.02.06	RMTS	Room Temperature Sensor	DI				125							Wall Mounted	WAITING ROOM	
1.6B.13.02.07	VAVTU	Variable Air Volume Terminal Unit Control Signal	AO				121,122							VAV Box 2.4	ENTRANCE	
1.6B.13.02.08	RMTH	Room Thermostat	AI				121							Wall Mounted	ENTRANCE	
1.6B.13.02.09	VAVTU	Variable Air Volume Terminal Unit Control Signal	AO				129							VAV Box 2.5	SCREENING	
1.6B.13.02.10	RMTS	Room Temperature Sensor	DI				129							Wall Mounted	SCREENING	
1.6B.13.02.11	VAVTU	Variable Air Volume Terminal Unit Control Signal	AO				138							VAV Box 2.7	FCL OBSERVATION	
1.6B.13.02.12	RMTS	Room Temperature Sensor	DI				138							Wall Mounted	FCL OBSERVATION	

1 REFERENCES

.1 Perform all work to meet or exceed the requirements of the Canadian Electrical Code, CSA Standard C22.1 - (latest edition).

.2 Consider CSA Electrical Bulletins in force at time of tender submission, while not identified and specified by number in this Division, to be forming part of related CSA Part II standard.

.3 Do overhead and underground systems in accordance with CSA C22.3 except where specified otherwise.

.4 Where requirements of this specification exceed those of above mentioned standards, this specification shall govern.

.5 Notify the NRC Departmental Representative as soon as possible when requested to connect equipment supplied by NRC which is not CSA approved.

.6 Refer to Sections 00 10 00 & 0015 45.

2 PERMITS AND FEES

.1 Submit to Electrical Inspection Department and Supply Authority necessary number of drawings and specifications for examination and approval prior to commencement of work.

.2 Pay all fees required for the performance of the work.

3 START-UP

.1 Instruct the NRC Departmental Representative and operating personnel in the operation, care and maintenance of equipment supplied under this contract.

4 INSPECTION AND FEES

.1 Furnish a Certificate of Acceptance from the Authorized Electrical Inspection Department on completion of work.

.2 Request and obtain Special Inspection approval from the Authorized Electrical Inspection Department for any non-CSA approved control panels or other equipment fabricated by the contractor as part of this contract.

.3 Pay all fees required for inspections.

5 FINISHES

.1 Shop finish metal enclosure surfaces by removal of rust and scale, cleaning, application of rust resistant primer inside and outside, and at least two coats of finish enamel.

.1 Outdoor electrical equipment "equipment green" finish to EEMAC Y1-1-1955.

.2 Indoor switchgear and distribution enclosures light grey to EEMAC 2Y-1-1958.

.2 Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint.

6 ACOUSTICAL PERFORMANCE

.1 In general provide equipment producing minimal sound levels in accordance with the best and latest practices established by the electrical industry.

.2 Do not install any device or equipment containing a magnetic flux path metallic core, such as gas discharge lamp ballasts, dimmers, solenoids, etc., which are found to produce a noise level exceeding that of comparable available equipment.

7 EQUIPMENT IDENTIFICATION

.1 Identify with 3mm (1/8") Brother, P-Touch non-smearing tape, or an alternate approved by the NRC Departmental Representative, all electrical outlets shown on drawings and/or mentioned in the specifications. These are the recessed and surface mounted receptacles such as those in offices and service rooms and used to plug in office equipment, telecommunication equipment or small portable tools. Indicate only the source of power (Ex. for a receptacle fed from panel L32 circuit #1: "L32-1").

.2 Light switches and light fixtures are the only exceptions for electrical equipment identification (except as noted in 7.13 below). They are not to be identified.

.3 Identify with lamicoid nameplates all electrical equipment shown on the drawings and/or mentioned in the specification such as motor control centers, switchgear, splitters, fused switches, isolation switches, motor starting switches, starters, panelboards, transformers, high voltage cables, industrial type receptacles, junction boxes, control panels, etc., regardless of whether or not the electrical equipment was furnished under this section of the specification.

.4 Coordinate names of equipment and systems with other Divisions to ensure that names and numbers match.

.5 Wording on lamicoid nameplates to be approved by the NRC Departmental Representative prior to fabrication.

.6 Provide two sets of lamicoid nameplates for each piece of equipment; one in English and one in French.

.7 Lamicoid nameplates shall identify the equipment, the voltage characteristics and the power source for the equipment. Example: A new 120/240 volt single phase circuit breaker panelboard, L16, is fed from panelboard LD1 circuit 10.

"PANEL L16
120/240 V
FED FROM LD1-10"

PANNEAU L16
120/240 V
ALIMENTE PAR LD1-
10

.8 Provide warning labels for equipment fed from two or more sources - "DANGER MULTIPLE POWER FEED" black letters on a yellow background. These labels are available from NRC's Facilities Maintenance group in building M-19.

.9 Lamicoid nameplates shall be rigid lamicoid, minimum 1.5 mm (1/16") thick with:

.1 Black letters engraved on a white background for normal power circuits.

.2 Black letters engraved on a yellow background for emergency power circuits.

.3 White letters engraved on a red background for fire alarm equipment.

.10 For all interior lamicoid nameplates, mount nameplates using two-sided tape.

.11 For all exterior lamicoid nameplates, mount nameplates using self-tapping 2.3 mm (3/32") dia. slot head screws - two per nameplate for nameplates under 75 mm (3") in height and a minimum of 4 for larger nameplates. Holes in lamicoid nameplates to be 3.7 mm (3/16") diameter to allow for expansion of lamicoid due to exterior conditions.

.1 No drilling is to be done on live equipment.

.2 Metal filings from drilling are to be vacuumed from the enclosure interiors.

.12 All lamicoid nameplates shall have a minimum border of 3 mm (1/8"). Characters shall be 9 mm (3/8") in size unless otherwise specified.

.13 Identify lighting fixtures which are connected to emergency power with a label "EMERGENCY LIGHTING/ÉCLAIRAGE D'URGENCE", black letters on a yellow background. These labels are available from NRC's Facilities Maintenance group in building M-19.

.14 Provide neatly typed updated circuit directories in a plastic holder on the inside door of new panelboards.

.15 Carefully update panelboard circuit directories whenever adding, deleting, or modifying existing circuitry.

8 WIRING IDENTIFICATION

.1 Unless otherwise specified, identify wiring with permanent indelible identifying markings, using either numbered or coloured plastic tapes on both ends of phase conductors of feeders and branch circuit wiring.

.2 Maintain phase sequence and colour coding throughout.

9 CONDUIT AND CABLE IDENTIFICATION

.1 Provide factory painted red covers for junction boxes and conduits of fire alarm system.

.2 Provide factory painted yellow covers of junction boxes and conduits of emergency power circuits.

.3 Provide factory painted blue covers of junction boxes and conduits of voice/data cables.

.4 Provide factory painted Orange covers of junction boxes and conduits of BAS cables.

.5 Provide factory painted Green covers of junction boxes and conduits of Security (CAAS) cables.

.6 Provide factory painted Purple covers of junction boxes and conduits of Gas Detection cables.

10 MANUFACTURER'S & APPROVALS LABELS

.1 Ensure that manufacturer's registration plates are properly affixed to all apparatus showing the size, name of equipment, serial number, and all information usually provided, including voltage, cycle, phase and the name and address of the manufacturer.

.2 Do not paint over registration plates or approval labels. Leave openings through insulation for viewing the plates. Contractor's or sub-contractor's nameplate not acceptable.

11 WARNING SIGNS AND PROTECTION

.1 Provide warning signs, as specified or to meet requirements of Authorized Electrical Inspection Department and NRC Departmental Representative.

.2 Accept the responsibility to protect those working on the project from any physical danger due to exposed live equipment such as panel mains, outlet wiring, etc. Shield and mark all live parts with the appropriate voltage. Caution notices shall be worded in both English and French.

12 LOAD BALANCE

.1 Measure phase current to new panelboards with normal loads operating at time of acceptance. Adjust branch circuit connections as required to obtain best balance of current between phases and record changes, and revise panelboard schedules.

.2 Measure phase voltages at loads and adjust transformer taps to within 2% of rated voltage of equipment.

13 MOTOR ROTATION

.1 For new motors, ensure that motor rotation matches the requirements of the driven equipment.

.2 For existing motors, check rotation before making wiring changes in order to ensure correct rotation upon completion of the job.

14 GROUNDING

.1 Thoroughly ground all electrical equipment, cabinets, metal supporting frames, ventilating ducts and other apparatus where grounding is required in accordance with the requirements of the latest edition of the Canadian Electrical Code Part 1, C.S.A. C22.1 and corresponding Provincial and Municipal regulations. Do not depend upon conduits to provide the ground circuits.

.2 Run separate green insulated stranded copper grounding conductors in all electrical conduits including those feeding toggle switches and receptacles.

15 TESTS

.1 Provide any materials, equipment and labour required and make such tests deemed necessary to show proper execution of this work, in the presence of the NRC Departmental Representative.

.2 Correct any defects or deficiencies discovered in the work in an approved manner at no additional expense to the Owner.

.3 Megger all branch circuits and feeders using a 600V tester for 240V circuits and a 1000V tester for 600V circuits. If the resistance to ground is less than permitted by Table 24 of the Code, consider such circuits defective and do not energize.

.4 The final approval of insulation between conductors and ground, and the efficiency of the grounding system is left to the discretion of the local Electrical Inspection Department.

16 COORDINATION OF PROTECTIVE DEVICES

.1 Ensure circuit protective devices such as overcurrent trips, fuses, are installed to values and settings as indicated on the Drawings.

17 WORK ON LIVE EQUIPMENT & PANELS

.1 NRC requires that work be performed on non-energized equipment, installation, conductors and power panels. For purposes of quotation assume that all work is to be done after normal working hours and that equipment, installation, conductors and power panels are to be de-energized when worked upon.

18 SEISMIC REQUIREMENTS

Work Included

.1 Conform to Section 26 05 01.00 – GENERAL INSTRUCTIONS FOR ELECTRICAL SECTIONS.

Definitions

.2 Priority Two (P2) Buildings: buildings in which life safety is paramount concern. It is not necessary that P2 buildings remain operative during or after an earthquake.

.3 SRS: acronym for Seismic Restraint System.

Limitations

.4 Only one trade to be responsible for all seismic restraint systems for all electrical systems and equipment.

General Description

.5 This section covers design, supply and installation of complete SRS for all systems.

.6 SRS to be fully integrated into, compatible with:

.1 Noise and vibration controls specified elsewhere in this project specification.

.7 Systems, equipment not required to be operational during and after seismic event.

.8 During seismic event, SRS to prevent systems and equipment from causing personal injury and from moving from normal position.

.9 Design to be by Professional Engineer specializing in design of SRS and registered in Province of Ontario.

References

.10 CAN/CSA-G40.21-04, Structural Quality Steels.

.11 CAN/CSA C22.2 No. 250.0-00 , Luminaires

Submittals

.12 Submit Shop Drawings and product data in accordance with Section 26 05 04.00 – SHOP DRAWINGS.

.13 Submittals to include:

.1 Full details of design criteria.

.2 Working drawings, materials lists, schematics full specifications for all components of each SRS to be provided.

.3 Design calculations (including restraint loads resulting from seismic forces in accordance with National Building Code, detailed work sheets, tables).

.4 Separate Shop Drawings for each SRS and devices for each system, equipment.

.5 Identification of location of each device.

.6 Schedules of types of SRS equipment and devices.

.7 Details of fasteners and attachments to structure, anchorage loadings, attachment methods.

.8 Installation procedures and instructions.

Design Factors

.14 Za = 40.

.15 Zv = 2.0.

.16 V = 0.1.

.17 I = 1.0.

.18 F = 1.3.

.19 R = 1.3.

.20 Cp = 1.0.

General

.21 SRS to provide gentle and steady cushioning action and avoid high impact loads.

.22 SRS to restrain seismic forces in all directions.

.23 Fasteners and attachment points to resist same load as seismic restraints.

.24 SRS of Conduit systems to be compatible with:

.1 Expansion, anchoring and guiding requirements.

.2 Equipment vibration isolation and equipment SRS.

.25 SRS utilizing cast iron, threaded pipe, other brittle materials not permitted.

.26 Attachments to RC structure:

.1 Use high strength mechanical expansion anchors.

.2 Drilled or power driven anchors not permitted.

.27 Seismic control measures not to interfere with integrity of firestopping.

SRS For Static Equipment, Systems

.28 Floor-mounted equipment, systems:

.1 Anchor equipment to equipment supports.

.2 Anchor equipment supports to structure.

.3 Use size of bolts scheduled in approved Shop Drawings.

.29 Suspended equipment, systems:

.1 Use one or combination of following methods:

.1 Install tight to structure.

.2 Cross-brace in all directions.

.3 Brace back to structure.

.4 Slack cable restraint system.

.2 SCS to prevent sway in horizontal plane, “rocking” in vertical plane, sliding and buckling in axial direction.

.3 Hanger rods to withstand compressive loading and buckling.

SRS For Vibration Isolated Equipment

.30 Floor mounted equipment, systems:

.1 Use one or combination of following methods:

.1 Vibration isolators with built-in snubbers.

.2 Vibration isolators and separate snubbers.

.3 Built-up snubber system approved by Engineer, consisting of structural elements and elastomeric layer.

.2 SRS to resist complete isolator unloading.

.3 SRS not to jeopardize noise and vibration isolation systems. Provide 4 mm – 8 mm (5/32 in. – 5/16 in.) clearance between seismic restraint snubbers and equipment during normal operation of equipment and systems.

.4 Cushioning action to be gentle and steady by utilizing elastomeric material or other means in order to avoid high impact loads.

.31 Suspended equipment, systems:

.1 Use one or combination of following methods:

.1 Slack cable restraint system.

.2 Brace back to structure via vibration isolators and snubbers.

Slack Cable Restraint System (SCS)

.32 Use elastomer materials or similar to avoid high impact loads and provide gentle and steady cushioning action.

.33 SCS to prevent sway in horizontal plane, “rocking” in vertical plane, sliding and buckling in axial direction.

.34 Hanger rods to withstand compressive loading and buckling.

Seismic

.35 Conduit:

.1 All conduit greater than 64 mm (2½ in.) in diameter.

.2 All conduit suspended by individual hangers 300 mm (1 ft.) or less as measured from the top of the pipe to the bottom of the support where the hanger is attached. However, if the 300 mm (1 ft.) limit is exceeded by any hanger in the run, seismic bracing is required for the run.

.3 The 300 mm (1 ft.) exemption applies for trapeze supported systems if the top of each item supported by trapeze qualifies. Structural connections must be a non-friction connection (no "C" clamps)

Part 2 Execution

1 Installation

.1 Attachment point and fasteners:

.1 To withstand same maximum load that seismic restraint is to resist and in all directions.

.2 Slack Cable Systems (SCS):

.1 Connect to suspended equipment so that axial projection of wire passes through center of gravity of equipment.

.2 Use appropriate grommets, shackles, and other hardware to ensure alignment of restraints and to avoid bending of cables at connections points.

.3 Conduit systems: provide transverse SCS at 10 m (32 ft. 10 in.) spacing maximum, longitudinal SCS at 20 m (65 ft. 7½ in.) maximum or as limited by anchor/slack cable performance.

.4 Small conduits may be rigidly secured to larger pipes for restraint purposes, but not reverse.

.5 Orient restraint wires on ceiling hung equipment at approximately 90° to each other (in plan), tie back to structure at maximum of 45° to structure.

.6 Adjust restraint cables so that they are not visibly slack but permit vibration isolation system to function normally.

.7 Tighten cable to reduce slack to 40 mm (1½ in.) under thumb pressure. Cable not to support weight during normal operation.

.3 Install SRS at least 25 mm (1 in.) from all other equipment, systems, and services.

.4 Co-ordinate connections with all disciplines.

END OF SECTION

PART 1 - GENERAL

1.1 SCOPE

.1 The work listed in these specifications involves hazardous voltages, materials, operations, and equipment. These specifications do not claim to address all of the safety problems associated with their use. It is the responsibility of the user to review all applicable regulatory limitations prior to the use of these specifications.

.2 The contractor shall provide qualified services, or shall engage the services of a specialized, qualified testing firm, for the purpose of performing inspections and tests as herein specified.

.3 The contractor, or specialized testing firm, shall provide all material, equipment, labor, and technical supervision to perform such tests and inspections.

.4 The contractor will arrange and pay for all required ESA maintenance and inspection certificates for their scope of work.

1.2 REFERENCES

.1 NETA, MTS-2007, Maintenance Testing Specification for Electrical Power Distribution Equipment and Systems.

.2 IEEE – Standard Collection C57 – 1998.

.3 IEEE – Standards Collection C37 – 1998.

.4 CSA Z462 ‘Workplace Electrical Safety’

1.3 QUALIFICATIONS OF TESTING FIRM

.1 The testing firm shall be regularly engaged in the testing of electrical equipment devices, installations, and systems.

.2 All employees of the testing firm shall be qualified as per CSA Z462 requirements.

.3 The testing firm shall have at least one person on site with the following qualifications to provide technical supervision and/or guidance as required for the remainder of the testing personnel:

.1 An employee certified by the InterNational Electrical Testing Association (NETA)

.2 A Professional Engineer (P. Eng) licensed in the Province of Ontario with specialized training and experience in the testing and inspection of electrical power distribution equipment

.3 A member of the Ontario Association of Certified Engineering Technicians and Technologists (OACETT) with specialized training and experience in the testing and inspection of electrical power distribution equipment

.4 The contractor is to supply the Client, within 10 business days of awarding of contract, the name and qualifications of the proposed on-site supervisor. Approval, in writing from the Client, is required if the contractor needs to change the on-site supervisor for any reason. The Client will have the right to reject candidates not meeting the above qualifications.

.4 All work designated 'Specialist Testing' shall be performed by employees of the specialist testing firm and all personnel must be qualified to operate, test, and commission high and low voltage electrical equipment.

.5 All work designated 'Generalist Testing' may be completed by qualified electricians, technicians, technologists, or engineers employed or subcontracted by the specialist testing firm or electrical contractor.

.6 The contractor to supply the Client with a list of people proposed for site work with their qualifications at least 5 business days before the shutdown, or as early as required to receive appropriate clearances. The Client will have the right to reject candidates not meeting the above qualifications.

.7 The agency must have the necessary wiring, materials, equipment, tools, instruments, measuring devices and all other tools necessary to carry out the work.

.8 The testing firm shall submit interim proof of all the above qualifications when responding to the Request for Proposals.

1.4 DIVISION OF RESPONSIBILITY

.1 The testing firm shall supply a suitable and stable source of electrical power to each test site unless notified by the client in writing that sufficient local power will be available for operating test equipment. All portable alternating current (AC) power sources shall operate at 60 Hz +/- 0.1 Hz or as indicated

.2 The testing firm shall supply adequate portable lighting for each test site unless notified by the client in writing that sufficient local lighting will be available for operating test equipment. Ensure adequate lighting is available both with and without normal and/or emergency power.

.3 The owner, or owner's representative, will supply an up to date short circuit analysis and coordination study, a protective device setting sheet, a complete set of electrical plans, specifications, and any pertinent change orders to the testing firm prior to commencement of testing.

.4 The owner, or owner's representative, shall notify the testing firm when equipment becomes available for maintenance tests. Work shall be coordinated to expedite project scheduling. Note: various pieces of equipment are required to maintain each buildings environmental condition. It is imperative that the

communication between each building's operations personnel and the testing firm be established prior to the isolation of any equipment. Sufficient time shall be given for the shutdown and startup of equipment such as chillers, pumps, and other essential equipment.

.5 The testing firm shall notify the owner, or owner's representative, prior to commencement of any testing.

.6 Deviation from the planed schedule of work for each stage of the work must be approved by the owner or owner's representative prior to the isolation of any additional equipment.

.7 The testing firm shall be fully responsible for their own safety, including all switching procedures, equipment isolation, and grounding procedures. At the end of each stage of the work, the testing firm shall ensure that all temporary grounds are removed from the equipment and all equipment is placed into its normal operation position prior to releasing the 'Station Guarantee'. It is the testing firm's responsibility to record the position of all circuit breakers and switches under the scope of the contract and to ensure that the 'As found' position is maintained after the work is completed.

1.5 SAFETY AND PRECAUTIONS

.1 Safety practices shall include, but are not limited to, the following requirements:

- .1 The current Occupational Health and Safety Act
- .2 CSA Z462 'Workplace Electrical Safety'
- .3 Workplace Hazardous Materials Information System (WHMIS). Submit to owner, or owner's representative, pertinent MSDS information.
- .4 Applicable Provincial, local, and client safety operating procedures
- .5 National Fire Protection Association – NFPA, and the National Fire Code of Canada 1995
- .6 OSHA 29 CFR 1910.147. Control of Hazardous Energy Sources (Lockout/Tagout)

.2 All tests shall be performed with apparatus de-energized except where otherwise specifically required. Lock out and tag procedures shall be in effect. All testing firm representatives shall lock and tag all equipment tested under the scope of work. The testing agency shall provide a 'lock box' for any equipment requiring more that 3 locks. All equipment to be tested under the scope of work shall be isolated from all sources of power, locked and tagged, tested for voltage potential with an approved potential tester rated for the voltage application, and grounded from all sources of power using approved temporary grounds.

.3 As per CSA Z462, all testing firm representatives shall wear the appropriate Personal Protective Equipment (PPE) including approved safety boots, side impact hard hats, safety glasses and/or safety shields, arc flash coveralls, and rubber gloves with protectors during switching operations. All PPE shall be rated for the appropriate voltage class application.

.4 The contractor shall review and supervise all operations with respect to safety, and notify any sub-contractors and/or the client of any known or found hazards or information about the client's installation that needs to be transmitted to sub-contractors.

1.6 TEST EQUIPMENT

.1 All test equipment shall be in good mechanical and electrical condition.

.2 Metering or monitoring equipment shall be true RMS sensing only. (Peak sensing equipment shall not be permitted).

.3 Field test metering used to check power system meter calibration must have an accuracy higher than that of the instrument being checked. Field Test Equipment shall meet the following criteria;

.1 1000 volt DC Insulation Resistance test equipment shall have a meter scale of at least 500 Gig Ohms.

.2 5000 volt DC Insulation Resistance test equipment shall have a meter scale of at least 500 Meg Ohms

.3 Low Resistance test equipment shall have a minimum of 5 ampere DC output and the ability to measure down to a 5 micro Ohms.

.4 Transformer turns ratio test equipment shall have a minimum of 130 to 1 ratio and scaled operate to three (3) significant digits. Test equipment shall have excitation current measurement capability to at least 5 amperes.

.5 Winding Resistance test equipment shall have a minimum of 5 ampere DC output and the ability to measure to a 100 milli-Ohms scale.

.6 Relay test equipment shall have a minimum of 100 amperes AC output in order to test standard mechanical overcurrent relays.

.7 Accuracy of metering in test equipment shall be appropriate for the test being performed but not in excess of 2% of the scale used.

.8 Waveshape and frequency of test equipment output waveforms shall be appropriate for the test and tested equipment. Test equipment shall not exceed 2.0 percent Total Harmonic Distortion THD output on voltage waveforms and 2.0 percent THD output on current waveforms.

.4 Test Instrument Calibration

.1 The testing firm shall have a calibration program, which assures that all applicable test instruments are maintained within rated accuracy.

.2 Calibration shall be done by a calibration agency compliant with International Standards Organization ISO 17025 and Standard Council of Canada CAN-P-4D.

.3 Dated calibration labels shall be visible on all test equipment.

.4 Records must be available and up to date for the owner, or owner's representative, to inspect calibration of each piece of equipment.

1.7 TEST REPORT

.1 The testing firm shall maintain a written or typed record of all field tests, and then shall assemble and certify a final completely typed test report.

.2 The test report shall include the following:

.1 Summary of project, complete with a detailed deficiency list, comments, results, analysis, and recommendations.

.2 Description of all equipment tested which shall include complete equipment nameplate values and/or installation information (e.g. Manufacturer, Date, Model Number, Serial Number, Voltage, Ampacity, Phases, kW, Power Factor, Horsepower, RPM, Torque, Type, Size, Insulation Type, Insulation Rating (100%, 133%, etc.), Shield if present, Number of conductors, Free air or Raceway rating, Configuration, etc.). Please note, the above list is not a complete and comprehensive list. Each device test sheet should have enough data to clearly identify the device, its location within the distribution system, a unique identifier, and all parameters which define its ratings and application. As a minimum, each device test sheet should usually include all parameters defined by the device's ruling Industry Standard.

.3 Include results from all tests above with starting conditions noted.

.4 Include any items found out of specified tolerances.

.5 Include any relevant comments about the condition of the switchgear.

.3 A blank copy of all applicable test sheets on the project shall be submitted to the Client for approval within five (5) business days of the contract issuance. The Client has the right to reject test sheets that do not include all required information or test results.

.4 Submit test results as per section 01 33 00.

PART 2 - INSPECTION AND TEST PROCEDURES

2.1 WORK COMMON TO MOST ELECTRICAL ASSEMBLIES

.1 Inspection

.1 Compare equipment nameplate information with latest single line diagram to ensure agreement.

.2 Inspect for evidence of corrosion, the presence of corona or insulation breakdown, and/or for environmental contamination, especially on insulators or insulating surfaces.

.3 Verify acceptable anchorage, required area clearances, and proper alignment.

.4 Verify presence of required warning signs.

.5 Verify that protective devices and settings, instrument transformers and ratios, and all other electrical elements correspond to single line drawings, coordination study, and/or relevant documentation.

.6 Verify that ventilation filters are present and in good condition, and/or that ventilation openings or vents are clear.

.7 Verify that there are no inadvertent connections of the ground bus to the neutral bus on any electrical systems containing a neutral. Ensure that a ground to neutral bond(s) is in the correct location.

.2 Mechanical/Functional Verification

.1 For commissioning, verify tightness of accessible bolted electrical connections by calibrated torque-wrench in accordance with manufacture's published data or, if not available, use NETA Table 10.12. For maintenance, verify general tightness of accessible bolted electrical connections.

.2 Test operation, alignment, and penetration of instrument and control power transformer withdrawal disconnects, current-carrying and grounding.

.3 Exercise all active components, and verify the operation of all mechanical indicating devices.

.4 Test all electrical and mechanical interlock systems for proper operation and sequencing:

.5 Attempt to close locked-open devices. Attempt to open locked-closed devices.

.6 Make Kirk Key exchanges with devices operated in off-normal positions.

.7 Verify that Kirk Key numbers match with the single line diagram and record them on the approved test sheet.

.3 Cleaning

.1 Thoroughly clean switchgear cells or electrical equipment prior to testing. Clean equipment using cleaning agents that have high dielectric properties, repel moisture, prevent corona tracking, and are not harmful to the electrical equipment insulation, such as Banwet manufactured by Brodi.

.2 Vacuum all loose elements from electrical switchgear, junction boxes, and other areas within or without electrical equipment. Blowers shall not be used unless no other methods to remove contaminants are possible.

.4 Lubrication

.1 Verify appropriate contact lubricant on moving current carrying parts. Refer to manufacturer's recommendations on lubrication of components.

.2 Verify appropriate lubrication on moving and sliding surfaces. Refer to manufacturer's recommendations on lubrication of components.

2.2 SWITCHGEAR ASSEMBLIES, GREATER THAN 750V

.1 Not Applicable

2.3 CABLES, LESS THAN 750V

.1 Visual and Mechanical Inspection, provide all typical inspections and cleaning, plus:

.1 Inspect exposed sections of cables for physical damage and evidence of overheating and corona.

.2 Inspect terminations and splices for evidence of overheating and corona.

.3 Verify tightness of accessible bolted electrical connections by calibrated torque-wrench in accordance with NETA standard Table 10.12.

.4 Inspect for shield grounding, cable support, and termination.

.5 Verify that visible cable bends meet or exceed ICEA and/or manufacturers minimum allowable bending radius.

.6 If cables are terminated through window type current transformers, make an inspection to verify that neutral and ground conductors are correctly placed and that shields are correctly terminated for operation of protective devices.

.2 Electrical Tests

.1 If required by electrical tests, disconnect all conductors prior to testing and ensure that all phases are properly identified (Phase A – Red, Phase B – Black, Phase C – Blue, Neutral – White). After testing, re-connect equipment and conductors in the original phasing order.

.2 Perform an insulation resistance test utilizing a megohmmeter with a voltage output of at least 500 volts DC for cables up to 250 volts, and at 1000 volts DC for cables rated from 250 to 600 volts AC. Individually test each conductor with all other conductors and shields grounded. Test duration shall be one minute.

.3 Test Values

.1 Minimum insulation resistance values should be comparable to previously obtained results, but not less than two megohms. Investigate values that differ from other phases by more than 50%.

2.4 CIRCUIT BREAKER TRIP UNITS, THERMAL MAGNETIC

.1 Visual and Mechanical Inspection, provide all typical inspections and cleaning, plus:

.1 Record as-found settings.

.2 Electrical Tests

.1 Verify functionality of trip unit by tripping using the trip button of the trip unit, if present.

.2 If requested by contract documents, provide primary injection of the circuit breaker trip unit.

.3 Test Values

.1 When not otherwise specified, use manufacturer's recommended tolerances.

.2 When critical test points are specified, the relay should be calibrated to those points.

2.5 PANELBOARDS AND MCCS, EITHER BREAKER OR FUSIBLE DISCONNECT (DISTRIBUTION, LIGHTING, EMERGENCY, ETC.)

.1 Visual and Mechanical Inspection, provide all typical inspections and cleaning, plus:

.1 Note the position of all circuit breakers or disconnects. Operate all circuit breakers or disconnects to ensure proper mechanical operation. Ensure that all devices are left in the original position.

.2 Inspect all wires for evidence of damage, chafing, or pinching in the panel board covers.

.3 Check tightness of all connections.

.2 Electrical Tests

.1 Perform insulation resistance tests on the main bus with all breakers open and control wiring disconnected. Energize each phase with the correct test voltage ensuring the opposing two phases and neutral (4 wire only) are grounded. Each test shall occur for a duration of one (1) minute. Electrical equipment rated from 120 volts AC to 250 volts AC shall be tested at 500 volts DC. Electrical equipment rated above 250 volts AC to 600 volts DC shall be tested at 1000 volts DC.

.2 If required for electrical testing, disconnect all equipment and conductors that are not part of the equipment assembly prior to testing and ensure that all phases are properly identified (Phase A – Red, Phase B –Black, Phase C – Blue, Neutral – White). After testing re-connect equipment and conductors in the original phasing order.

.3 Test Values

.1 Insulation resistance values for bus shall be in accordance with manufacturers published data. In the absence of manufacturers published data, use NETA Standard Table 10.1. (Note: Do not use test voltage levels in NETA Table 10.1) Values of insulation resistance less than this table or manufacturers minimum should be investigated.

2.6 SPLITTER TROUGHS

.1 Visual and Mechanical Inspection, provide all typical inspections and cleaning, plus:

.1 Inspect all wires for evidence of damage, chafing, or pinching in the panel board covers.

.2 Check tightness of all connections.

.2 Electrical Tests

.1 Perform insulation resistance tests on the main bus. Energize each phase with the correct test voltage ensuring the opposing two phases and neutral (4 wire only) are grounded. Each test shall occur for a duration of one (1) minute. Electrical equipment rated from 120 volts AC to 250 volts AC shall be tested at 500 volts DC. Electrical equipment rated above 250 volts AC to 600 volts DC shall be tested at 1000 volts DC.

.2 If required by electrical testing, disconnect all equipment and conductors that are not part of the equipment assembly prior to testing and ensure that all phases are properly identified (Phase A – Red, Phase B –Black, Phase C – Blue, Neutral – White). After testing re-connect equipment and conductors in the original phasing order.

.3 Test Values

.1 Insulation resistance values for bus shall be in accordance with manufacturers published data. In the absence of manufacturers published data, use NETA Standard Table 10.1. (Note: Do not use test voltage levels in NETA Table 10.1) Values of insulation resistance less than this table or manufacturers minimum should be investigated.

2.7 TRANSFORMERS, AIR COOLED, SMALL (LESS THAN 167 KVA SINGLE PHASE OR 500 KVA THREE PHASE)

.1 Visual and Mechanical Inspection, provide all typical inspections and cleaning, plus:

.1 Inspect core and coil for evidence of insulation breakdown due to excessive heating.

.2 Check tightness of all connections.

.2 Electrical Tests

.1 Verify correct secondary voltage phase to phase and phase to neutral after energization and loading.

.2 If testing requires cable disconnection, disconnect all equipment and conductors that are not part of the equipment assembly prior to testing and ensure that all phases are properly identified (Phase A – Red, Phase B – Black, Phase C – Blue, Neutral – White). After testing, re-connect equipment and conductors in the original phasing order.

2.8 DISCONNECTS (FUSED AND UNFUSED), LESS THAN 750V

.1 Visual and Mechanical Inspection, provide all typical inspections and cleaning, plus:

.1 Inspect physical and mechanical condition, including:

.1 Blade and Jaw - verify correct blade alignment, blade penetration, travel stops, and mechanical operation.

.2 Operating Arm – free movement, break over

.3 Operating Mechanism – sprockets, chain, pushrod arms, lubrication.

.4 Door interlock – verify door unable to open when switch closed.

.2 Inspect fuses if present.

.3 Check tightness of all connections.

.4 Note position and exercise switch, returning switch to original position.

2.9 DC BATTERY SYSTEMS

.1 Ensure adequate protective equipment is used during all following tests, which shall include at least the following:

.1 Goggles and face shields

.2 Acid-resistant gloves

.3 Protective aprons

.4 Portable or stationary water facilities for rinsing eyes and skin in case of contact with electrolyte

.5 Bicarbonate of soda solution, mixed 100 grams bicarbonate of soda to 1 litre of water, to neutralize acid spillage. NOTE - the removal and/or neutralization of an acid spill may result in production of hazardous waste. The user should comply with appropriate governmental regulations.

.6 Class C fire extinguisher

.7 Adequately insulated tools

.2 The following protective procedures shall be observed during maintenance:

.1 Use caution when working on batteries since they represent a shock hazard.

.2 Prohibit smoking and open flames, and avoid activities that increase the chances of arcing in the immediate vicinity of the battery.

.3 Ensure that the load test leads are clean, in good condition, and connected with sufficient length of cable to prevent accidental arcing in the vicinity of the battery.

.4 Ensure that all connections to load test equipment include appropriate short-circuit protection.

.5 Ensure that battery area ventilation is operating per its design.

.6 Ensure unobstructed egress from the battery area.

.7 Avoid the wearing of metallic objects such as jewellery.

.8 Neutralize static build up just before working on the battery by contacting the nearest effectively grounded surface.

.9 If installed, ensure that the battery monitoring system is operational.

.3 Provide the following visual, mechanical, and electrical inspections, noting that all inspections should be made under normal float conditions.

.1 Inspect the battery rack/cabinet and anchors for rusting, corrosion, and other deterioration that could affect the battery rack structural or seismic integrity and strength and inspect approximately 10% of the battery rack fasteners for tightness.

.2 Perform the following steps for seismic installations.

.1 Inspect the battery to ensure an intercell spacer is present between each battery jar.

.2 Inspect the intercell spacers in place for deterioration (broken, warped, crumbling, etc.).

.3 Verify that the space between each of the end-rails and the end battery jars is less than or equal to 3/16" or a value specified by the manufacturer.

.3 Verify that the rail insulators are in place and in good condition.

.4 Verify that the electrolyte level of each cell is between the high- and low-level marks imprinted on the cell case. When any cell electrolyte reaches the low-level line, distilled or other approved-quality water should be added to bring the cells to the manufacturer's recommended full level line. Water quality should be in accordance with the manufacturer's instructions.

.5 Inspect each battery cell jar, cell jar cover, and seals (jar to cover seal, post to cover seal) for deterioration (acid leakage, cracking, crazing-spider web effect, distortion, etc.).

.6 Examine the plates in each cell for sulfation. NOTE - sulfation can sometimes be detected on the plate edges by shining a light source on the plates, which will reflect off the yellowish sulfate crystals.

.7 Examine the plates in each cell for the proper color that indicates a fully charged battery based on the manufacturer's information. NOTE - normally, fully-charged, positive plates are coloured a deep chocolate-brown color. Negative plates are normally a medium grey. A horizontal ring of white deposits around the plates and on the inside of the jar indicates hydration. This is a result of the lead sulfate precipitating out of solution after the recharge of an over discharged cell or the recharge of a discharged cell that has not been promptly recharged. Consult your manufacturer's maintenance instructions for further guidelines in this area. If any negative plates are reddish in color, this indicates copper contamination, and the cell should be replaced as soon as practical.

.8 Examine through the clear battery jar case, the plates, bus bar connection to each plate, and bus bar connection to the post of each battery cell for corrosion and other abnormalities. Inspect the lower part of the post seals and the underside of the cover for cracking or distortion.

.9 Examine the cell plates, spacers, and sediment space of each cell to determine if any deterioration (warped plates and spacers, lifted cell posts, pieces of plate material that have fallen off, shorted plates, excessive sediment in the bottom of the cell, plates that have dropped lower than the other plates, etc.) has occurred that could affect a cell relative to the rest of the cells in the battery.

.10 Examine the cell posts of each cell to determine if any of them have grown or lifted to a larger degree than the rest of the posts of the battery. NOTE - the positive plates of lead-acid batteries normally swell or grow with age and use. Most manufacturers claim that 5% growth is the expected maximum limit during the life of the battery.

.11 Inspect each electrical cell-to-cell and terminal connection to ensure they are clean (no significant corrosion or foreign matter) and the connection

surfaces remain coated with a thin layer of anti-corrosion material. If corrosion is noted, remove the visible corrosion and check the resistance of the connection as per item 2.9.3.25 below. NOTE - unless corrosion is cleaned off of battery terminals periodically, it will spread into the area between the posts and the connectors.

.12 Verify that all cells of the battery remain properly numbered.

.13 Verify that each battery cell vent, flame arrestors, and dust caps are present and inspect each for damage.

.14 Examine the general condition of the battery, battery rack and/or cabinet, and the battery room to determine if they are clean and in good order. When excessive dirt is noted on cells or connectors, remove it with a water-moistened clean wipe. Remove electrolyte spillage on cell covers and containers with a solution of bicarbonate of soda mixed with 100 grams of soda to 1 liter of water. Avoid the use of hydrocarbon-type cleaning agents (oil distillates) and strong alkaline cleaning agents, which may cause containers and covers to crack or craze. Do not allow the cleaning compound to enter the cell.

.15 Inspect for unintentional battery grounds

.16 Record float voltage measured at battery terminals. When the float voltage measured at the battery terminals is outside of its recommended operating range, it should be adjusted. Nominal float voltage should be as recommended by manufacturer. Maximum float voltage or Nominal Equalize voltage should be as recommended by manufacturer.

.17 Record charger output current and voltage. Maximum provided voltage from the charger should be as recommended by manufacturer.

.18 Record ambient temperature and ventilation

.19 Check approximately 10% of the battery rack fasteners for tightness.

.20 Measure and record the voltage of each cell

.21 Measure and record specific gravity of 10% of the cells of the battery if battery float charging current is not used to monitor state of charge.

.22 Measure and record electrolyte temperature of 10% or more of the battery cells. When cell temperatures deviate more than 3°C from each other during a single inspection, determine the cause and correct the problem. If sufficient correction cannot be made, contact the manufacturer for allowances that must be taken. NOTE - when working with large multi-tier installations, the 3°C allowable

deviation may not be achievable, especially when relating the bottom to top tier temperature measurements. Typically, the deviation limit should be maintained within tiers.

.23 Measure and record specific gravity and temperature of each cell. Please note, specific gravity values are based on a temperature of 25°C, and should be corrected for the actual electrolyte temperature and level. For each 1.67°C above 25°C add 1 point (0.001) to the value. Subtract 1 point for each 1.67°C below 25°C.

.24 Check all battery rack connection fasteners for tightness.

.25 Cell-to-cell and terminal connection resistance. (NOTE – do not take measurements across the cell. This improper action could cause

personal injury, damage to the test equipment, and damage the cell.) If resistance measurements obtained are more than 20% above the installation value, or the greater of 20% or 5 micro-ohms above the average value, or if loose connections are noted, torque and re-test. If retested resistance value remains unacceptable, the connection should be disassembled, cleaned, reassembled, and retested. Typically, this will involve the following steps:

.1 Clean posts and connectors and apply a thin coat of heated (between 71 and 85°C) no-oxide grease.

.2 Re-Install existing inter-cell and inter-tier connectors, and hand tighten nuts in accordance with manufacturer's instructions.

.3 Using torque wrenches, tighten nuts in accordance with manufacturer's recommended value.

.4 Refer to IEEE Std. 484-1996 for detailed procedures and IEEE Std. 450-2002 D.2 and Annex F for further discussions.

.26 Structural integrity of the battery rack and/or cabinet.

PART 3 - FIELD TAPING PROCEDURE

3.1 APPLICATION ON JOINTS WITH HARDWARE

.1 Clean area of dirt and foreign matter.

.2 Apply filler over bare conductor and hardware to cover and smooth out the surface. Blend contour into pre-insulation surfaces. Cover conductors and hardware with at least 1/8 inch of filler.

.3 Apply pad(s) of insulating tape of sufficient width to overlap pre-insulation by one inch or more.

.4 Apply one layer of insulating tape, lapping as specified in the chart, overlapping any pre-insulation or pads by 1-1/2 inches.

3.2 TAPING CHART

Taping Chart

Rated kV of Equipment	Pre-insulation or Pad Overlap Min. Inches	Insulating Tape Lap of Tape	Min. Layers	No. of Pads
Up to 5	1-1/2	1/2	1	1
Up to 15	1-1/2	2/3	2	2
Up to 27	1-1/4	2/3	3	3
Up to 46	1-1/4	2/3	4	4

3.3 DEFINITIONS

.1 Joint: Area to be covered with tape which consists of bare conductor and 1-1/2 inches of any pre-insulation next to the bare conductor.

.2 Pre-Insulation: Any insulating tape applied which is wider than one inch, which includes a band of tape consisting of one or more turns wrapped directly on top of each other.

.3 Layer: Insulating tape, 1 inch wide, wrapped from one end of the joint to the other (or to a pad) so each succeeding turn laps the previous turn by the amount specified in the chart.

.4 Overlap: A specified distance measured along the pre-insulation starting from where the pre-insulation ends and the exposed conductor begins.

PART 4 - EXECUTION

4.1 GENERAL REQUIREMENTS

.1 Testing to be completed on all equipment supplied under this contract.

.2 Keep working area clean and safe, all testing and maintenance areas are to be cleaned after usage.

.3 The contractor is responsible for verifying all types of distribution equipment to be tested, and ensuring they have the proper equipment to test equipment, especially proprietary trip units, relays, controllers, and other similar items.

END OF SECTION

Part 1 General

1.1 RELATED WORK SPECIFIED ELSEWHERE

.1 Common Work Results - Electrical Section 26 05 00

1.2 MATERIALS

.1 Provide only new equipment and materials, without blemish or defect, bearing Canadian Standards Association or Authorized Electrical Inspection Department labels, and subject to the approval of the NRC Departmental Representative.

.2 After a contract is awarded, utilize alternative methods and/or materials only after receiving the NRC Departmental Representative's approval.

Part 2 Products

2.1 BUILDING WIRES AND GENERAL REQUIREMENTS

.1 Conductor material for branch circuit wiring and grounding:

- .1 Stranded copper.
- .2 Neutral wire: continuous throughout its length without breaks.
- .3 Separate insulated green grounding conductors in all electrical conduits.
- .4 All wire and cable insulation shall meet the C.S.A. Standards for the types and services hereinafter specified. Colours as per section 4-036 of Electrical Code.
- .5 Where otherwise specified, use wire and cable types as follows:
  - .1 Type R90 XLPE cross-link polyethylene stranded for applications using wires sized No. 8 and larger.
  - .2 Type T90 stranded for applications using wires sized No. 10 and smaller.
  - .3 For fire alarm wiring refer to Section 283100.
  - .4 Approved heat resistant wire for wiring through and at lighting and heating fixtures. Where insulation types are shown on the drawings other types shall not be used unless the specification is more restrictive.
- .6 Use BX cable only under the following conditions:
  - .1 Wiring from a junction box to a recessed lighting fixture in suspended ceilings. Cable length not to exceed 1.5 m (5'), or
  - .2 Wiring or switches or 15 amp receptacles in partitions having removable wall panels, or
  - .3 When specifically called for on drawings.
- .7 Use stranded wire no smaller than No. 12 AWG for lighting and power and no smaller than No. 16 AWG for control wiring.

.8 Conductors shall be soft copper properly refined and tinned having a minimum conductivity of 98%.

Part 3 Execution

3.1 BUILDING WIRES

.1 Install building wires as follows:

.1 Make joints, taps and splices in approved boxes with solderless connectors. Joints and/or splices are not acceptable inside a panelboard.

.2 Ensure the lugs accommodate all the strands of the conductor.

.3 Replace any wire or cable showing evidence of mechanical injury.

.4 Use No. 10 AWG for branch circuit wiring extending more than 30 m (100 ft.) to farthest outlet from panel.

.5 Circuit numbers indicated on the drawing are intended as a guide for the proper connection of multi-wire circuits at the panel.

.6 Take care to keep the conductors free from twisting.

.7 Use an approved lubricant for pulling in conduit.

.8 Leave sufficient slack on all runs to permit proper splicing and connection of electrical devices.

.9 Branch circuit wiring of 120 volt applications to be multi-wire utilizing common neutrals. Under no condition shall any switch break a neutral conductor.

.10 Provide and install an approved fire- retardant wrap or coating for PVC jacketed cables installed in a grouped configuration of two or more.

END OF SECTION

Part 1 General

1.1 RELATED WORK SPECIFIED ELSEWHERE

.1 Common Work Results - Electrical Section 26 05 00

1.2 MATERIALS

.1 Provide only new equipment and materials, without blemish or defect, bearing Canadian Standards Association or Authorized Electrical Inspection Department labels, and subject to the approval of the NRC Departmental Representative.

.2 After a contract is awarded, utilize alternative methods and/or materials only after receiving the NRC Departmental Representative's approval.

Part 2 Products

2.1 WIRE AND BOX CONNECTORS

.1 Pressure type wire connectors sized to fit conductors.

2.2 WIRING TERMINATIONS

.1 Provide first grade wire and cable connectors suitable for the service on which they are used and install them in accordance with the latest trade practice.

.2 Provide high quality extruded copper-free aluminium (0.4% or less) connectors for single and multi conductor cable. Steel and then zinc plated connectors for multi conductor cables.

.3 When used in hazardous area, connectors should be certified for such location in Class, Division and Group.

.4 For large conductor sizes, use bolted or compression solderless type connectors.

.5 Use high temperature connectors and insulation on all connections of high temperature conductors.

.6 Where connector types are called for on the drawings or in the specification, do not use other types.

.7 Lugs, terminals, screws used for termination of wiring to be suitable for copper conductors.

.8 For fire alarm wiring refer to Section 28 31 00.

Part 3 Execution

3.1 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.

END OF SECTION

Part 1 General

1.1 RELATED WORK SPECIFIED ELSEWHERE

.1 Common Work Results - Electrical Section 26 05 00

1.2 MATERIALS

.1 Provide only new equipment and materials, without blemish or defect, bearing Canadian Standards Association or Authorized Electrical Inspection Department labels, and subject to the approval of the NRC Departmental Representative.

.2 After a contract is awarded, utilize alternative methods and/or materials only after receiving the NRC Departmental Representative's approval.

Part 2 Products

2.1 FITTINGS

.1 Fittings: manufactured for use with conduit specified. Coating: same as conduit.

.2 Fittings for liquid-tight flexible conduits shall be liquid-tight connectors.

.3 Provide expansion couplings for all conduits running in slabs through expansion joints. These shall be the type approved for use in concrete with a bonding conductor.

2.2 OUTLET BOXES

.1 Size boxes in accordance with CSA-C22.

.2 Unless otherwise specified, provide galvanized steel outlet boxes at least 40mm (1-1/2") deep, single or ganged style, of proper size to accommodate devices used and shall be equipped with covers as necessary of the type designed for the specified fittings. Pull boxes shall be steel and shall be galvanized or painted to prevent rusting. For lighting fixture outlets, use 100mm (4") octagon boxes.

.3 Equip with plaster rings for flush mounting devices in finished walls.

.4 Blank cover plates for boxes without wiring devices.

.5 Equip with centre fixture studs for light fixtures.

.6 Use cast boxes where indicated and for surface mounted wiring. In areas above hung ceilings where appearance is not significant, pressed steel surface boxes may be used.

.7 Supply all outlet boxes and pull boxes sized according to code requirements unless specified otherwise on the drawings.

2.3 SUPPORT HARDWARE

.1 Use 10mm (3/8") threaded rod for suspended unistrut and conduit.

.2 Unless otherwise specified, use 41mm x 41mm (1-5/8" x 1-5/8") galvanized steel unistrut for conduit support systems.

Part 3 Execution

3.1 INSTALLATION

.1 Install outlet boxes as follows:

.1 Support boxes independently of connecting conduits.

.2 Make necessary mounting adjustments to the outlet to match interior finish.

.3 Fill boxes with paper, sponges or foam or similar approved material to prevent entry of construction material.

.4 Where more than one conduit enters a switch or receptacle box on the same side, provide a 100mm (4") minimum square box with a suitable plaster ring.

.5 Location and appearance to be to the NRC Departmental Representative's approval.

END OF SECTION

Part 1 General

1.1 RELATED WORK SPECIFIED ELSEWHERE

.1 Common Work Results - Electrical Section 26 05 00

1.2 MATERIALS

.1 Provide only new equipment and materials, without blemish or defect, bearing Canadian Standards Association or Authorized Electrical Inspection Department labels, and subject to the approval of the NRC Departmental Representative.

.2 After a contract is awarded, utilize alternative methods and/or materials only after receiving the NRC Departmental Representative's approval.

Part 2 Products

2.1 RACEWAYS

.1 Conduit:

.1 Each length of conduit to be new and bear the CSA Stamp of Approval. Refer to section 26 05 00 for factory supplied color coding.

.2 Conduit, unless otherwise noted, to be EMT, no smaller than 12mm (1/2").

.2 Bushings and Connectors:

.1 Insulated type, with the insulation an integral part of the fitting.

.3 Conduit Fastening:

.1 One hole malleable iron straps to secure surface conduits. Two hole straps for conduits larger than 50mm (2").

.2 Beam clamps to secure conduits to exposed steel work.

.3 Channel type supports for two or more conduits.

.4 Pull Cord:

.1 Polypropylene cord in empty conduit.

.5 Unless specifically called for on the drawings, do not use flexible conduits but it is recognized that there may be applications where this material will be useful, such as equipment connections, etc. In such cases, obtain permission for its use from the NRC Departmental Representative. For tender purposes, assume that flexible conduits will not be permitted unless specifically called for on the drawings or equipment specifications. All flexible conduits for vapour-tight applications shall be liquid-tight flexible conduits (seal-tight).

.6 Provide expansion couplings for all conduits running in slabs through expansion joints. These shall be the type approved for use in concrete with a bonding conductor.

2.2 SURFACE RACEWAY SYSTEM

.1 1and 2-channel, Steel construction. Grey in colour.

.2 To be complete with covers, cover plates, elbows, joints, end caps and all other accessories required to form a complete and functional system.

.3 Standard of acceptance: Hubbell HBL4750 series or approved equal.

2.3 SUPPORT HARDWARE

.1 Use 10mm (3/8") threaded rod for suspended unistrut and conduit.

.2 Unless otherwise specified, use 41mm x 41mm (1-5/8" x 1-5/8") galvanized steel unistrut for conduit support systems.

Part 3 Execution

3.1 RACEWAYS

.1 Install raceways as follows:

.1 Rigidly supported.
.2 Workmanlike manner.
.3 Maintain maximum headroom.
.4 Concealed in finished area.
.5 Surface-mounted in open area.
.6 Do not pass conduits through structural members except as indicated.
.7 Parallel to or at right angles to the building lines.
.8 Thoroughly ream all conduits at ends and terminate with appropriate locknuts and bushings.
.9 Cause minimum interference in spaces through which they pass.
.10 Plug or cap conduit during construction to protect from dust, dirt or water.
.11 Unless specifically indicated on drawings or with the permission of the NRC Departmental Representative, do not cast conduits in concrete.
.12 Dry conduits out before installing wire.
.13 Mechanically bend steel conduit larger than 22 mm (3/4") diameter. Bend conduit cold.
.14 Do not cut or modify prefabricated bends.

.15 PVC conduit as indicated.

.16 Function and appearance to be to the NRC Departmental Representative's approval.

.17 Seal conduit and cable openings in fire- rated walls and floors with an approved fire stop material.

.18 Seal conduit and cable openings in exterior walls with a weatherproof silicone sealant.

.19 Paint exposed conduits and boxes to match existing wall / ceiling.

END OF SECTION

Part 1 General

1.1 SHOP DRAWINGS AND PRODUCT DATA

.1 Submit shop drawings and product data in accordance with Section 00 10 00.

.2 Include schematic, wiring, interconnection diagrams.

Part 2 Products

2.1 CONTROL TRANSFORMER

.1 Single phase, dry type, control transformer with primary voltage as indicated and 120V secondary, complete with secondary fuse, installed as indicated.

.2 Size control transformer for control circuit load plus 20% spare capacity.

2.2 FINISHES

.1 Apply finishes to enclosure in accordance with Section 26 05 00 Common Work Results - Electrical.

2.3 EQUIPMENT IDENTIFICATION

.1 Apply finishes to enclosure in accordance with Section 26 05 00 Common Work Results - Electrical.

.2 Provide equipment identification in accordance with Section 26 05 00 Common Work Results - Electrical.

Part 3 Execution

3.1 INSTALLATIONS

.1 Install control transformers and interconnect as indicated.

.2 Install correct fuses and overload device elements.

3.2 TESTS

.1 Perform tests in accordance with Section 26 05 00 Common Work Results - Electrical and Manufacturer's instructions.

END OF SECTION

Part 1 General

1.1 SHOP DRAWINGS AND PRODUCT DATA

.1 Submit shop drawings and product data in accordance with Section 00 10 00.

.2 Submit stamped engineered drawings for structures supporting transformers on walls or other structures other than the floor.

.3 Prior to any installation of circuit breakers in either a new or existing installation, Contractor must submit three (3) copies of a certificate of origin, from the manufacturer, duly signed by the factory and the local manufacturer's representative, certifying that all circuit breakers come from this manufacturer, they are new and they meet standards and regulations. These certificates must be submitted to the Departmental Representative for approval.

.1 The above applies to all breakers rated above 240V.

.2 The above applied to all breakers rated up to 240V and 100A or more.

.4 A delay in the production of the certificate of origin won't justify any extension of the contract and additional compensation.

.5 Any work of manufacturing, assembly or installation should begin only after acceptance of the certificate of origin by Departmental Representative. Unless complying with this requirement, Departmental Representative reserves the right to mandate the manufacturer listed on circuit breakers to authenticate all new circuit breakers under the contract at the Contractor's expense.

.6 In general, the certificate of origin must contain:

.1 The name and address of the manufacturer and the person responsible for authentication. The responsible person must sign and date the certificate;

.2 The name and address of the licensed dealer and the person of the distributor responsible for the Contractor's account.

.3 The name and address of the Contractor and the person responsible for the projet.

.4 The name and address of the local manufacturer's representative. The local representative must sign and date the certificate.

.5 The name and address of the building where circuit breakers will be installed:

.1 Project title.

.2 End user's reference number.

.3 The list of circuit breakers.

.7

1.2 IDENTIFICATION

.1 Identification as per Section 26 05 00.

Part 2 Products

2.1 DISCONNECT SWITCHES, FUSED AND NON-FUSED

.1 Fusible and non-fusible disconnect switches in EEMAC Enclosure as indicated.

.2 Provision for padlocking in "OFF" switch position.

.3 Mechanical voidable door interlock in "ON" position.

.4 Fuses: size and type as indicated.

.5 Fuseholders in each switch to be suitable without adaptors, for type and size of fuse indicated.

.6 Quick-make, quick-break action.

.7 "ON-OFF" switch position indication on switch enclosure cover.

.8 Standard of acceptance: Square D, Cutler-Hammer, Siemens.

2.2 GROUNDING

.1 Insulated grounding conductors in accordance with Section 26 05 00.

.2 Compression connectors for grounding to equipment provided with lugs.

2.3 DRY TYPE TRANSFORMER

.1 Type ANN, C802.2.

.2 Single or three phase, KVA rating, input and output voltage as indicated.

.3 Class 220, 150℃ temperature rise insulation system.

.4 Copper windings.

.5 Four 2.5% taps, 2-FCAN and 2-FCBN.

.6 EEMAC 1 enclosure with lifting lugs, removable metal front and side panels.

.7 Drip shield.

.8 Standard of acceptance: Hammond or approved equal.

2.4 FREQUENCY CONVERTER

.1 Client supplied frequency converter designed to generate 400 Hz power and 28.5 volts DC power output package, for aircraft as a decentralised ground power system 3 phase. kVA as indicated , 600V input, 400 Hz, output or voltage or as indicated, 400 Hz. Unit to be Piller or equal with the following features:

2.5 PANELBOARDS

.1 600 volt panelboards: bus and breakers rated for 42,000 amp r.m.s. symmetrical interrupting capacity or as indicated.

.2 250 volt branch circuit panelboards to have minimum interrupting capacity of 18,000 amp r.m.s. symmetrical.

.3 Panelboards are to have a main breaker that shall be service entranced approved (i.e. barrier to separate main breaker from remainder of panels).

.4 Sequence phase bussing with odd numbered breakers on left and even on right, with each breaker identified by permanent number identification as to circuit number and phase.

.5 Panelboards: mains, number of circuits, number and size of branch circuit breakers as indicated.

.6 Two keys for each panelboard and all panelboards to be keyed alike.

.7 Copper bus, neutral and ground bar with neutral of same ampere rating as mains.

.8 Suitable for: plug-in or bolt-on breakers.

.9 Trim and door finish: baked grey enamel.

.10 Drip shield.

.11 Complete circuit directory with typewritten legend showing description of each circuit.

.12 Manufacturer: Square D, Cutler-Hammer, Siemens.

2.6 MOULDED CASE CIRCUIT BREAKER

.1 Thermal-magnetic moulded case circuit breakers, quick-make, quick-break type, for manual and automatic operation with temperature compensation for 40℃ ambient.

.2 Common-trip breakers with single handle for multiple applications.

.3 All new 120V to 600V circuit breakers installed on this project are to include the handle accessory, "Handle Padlock Attachment", which locks breakers on or off.

.4 Magnetic instantaneous trip elements in circuit breakers, to operate only when the value of current reaches 10 times their setting.

.5 Circuit breaker and panel to be of same manufacturer.

.6 Circuit breakers minimum rating: 10K for 120/240V and 42K for 600/347V or greater if indicated.

.7 400Hz circuit breakers to be rated for selected frequency as indicated on drawings minimum rating: 25K for 120/208V

.8 Standard of acceptance: Square D, Cutler-Hammer, Siemens.

2.7 FUSES

.1 250V and 600V time delay, rejection style, HRC-I, Class RK5.

.2 Standard of acceptance: Gould-Shawmut.

2.8 METERING

.1 Installed near each tenant's main switch or circuit breakers. Meters to accurately measure electricity that each tenant used and stores the information in non-volatile, solid state memory. The metering panels shall be networked together to allow remote computerized access for remote meter reading and automated bill generation. System to be equal to Schneider ION. 7350

.2 The meter shall be able to be used on polyphase services. Wiring includes: connection of the meters to the line voltage, connection of the through-type current transformers/transducers installed at the circuit breakers, connection of network communications (wired or, if applicable, wireless communications devices).

.3 Application Voltages: The metering panel will accommodate all approved North American Distribution voltages up to 600 Volts. For higher voltages, potential transformers shall be used.

.4 Operating Frequency: 50/60 Hz.

.5 Power Factor Range: 0.5 to 1.0 lead/lag.

.6 Power Supply Requirements: Self-powered.

.7 Current Ranges: 100/200/400 Amps or 5/10 AMP interface (services over 400A or critical loads)

.8 Accuracy: +/- 0.5% of 100% registration @ 1.0 pf, 1% to 100% load to meet: Measurement Canada.

.9 Operating Temperature Range: -40 degrees to +55 degrees C.

.10 Meters and their elements must conform to the Measurement Canada “Standard Drawings for Electrical Metering Installations” to ensure accurate metering. All configurations shall come with current transformers/transducers required in the “Standard Drawings”.

Part 3 Execution

3.1 DISCONNECT SWITCHES

.1 Install disconnect switches complete with fuses as indicated.

3.2 GROUNDING

.1 Install complete permanent, continuous, system and circuit, equipment, grounding systems including, conductors, compression connectors, accessories, as indicated, to conform to requirements of Engineer, and local authority having jurisdiction over installation. Where EMT is used, run ground wire in conduit.

.2 Install connectors in accordance with manufacturer's instructions.

.3 Protect exposed grounding conductors from mechanical injury.

.4 Soldered joints not permitted.

3.3 DRY TYPE TRANSFORMER

.1 Transformers above 75 kVA mount on floor.

.2 Provide adequate clearance around transformer for ventilation.

.3 Install transformers in level upright position.

.4 Remove shipping supports only after transformer is installed and just before putting into service.

.5 Loosen isolation pad bolts until no compression is visible.

.6 Make primary and secondary connections shown on wiring diagram.

.7 Energize transformers immediately after installation is completed, where practicable.

.8 Provide equipment identification in accordance with Section 26 05 00.

.9 Connect transformer through side of housing.

3.4 FREQUENCY CONVERTER INSTALLATION

.1 Mount frequency converter on floor.

.2 Ensure adequate clearance around frequency converter for ventilation.

.3 Install frequency converter in level upright position.

.4 Remove shipping supports only after frequency converter is installed and just before putting into service.

.5 Loosen isolation pad bolts until no compression is visible.

.6 Make primary and secondary connections in accordance with wiring diagram.

.7 Energize frequency converter after installation is complete.

.8 Make conduit entry into bottom 1/3 of frequency converter enclosure.

.9 Include for manufacturer representative to commission and include 4 hrs training session.

3.5 DC CONVERTER INSTALLATION

.1 Mount transformers on floor.

.2 Provide adequate clearance around transformer for ventilation.

.3 Install transformers in level upright position.

.4 Remove shipping supports only after transformer is installed and just before putting into service.

.5 Loosen isolation pad bolts until no compression is visible.

.6 Make primary and secondary connections shown on wiring diagram.

.7 Energize transformers immediately after installation is completed, where practicable.

.8 Provide equipment identification in accordance with Section 26 05 00.

.9 Connect transformer through side of housing.

3.6 PANELBOARDS

.1 Locate panelboards as indicated and mount securely, plumb, and square, to adjoining surfaces.

.2 Mount panels to height specified in section 26 27 26 or as indicated.

.3 Connect loads to circuits as indicated.

.4 Connect neutral conductors to common neutral bus.

3.7 MOULDED CASE CIRCUIT BREAKERS

.1 Install circuit breakers as indicated.

3.8 FUSES

.1 Install fuses in mounting devices immediately before energizing circuit.

.2 Install fuses correctly sized to assigned electrical circuits.

.3 Provide 3 spare fuses for each rating supplied.

END OF SECTION

Part 1 General

1.1 RELATED WORK

.1 Motors and controls to Sections 26 22 19, 26 29 03 & 26 29 10.

1.2 MATERIALS

.1 Provide only new equipment and materials, without blemish or defect, bearing Canadian Standards Association or Authorized Electrical Inspection Department labels, and subject to the approval of the NRC Departmental Representative.

.2 After a contract is awarded, utilize alternative methods and/or materials only after receiving the NRC Departmental Representative's approval.

1.3 SHOP DRAWINGS AND PRODUCT DATA

.1 Submit shop drawings and product data in accordance with Section 00 10 00.

1.4 IDENTIFICATION

.1 Identification as per Section 26 05 00.

Part 2 Products

2.1 WIRING DEVICES

.1 Switches:

.1 Specification grade, shallow body, designed to withstand high inductive fluorescent loads CSA C22.2 No. 55.

.2 Number of poles as indicated.

.3 Captive mounting screws, quiet safe mechanical action with rust-proofed mounting strap and silver alloy contact points.

.4 Toggle actuated, colour white unless otherwise indicated.

.5 Brass screw terminals rated 20 AMP at 125 volt.

.6 Standard of acceptance: Hubbell, Leviton.

.2 LED Dimming Switches:

.1 0-10VDC, electronic, suitable for use with installed light fixture and central dimming and control system.

.2 Rated for 1200W.

.3 Suitable for use in “3-way” configuration where indicated.

.4 Standard of acceptance:

.1 To be approved by NRC Departmental Representative.

.2 3-way style to be approved by NRC Departmental Representative.

.3 Receptacles:

.1 Duplex type, CSA type 5-15R, 125 volt, 15A, U ground, specification grade with the following features:

.1 Flush type with parallel blade slots.

.2 Double-wiping contacts.

.3 Double-grounding terminals.

.4 Break-off feature for separate feeds.

.5 One piece body, colour white unless otherwise indicated.

.2 Special receptacles with ampacity and voltage as indicated.

.3 Receptacles of one manufacturer throughout the project.

.4 Cover Plates:

.1 Cover plates for wiring devices.

.2 Smooth white plastic for wiring devices mounted in flush-mounted outlet box.

.3 Sheet metal cover plates for wiring devices mounted in surface-mounted outlet box.

.4 Weatherproof covers as indicated.

.5 Multi-outlet covers as indicated.

.5 Splitters, Junction Boxes & Cabinets:

.1 Sheet metal enclosure, welded corners and formed cover, provided as required.

.6 Special Receptacles:

Special Receptacles with size and voltage as indicated.

.7 Hand Dryer:

.1 Wall mount, brushed stainless steel enclosure, hands free operation, 15A, 208V, Xlerator or equal.

.8 Pipe Freeze Protection:

.1 Self regulating pipe freeze protection heating cable, 8w/ft, nickel plated copper bus wiring, tinned-copper braid cover with modified polyolefin outer jacket, Rachem XL trace or equal.

Part 3 Execution

3.1 LOCATION OF OUTLETS

.1 The number and general location of outlets for lighting, power, telephones, etc., are to be as shown on the drawings. Install all outlets accurately and uniformly with respect to building details. When centering outlets, make allowance for overhead pipes, ducts, etc. and for variations in wall or ceiling finish, window trim,

etc. Reinstall incorrectly installed outlets at no cost to the Owner. Make field power and control connections as indicated.

.2 The location of all outlets as shown on the plans are approximate and are subject to change, up to 3m (10') without extra cost or credit provided the information is given prior to the installation of the outlet.

.3 Unless otherwise specified, locate light switches on latch side of doors. Determine the direction of all door swings from the architectural drawings or on site, not from the electrical drawings.

3.2 MOUNTING HEIGHTS

.1 Mounting height of equipment is from finished floor to centreline of equipment unless specified or indicated otherwise.

.2 If mounting height of equipment is not indicated verify before proceeding with installation.

.3 Generally, locate outlets as follows: (except those otherwise shown on the drawings):

.1 Local switches 1.2m (3'-11") to top.
.2 Wall receptacles 400mm (1'-4") to centreline.
.3 Clock receptacles 2.4m (8'-0") to centreline.
.4 Lighting panels 1.8m (6'-0") to top.
.5 Telephone and data communications outlet 400mm (1'-4") to centreline.
.6 Fan coil speed control switch 1.2m (3'-11") to centreline.

3.3 WIRING DEVICES

.1 Install wiring devices as follows:

.1 Where more than one local device is shown at one location, they are to be set under one cover plate.
.2 Install single throw switches with handle in "up" position when switch closed.
.3 Devices in gang type outlet box when more than one device is required in one location.
.4 Protect stainless steel cover plate finish with paper or plastic film until painting and other work is finished.
.5 Do not use cover plates meant for flush outlet boxes on surface-mounted boxes.
.6 Install metal barriers where required.
.7 Remove insulation carefully from ends of conductors and connect wiring as required.
.8 Bond and ground as required.

3.4 DIMMING SYSTEM

.1 Install wiring devices as follows:

.1 Protect stainless steel cover plate finish with paper or plastic film until painting and other work is finished.

.2 Remove insulation carefully from ends of conductors and connect wiring as required.

.3 Bond and ground as required.

3.5 SPLITTERS AND DEVICES

.1 Installation of splitters, junction boxes, pull boxes & cabinets as follows:

.1 Mount plumb, true and square to the building lines.

.2 Install in inconspicuous but accessible locations.

.3 Install pull boxes so as not to exceed 30 m (100') of conduit run between boxes or as indicated.

3.6 HAND DRYER

.1 Installation of hand dryers as follows:

.1 Mount plumb, true and square to the building lines.

.2 Mount to manufacturer recommendations for accessible

END OF SECTION

Part 1 General

1.1 RELATED WORK SPECIFIED ELSEWHERE

.1 Common Work Results - Electrical Section 26 05 00

1.2 MATERIALS

.1 Provide only new equipment and materials, without blemish or defect, bearing Canadian Standards Association or Authorized Electrical Inspection Department labels, and subject to the approval of the NRC Departmental Representative.

.2 After a contract is awarded, utilize alternative methods and/or materials only after receiving the NRC Departmental Representative's approval.

1.3 SHOP DRAWINGS AND PRODUCT DATA

.1 Submit shop drawings and product data in accordance with Section 00 10 00.

Part 2 Products

2.1 AC CONTROL RELAYS

.1 Convertible contact type: contacts field convertible from N/O to N/C, electrically held or permanent magnet latched or double- voltage type as indicated. Coil rating: 120V, Contact rating: 120V.

.2 Standard of acceptance: Allen Bradley.

2.2 SOLID STATE TIMING RELAYS

.1 Construction: AC operated electronic timing relay with solid-state timing circuit to operate output contact. Timing circuit and output contact completely encapsulated to protect against vibration, humidity and atmospheric contaminants.

.2 Operation: on-delay or off-delay.

.3 Potentiometer: self contained to provide time interval adjustment.

.4 Supply voltage: 120V, 60 Hz. or as specified.

.5 Temperature range: -20°C to 60°C.

.6 Output contact rating: maximum voltage 300V AC or DC.

.7 Timing ranges: as indicated.

.8 Standard of acceptance: Agastat.

2.3 OPERATOR CONTROL STATIONS

.1 Enclosure: CSA Type and mounting as indicated.

2.4 PUSHBUTTONS

.1 As indicated on control schematic.

2.5 SELECTOR SWITCHES

.1 As indicated on control schematic.

2.6 CONTROL AND RELAY PANELS

.1 As indicated on control schematic.

2.7 FINISHES

.1 Apply finishes to enclosure in accordance with Section 26 05 00.

2.8 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section 260500.

Part 3 Execution

3.1 INSTALLATION

.1 Install control devices and relay panels and interconnect as indicated.

.2 Install correct fuses and overload device elements.

3.2 TESTS

.1 Perform tests in accordance with Section 26 05 00 and Manufacturer's instructions.

.2 Operate switches, contactors to verify correct functioning.

.3 Perform starting and stopping sequences of contactors and relays.

.4 Check that sequence controls, interlocking with other separate related starters, equipment, control devices, operate as indicated.

END OF SECTION

Part 1 General

1.1 RELATED WORK SPECIFIED ELSEWHERE

.1 Common Work Results - Electrical Section 26 05 00

1.2 SHOP DRAWINGS AND PRODUCT DATA

.1 Submit shop drawings and product data in accordance with Section 00 10 00.

.2 Include schematic, wiring, interconnection diagrams.

.3 Indicate:

.1 Mounting method and dimensions.
.2 Starter size and type.
.3 Layout of identified internal and front panel components.
.4 Enclosure types.
.5 Wiring diagram for each type of starter.
.6 Interconnection diagrams.

.4 Motors specified and supplied with mechanical equipment. Refer to Division 23.

1.3 OPERATION AND MAINTENANCE DATA

.1 Provide operation and maintenance data for motor starters for incorporation into manual specified in Section 00 10 00.

.2 Include operation and maintenance data for each type and style of starter.

Part 2 Products

2.1 MATERIALS

.1 Starters:

.1 IEC rated starters not acceptable.

2.2 MANUAL MOTOR STARTERS

.1 Single and three phase manual motor starters of size, type, rating, and enclosure type as indicated, with components as follows:

.1 Switching mechanism, quick make and break.
.2 One and three overload heaters as indicated, manual reset, trip indicating handle.

.2 Accessories:

.1 Toggle switch, key switch or pushbutton as specified.
.2 Indicating light: type and colour as indicated.
.3 Locking tab to permit padlocking in "ON" or "OFF" position.

.3 Standard of acceptance: Square D, Class 2510 or approved equal.

2.3 FULL VOLTAGE MAGNETIC STARTERS

.1 Magnetic and combination magnetic starters of size, type, rating and enclosure type as indicated with components as follows:

.1 Contactor solenoid operated, rapid action type.

.2 Motor overload protective device in each phase, manually reset from outside enclosure.

.3 Power and control terminals.

.4 Wiring and schematic diagram inside starter enclosure in visible location.

.5 Identify each wire and terminal for external connections, within starter, with permanent number marking identical to diagram.

.2 Combination type starters to include motor circuit interrupter or circuit breaker with operating lever on outside of enclosure to control motor circuit interrupter or circuit breaker and provision for:

.1 Locking in "OFF" position with up to 3 padlocks.

.2 Locking in "ON" position.

.3 Independent locking of enclosure door.

.4 Provision for preventing switching to "ON" position while enclosure door open.

.3 Accessories:

.1 Pushbuttons and selector switches: type and labelled as indicated.

.2 Indicating lights: type and color as indicated.

.3 1-N/O and 1-N/C spare auxiliary contacts unless otherwise indicated.

.4 Standard of acceptance: Square D, Class 8539 or approved equal.

2.4 FINISHES

.1 Apply finishes to enclosure in accordance with Section 26 05 00.

2.5 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section 260500.

Part 3 Execution

3.1 INSTALLATION

.1 Install starters, connect power and control as indicated.

.2 Install control devices and relay panels and interconnect as indicated.

.3 Install correct fuses and overload device elements.

.4 Megger all motors. Dry out motor if dampness is present in accordance with manufacturer's recommendations.

.5 For installation of motor with mechanical equipment refer to Division 23.

.6 Make connection to motor as indicated. Use liquid-tight PVC jacketted flexible conduit between rigid conduit and motor.

.7 Make flexible conduit long enough to permit movement of motor.

3.2 TESTS

.1 Perform tests in accordance with Section 26 05 00 and Manufacturer's instructions.

.2 Operate switches, contactors to verify correct functioning.

.3 Perform starting and stopping sequences of contactors and relays.

.4 Check that sequence controls, interlocking with other separate related starters, equipment, control devices, operate as indicated.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 26 05 32.

1.2 REFERENCES

.1 American National Standards Institute (ANSI)

.1 ANSI C82.1, Lamp Ballasts-Line Frequency Fluorescent Lamp Ballast.

.2 Canadian Standards Association (CSA International)

.3 ICES-005, Radio Frequency Lighting Devices.

.4 Underwriters' Laboratories of Canada (ULC)

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.

.2 Provide complete photometric data prepared by independent testing laboratory for luminaires where specified, for approval review by Departmental Representative.

1.4 QUALITY ASSURANCE

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

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.

.2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

.3 Packaging Waste Management: remove for reuse and return by manufacturer of packaging materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

.4 Divert unused metal materials from landfill to metal recycling facility.

.5 Disposal and recycling of fluorescent lamps as per local regulations.

.6 Disposal of old PCB filled ballasts.

Part 2 Products

2.1 LIGHTING

.1 LED

.1 Type A:

.1 l20V, 300mm x 1200mm, LED 28W, troffer, suitable for recessed mounting in T-bar ceiling.

.2 5-year warranty.

.3 Removable LED boards and driver for ease of service/replacement.

.4 Rated to deliver L70 performance for 50,000 hours.

.5 4000k colour temperature, 82 CRI, minimum 4000 lumen output minimum.

.6 Standard of acceptance: Lithonia 2GTL-4-40L-LP840, CFI SpecPlus SPS24G-FS-VA-43A-40-U-LAG, Columbia LLT-24-40-ML-G-FS-A12F-U, CREE ZR24-40L-40K-10V or equivalent approved by the NRC Departmental Representative.

.2 Type A1:

.1 120V, 300mm x 1200mm, 28W, suitable for surface mounting with wraparound lens.

.2 Rigid die embossed steel housing, 100mm deep, powder coated housing.

.3 5-year warranty.

.4 Removable LED boards and driver for ease of service/replacement.

.5 0-10V DC dimming.

.6 Rated to deliver L80 performance for 50,000 hours.

.7 4000k colour temperature, minimum Lumen output.

.8 Standard of acceptance: Philips 4114D1STL8ADS11E or equivalent approved by the NRC Departmental Representative.

.3 Type B:

.1 120V, 1140-1220mm long, LED linear strip, wireguard, suitable for surface or suspended mounting.

.2 5-year warranty.

.3 Rated to deliver L70 performance for 100,000 hours.

.4 4000k colour temperature, minimum 3800 lumen output.

.5 Standard of acceptance: Philips Fluxstream LF-4-FR-39-40-U-LAG, Peerless Electric NSL-4-46-40k-RA-WH-MV, CREE LS4-40L-40K-10V or equivalent approved by the NRC Departmental Representative.

.4 Type C:

.1 120V, 600mm x 1200mm, 54W, suitable for surface mounting with wraparound lens.

.2 Rigid die embossed steel housing, 100mm deep, powder coated housing.

.3 5-year warranty.

.4 Removable LED boards and driver for ease of service/replacement.

.5 0-10V DC dimming.

.6 Rated to deliver L80 performance for 50,000 hours.

.7 4000k colour temperature, minimum Lumen output.

.8 Standard of acceptance: Philips 4124S1STL8ACS11E or equivalent approved by the NRC Departmental Representative.

.5 Type D:

.1 l20V, 600mm x 1200mm, LED troffer, suitable for recessed mounting in T-bar ceiling.

.2 5-year warranty.

.3 Removable LED boards and driver for ease of service/replacement.

.4 Rated to deliver L70 performance for 50,000 hours.

.5 4000k colour temperature, 82 CRI, minimum 4000 lumen output minimum.

.6 Standard of acceptance: Lithonia 2GTL-4-40L-LP840, CFI SpecPlus SPS24G-FS-VA-43A-40-U-LAG, Columbia LLT-24-40-ML-G-FS-A12F-U, CREE ZR24-40L-40K-10V or equivalent approved by the NRC Departmental Representative.

.6 Type F:

.1 120V, 150mm x 1200mm, 74W, high output LED suitable for surface mounting with wraparound lens.

.2 Rigid die embossed steel housing, 100mm deep, powder coated housing.

.3 5-year warranty.

.4 Removable LED boards and driver for ease of service/replacement.

.5 0-10V DC dimming.

.6 Rated to deliver L80 performance for 50,000 hours.

.7 4000k colour temperature, minimum Lumen output.

.8 Standard of acceptance: Philips LFR4FLPER3740ULAG or equivalent approved by the NRC Departmental Representative.

.7 Type G:

.1 l20V, 150mm LED drum light, suitable for surface mounting in ceiling or wall.

.2 5-year warranty.

.3 3500k colour temperature, 82 CRI, minimum 1500 lumen output.

.4 Standard of acceptance: Philips S7R830K10 or equivalent approved by the NRC Departmental Representative.

.8 Type H:

.1 Wall-mounted 45W, 120Y, LED wall pack.

.2 Die-cast aluminum housing, bronze in colour.

.3 18 LEDs, type 3 optics, full cut-off. 3311 lumen output.

.4 Built in photo control.

.5 Standard of Acceptance: Hubbell outdoor lighting Laredo Series LNC2- 18LU-5K-3-1-PCI or equivalent approved by the NRC Departmental Representative.

.9 Type H1:

.1 Wall-mounted 71W, 120Y, LED wall pack.

.2 Die-cast aluminum housing, bronze in colour.

.3 18 LEDs, type 3 optics, full cut-off. 4673 lumen output.

.4 Built in photo control.

.5 Standard of Acceptance: Hubbell outdoor lighting Laredo Series LMC30LU-3-1-PCI or equivalent approved by the NRC Departmental Representative.

.10 Type J:

.1 l20V, 150mm open LED downlight, suitable for recessed mounting in drywall or T-bar ceiling.

.2 5-year warranty.

.3 3500k colour temperature, 82 CRI, minimum 1500 lumen output.

.4 Standard of acceptance: Lithonia Reality REAL6C6D-MW-ESL-1500L-35K-.95SC-120, Philips Lightolier C6L-15-N-U-VB-ZIOV with trim kit C6L-1520-DL-35K-W-WH-W-VB, Prescolite LiteFrame LC6LED-120-6LCLED-7-35K-8-WH-WT, CREE KR6-20L-40K-120-10V or equivalent approved by the NRC Departmental Representative.

.11 Type K1:

.1 120V, 100mm x 1200mm, 54W, LED linear suitable for surface mounting.

.2 Rigid die embossed steel housing, 100mm deep, powder coated housing.

.3 5-year warranty.

.4 Removable LED boards and driver for ease of service/replacement.

.5 0-10V DC dimming.

.6 Rated to deliver L80 performance for 50,000 hours.

.7 4000k colour temperature, minimum Lumen output.

.8 Standard of acceptance: Philips Jump 1201LBEP11EB or equivalent approved by the NRC Departmental Representative.

2.2 LIGHTING CONTROL PANEL

.1 The Centralized Lighting Control Systems with local controls shall have the following features:

.1 Provisions for control of any zone or group of zones in any area on a processor; fine tune in 1% increments with graphic and numeric feedback

.2 Restrict set up and programming configuration options via numeric passcode

.3 Menus and help screens can be displayed in one of 7 languages: Enables a single view of the lighting and timeclock status of all the areas on a processor

.4 Control Station Devices (CSD) Link shall be:

.1 Wires like Wallstations/Control Interfaces

.2 Wire: (2) #12 AWG (2.5mm2), (1) twisted, shielded pair #18 AWG (1.0mm2) plus (1) #18 AWG (1.0mm2)

.3 Maximum wiring Distance: 2,000’ (610m)

.5 Installation: Daisy chain (no home-run wiring)

.6 Power: 33VDC (from **Centralized Lighting Control System** Processor)

.7 Configuration: Requires no programming; automatically downloads

.8 LC & D GR2400, or equal to Leviton GreenMAX.

.2 Remote dimming stations to be equipped with 4 scene, on/off and +- manual dimming

2.3 FINISHES

.1 Light fixture finish and construction to meet ULC listings and CSA certifications related to intended installation.

2.4 OPTICAL CONTROL DEVICES

.1 As indicated in luminaire schedule.

Part 3 Execution

3.1 INSTALLATION

.1 Locate and install luminaires as indicated.

.2 Supply and install all components required to form a fully functional lighting control system even if not specifically call for on the drawings or in specifications.

.3 Provide adequate support to suit ceiling system.

3.2 WIRING

.1 Connect luminaires to lighting circuits:

.1 Install flexible or rigid conduit for luminaires as indicated.

3.3 LUMINAIRE SUPPORTS

.1 For suspended ceiling installations support luminaires independently of ceiling.

3.4 LUMINAIRE ALIGNMENT

.1 Align luminaires mounted in continuous rows to form straight uninterrupted line.

.2 Align luminaires mounted individually parallel or perpendicular to building grid lines.

3.5 LIGHTING CONTROL PANEL

.1 Include for lighting control manufacturer to finalize installation and commission system.

.2 Include for lighting control manufacturer to provide 2 x 3 hr training sessions at time pre determined by owner.

3.6 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, recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

END OF SECTION

Part 1 General

1.1 RELATED WORK SPECIFIED ELSEWHERE

.1 Common Work Results - Electrical Section 26 05 00

1.2 MATERIALS

.1 Provide only new equipment and materials, without blemish or defect, bearing Canadian Standards Association or Authorized Electrical Inspection Department labels, and subject to the approval of the NRC Departmental Representative.

.2 After a contract is awarded, utilize alternative methods and/or materials only after receiving the NRC Departmental Representative's approval.

1.3 SHOP DRAWINGS AND PRODUCT DATA

.1 Submit shop drawings and product data in accordance with Section 00 10 00.

Part 2 Products

2.1 EXIT LIGHTS

.1 Housing: one piece extruded aluminum with aluminum grey baked epoxy finish.

.2 Face plates:

.1 Extruded 2.5 mm (0.1") thick aluminum complete with knock-out arrows.
.2 Single and double face (refer to drawings).
.3 Pictogram identification
.4 Mounting: universal-surface-end and ceiling with canopy.
.5 Downlight: prismatic plastic.
.6 Lamp: LED 120VAC
.7 To meet CAN/CSA C860-01

2.2 EMERGENCY BATTERY UNITS

.1 Supply voltage 120 V dc.

.2 Output voltage 12 V dc.

.3 Batteries: sealed lead acid calcium alloy grid type sized to operate the lamp load to 91% of initial voltage for 30 minutes.

.4 Battery charger: solid state, multi-rate, voltage/current regulated, sized to restore battery to full charge in 12 hours.

.5 Low voltage disconnect: solid state, modular, operates at 80% battery voltage.

.6 EEMAC 1 code gauge steel housing.

.7 Auxiliary equipment:

.1 "AC Power ON"

.2 "Fast charge" pilot light

.3 Voltmeter

.4 Test switch

.5 5 minute time delay relay

.6 Cord and plug

.8 Lamp heads: mounted as indicated, 360° horizontal and 180° vertical adjustment, (12W) (20W) (55W) (micro quartz) (quartz halogen composite) lamps.

.9 Acceptable Manufacturers:

.1 Rycroft - Lumacell

.2 Emergi-Lite

Part 3 Execution

3.1 EXIT LUMINAIRES

.1 Connect fixtures to emergency power circuits as indicated.

.2 Ensure that the exit light circuit breaker is locked in the "ON" position.

END OF SECTION

Part 1 General

1.1 RELATED WORK SPECIFIED ELSEWHERE

.1 Common Work Results - Electrical Section 26 05 00

1.2 MATERIALS

.1 Provide only new equipment and materials, without blemish or defect, bearing Canadian Standards Association or Authorized Electrical Inspection Department labels, and subject to the approval of the NRC Departmental Representative.

1.3 SYSTEM DESCRIPTION

.1 Empty telecommunications raceways system consists of outlet boxes, cover plates, distribution cabinets, conduits, pull boxes, sleeves and caps, fish wires.

Part 2 Products

2.1 MATERIALS

.1 Raceways: Minimum 19mm (3/4") EMT larger sizes as indicated on drawing.

.2 Provide factory painted blue covers of junction boxes and conduits of voice/data cables.

.3 Tele-Power poles/Jiffy poles: type as indicated on drawings.

.4 Floor mounted outlets: type as indicated on drawings.

.5 Cable tray:

1.Basket type: ASTM A510, Grade 1008, Electroplated Zinc Galvanized Finish, complete with splicing kits, elbows, drop out fittings, mounting brackets and fittings, sized as indicated.

2.Ladder type: Aluminum, ventilated, 6” rung spacing complete with splicing plates, adjustable splice plates, blind end plates, elbows, drop out fittings, mounting brackets and hold down clips, sized as indicated.

3.Solid Bottom type: Aluminum, solid bottom, open top complete with splicing plates, adjustable splice plates, blind end plates, elbows, drop out fittings, mounting brackets and hold down clips, sized as indicated.

Part 3 Execution

3.1 CONDUIT AND CABLE TRAY SYSTEMS

.1 Run conduit from wall outlets to 150mm (6") above false ceiling or to a point indicated on drawings.

.2 Install nylon pullcords in all empty conduits.

.3 Install additional steel pull boxes where necessary so that throughout the entire system, wires may be pulled in or withdrawn with reasonable ease. Pull boxes shall be installed in straight runs only.

.4 Install nylon bushings at open ends of conduit.

.5 Do not run communications cables in the same raceway as power and lighting conductors.

.6 Provide seismic bracing for all cable tray and conduit systems.

3.2 MOUNTING

.1 Recess mount wall outlets unless otherwise indicated. Mount wall outlets to height specified in section 26 27 26 or as indicated.

3.3 WORK BY OTHERS

.1 Cables and terminations.

END OF SECTION

1 General

1.1 **SUMMARY**

.1 Section includes:

.1 Labour, products, equipment and services necessary to complete the work of this Section.

.2 Common Work Results - Electrical Section 26 05 00

1.2 **GENERAL REQUIREMENTS**

.1 Provide a completely installed and satisfactorily operating public address and tone signal system as described in, and in compliance with, this specification and the contract drawings.

.2 Confirm that the system specified herein has the capability to meet the design intent, or propose an alternative system, either fully or in part.

.3 Ambient noise levels 60 - 65 dBA

.4 Acceptable P.A. system output sound pressure levels are 10 dB above ambient.

.5 Make adjustments to the design of the system to ensure that the acceptable sound pressure levels are met.

.6 Use only electronic and electro-mechanical equipment produced by a manufacturer with a minimum 5 year period of experience producing similar products and who can refer to similar installations now rendering satisfactory service.

.7 Provide equipment of modular design and solid state devices except for electro-mechanical components.

.8 Reference to model numbers and other information is intended to establish the standards of performance, quality, and appearance which must be met.

.9 Furnish four sets of instruction material requisite for proper operation of the equipment by Owner's personnel.

.10 Prepare and supply not fewer than six bound copies of a manual incorporating:

.1 System block diagrams and functionals.

.2 Schematic diagrams of all equipment and devices.

.3 Complete "as built" wiring diagram showing all device wiring and the connections, including colour codes, cable numbering and terminal numbering.

.4 Operating instructions for all supplied equipment.

.5 Service manuals for all supplied equipment.

.11 Guarantee equipment to be free from defective material and workmanship for a period of one year from date of final acceptance by Owner, except where damage is caused by Owner through accident, abuse, improper operation or neglect. Provide maintenance, pursuant to this guarantee during normal working hours at no expense to the Owner.

.12 Provide satisfactory evidence of the maintenance of a service organization capable of furnishing adequate inspection and service to the equipment and be prepared to offer a service contract for maintenance of the system after guarantee period.

.13 Test entire system after completion of installation in accordance with Owner's requirements. Submit a test report to the Consultant.

.14 Verify site conditions before commencing work. Examine location conditions and submit, in writing to the Engineer prior to proceeding with the work, justification for deviating from the installation parameters shown on the contract drawings, including: mounting height, orientation, power setting, and speaker or horn type, or any other parameter that may be indicated. Make these adjustments only after receipt of approval in writing from the Engineer and at no additional cost to the Owner.

.15 Provide any other equipment, labour or material necessary to fulfil the functional and performance criteria of the system whether shown in the specification or contract drawings or not.

.16 Tender a price based on the make and model of the stipulated representative unit or units. Where the stipulated unit or units cannot be supplied, state reason and propose a substitution with equivalent unit.

.17 Propose alternative units where such substitutions can be demonstrated to be to the benefit of the Owner.

.18 Where alternative units are proposed with Tender package, and reflected in the Tender price, clearly identify the unit for which the alternative is intended to substitute, note the applicable section in the specification, include full technical and mechanical details of the proposed substitution and clearly show the cost increase or decrease in the Tender price resulting from the use of the substitute unit or units.

.19 Proposal lacking full technical documentation of proposed substitute units may be rejected at the discretion of the Owner.

.20 Submit with the Tender price a complete list of all components and their unit prices.

1.3 STANDARDS AND CODES

.1 Components and system to comply with:

.1 Applicable EIA standards

.2 CSA C22.1 1982

.3 Ontario Electrical Safety Code

.4 Ontario Building Code

.2 Bring to the attention of the Engineer any occurrence where this specification disagrees with any of the cited or otherwise applicable codes or standards.

1.4 DESCRIPTION OF SYSTEM

.1 Provide a fully functioning public address system to provide the following services:

.1 Mute override

.2 Live emergency voice paging

.3 Prerecorded announcements

.4 Live general voice paging (direct and/or delayed)

.5 Live general voice paging from telephone interface

.6 Tune and/or program signals or tones

.7 Background music

.8 Individual room sound masking

.2 Provide a multichannel system so that each P.A. zone may operate independent of all others.

.3 Provide an interconnect between the telephone system and the voice paging feature to allow for voice paging from selected telephone extensions. Coordinate with supplier of telephone switching equipment.

.4 Provide a microphone in the two control rooms indicated.

.5 Provide a microphone located on the main processor equipment rack for emergency voice paging.

.6 Provide background music from a AM/FM tuner, CD player or external source switch selectable from equipment rack.

.7 Provide time annunciation interconnected with master clock system and manual time/zone switch to announce time of day signals as programmed on a 6 tone multi-tone signal generator.

.8 Provide a means of automatically adjusting for each zone separately the system output level to compensate for changes in ambient noise level.

.9 Provide secondary equipment racks and equipment in locations shown on the contract drawings. Make connections between equipment in the main equipment rack and equipment in the secondary racks.

.10 Connect speakers and/or horns to the amplifiers located in the secondary or the main equipment rack(s).

.11 Use cone type speakers in all areas designated as office areas. Use horn type speakers in all other areas.

.12 Coordinate with supplier of fire alarm system for control feed to mute P.A. system during fire alarm or fire alert warnings.

.13 Tone generator - pre-announcement tone generator to provide signal prior to announcements.

.14 White noise generator - White noise tone generator to provide individual

.15 Digital voice announcer - system to have a library of pre-recorded announcements which can be selected on demand or signalled by master clock system for broadcast.

1.5 CARE, OPERATION AND START-UP

.1 Provide instruction and demonstrate the use of the system in accordance with General Section

.2 Provide manufacturer's factory trained service engineers to instruct:

.1 Maintenance personnel in maintenance of system

.2 Operating personnel in the use of system

1.6 PRODUCT DATA AND SHOP DRAWINGS

.1 Submit product data and shop drawings in accordance with General Sections

.2 Submit a riser diagram and block diagram of the complete P.A. and sound system to the Engineer for approval prior to commencing installation work.

.3 Submit system design criteria to the Engineer for approval prior to commencing installation work.

.4 Provide functional and wiring diagrams showing all interconnections, within the systems and between this system and other auxiliary systems specified herein.

.5 Include internal and external component layouts including terminal block locations and numbering, cable numbering and equipment identification.

.6 Prior to commencement of any work, supply rack layouts, and a detailed block functional diagram of the cable routing to the Consultant for approval. No work shall be done until the client representative has reviewed the Contractor's shop drawings and approval is given.

.7 The review of the shop drawings by the Owner's Representative does not relieve the Contractor of the responsibility to provide a complete and working system, based on the intent outlined in these documents.

1.7 **MAINTENANCE AND OPERATION DATA**

.1 Provide maintenance manual in accordance with General Sections

.2 Include description of system operation.

.3 Include parts list, using component identification numbers standard to electronics industry.

.4 Include a priced spare parts list noting address, telephone number and contact name of available suppliers.

1.8 **RELATED WORK**

.1 Building wires where indicated to General Sections

.2 Verify that existing conduits and outlet boxes intended for the P.A. system are adequate. Extend conduits to those locations and devices necessary to complete and provide satisfactory system conduits and outlet boxes in accordance with General Sections

.3 Provide conductors and connections for P.A. and sound system.

2 Products

2.1 **ACCEPTABLE SUPPLIERS/INSTALLER**

.1 The following are acceptable suppliers/installers of paging and sound system equipment:

.1 Engineered Sound

.2 Audiospec Inc.

.3 Mancom Communications

2.2 SYSTEM CRITERIA

.1 Public address system to operate on 120 V nominal, 60 Hz input voltage.

.2 Continuous duty cycle.

.3 Modular system design.

.4 Components: solid state, and suitable for 19" rack mounting.

.5 Maximum operating temperature: 65°C.

.6 Maximum rise above ambient: 15°C.

.7 Fan cooling of components.

2.3 EQUIPMENT CABINET

.1 660 mm wide by 762 mm deep cabinet.

.2 Fully equipped with top cover, two side panels, vented rear door, internal cable tray, transparent plexiglass front door kit and 2 internal 482 mm19" fixed mounting shelves.

.3 Include integrated vertical patch cord wire management hardware to organize vertical movement of patch cables.

.4 Provide (10) receptacle filtered and surge suppressed power strip vertically mounted at the back of distribution cabinet. Power strip to be 75% of vertical height of cabinet and complete with 1828 mm6'-0" cord with Hubbell twist-lock plug.

.5 Levelling feet, 2 ground studs, and 2 - 100 cfm fans.

.6 Acceptable manufacturer or approved equivalent:

.1 Cabletalk Systems - Cat. # CTC3-3100-B

.2 Hammond

.7 Provide racks of only one colour. Choice of colour from:

.1 Black

.2 Grey

.3 Match existing

.8 Provide sufficient air flow or cooling to limit air temperature rise above ambient to 15°C with 8000 W full rack loading.

.9 Do not exceed 75% of full rack space. Provide blank panels to fill unused spaces.

.10 Pass cables entering the rack from above or below through conduits sized to limit cable occupancy to 40% or less. Conduits for power cable to be not less than ¾"19

mm. Conduits for signal cable to be not less than 2"50 mm and not greater than 4"100 mm. Run power cables, signal cables and speaker cables through separate conduit systems.

2.4 MONITOR PANEL

.1 Extend existing monitoring system to new amplifiers and equipment when mounting new amplifiers and equipment in existing rack.

.2 Provide monitoring panel for each new rack and equipment or amplifier.

.3 Each monitoring panel to consist of:

.1 Speaker minimum 76 mm diameter with matching transformers required and level control

.2 Monitoring amplifier able to deliver minimum of 1 watt to 8 ohm load

.3 Professional V.U. meter with minimum 50 mm scale

.4 Headphone socket to suit high impedance headphone

.5 Rotary switch to select between each programme source, each amplifier output and each line level input and output

.6 Panel mounted socket switchable between line level input and microphone level input

2.5 MICROPROCESSOR AUDIO CONTROLLER

.1 Provide comprehensive computer programmable and microprocessor audio controller with the following functions and specifications.

.1 Expandable to 125 Paging Consoles

.2 Expandable to 252 independent Output Zones

.3 Expandable for 10 Prerecorded Messages

.4 Expandable to 3 Distinct Background Music Sources

.5 User-programmable Microprocessor using PC & AMSYS Software

.6 Maintain audio all zone paging in failure mode

.7 Programmable Zone assignment

.8 Programmable Paging Priority and Audio input sources

.2 Preferred or representative model of audio controller: AMSYS by Mark IV Audio.

.3 Provide the necessary quantity of card cage units with the following specifications:

.1 16 Audio Buses for Control Cards

.2 Master CPU, system Clock, ROM & RAM and Power Supply

.3 Frequency Response 20 Hz to Khz with >90dB S/N Ration

.4 Distortion of 0.01% at –10 dBv

.5 Occupy 13.34 cm (3 rack units)

.4 Preferred or representative model of card cage: 2591/100/120AMS.

.5 Provide the necessary quantity of 4 channel audio output card with the following features and description:

.1 Zone distribution for any of the four outputs through a matrix configuration

.2 Signal control via the CPU controlled analog switches

.3 Actively balanced with a 600 Ohm minimum impedence

.4 Direct input gain from 0 to +20 dBu

.5 Each channel to possess +20 dB headroom with +4 dBm signal level

.6 Frequency response 20 Hz to 20 KHz with 90 dB dynamic range

.7 Output card with 4 outputs, a direct output and emergency bypass

.8 Input and output connections made via modular connectors

.6 Preferred or representative model of 4 Channel Audio Output Card: 2554A.

.7 Provide the necessary quantity of 4 Channel Audio Input Card with the following features and description.

.1 Allow signal routing of any input to one of four outputs in a matrix configuration.

.2 Signal control via the CPU controlled analog switches

.3 Actively balanced with a 600 ohm minimum impedance

.4 Direct input gain from 0 to +20 dBu

.5 Each channel to possess +20 dB headroom with +4 dBm input signal levels

.6 Frequency response shall be 20 Hz to 20 Khz with 90 dB dynamic range

.7 Output card with 4 outputs, a direct output and emergency bypass

.8 Preferred model of audio import card: 2534.

.9 Provide the necessary quantity of I/O interface module with the following features and specifications:

.1 Provide control and supervision of three message stackers and nine prerecorded message playback units

.2 Switch input sensors using a row-by-column keypad scanning algorithm

.3 Outputs using latched open collector drivers

.4 Output drivers with capacity of up to 400 Ma loads at 50Vdc

.5 Input/output connections using compression type screw terminals

.6 Universal communications between the CPU and devices adhering to IEEE RS-485 standard

.10 Preferred model of I/O interface module: 2622.

.11 Provide the necessary quantity of power supply with the following features and specifications:

.1 Switchable source of power for units operating on 24 Vdc

.2 Employ short-circuit protection and forced air cooling to ensure long term operation and reliability

.3 Rated output current: 12 amps

.4 Residual ripple of less than 100 mV p.p.

.5 Power consumption of at full load: 360 Watts

.6 Rack mountable: 2RU or 8.8 cm

.7 Ambient temperature operation: -5C to +40C

.8 Battery input terminals

.12 Preferred model of Power Supply: DEM-209.

.13 Provide additional blank cover panels to fit unused card slots.

2.6 PAGING CONSOLES

.1 Provide paging consoles for AMSYS system with the following functions and specifications:

.1 Push to talk, eight speed dialing buttons and telephone keypad

.2 Two transformed balanced microphone inputs

.3 An LCD readout to report messages to user

.4 Frequency response: 125 Hz to 20 Khz +/-5 dB with -124 dBm input noise

.5 Nominal input impedance of 600 ohms

.6 Include high quality gooseneck microphone with quiet gooseneck in desk units

.7 Rack mount unit, complete with female XLR to connect handheld microphone (model D91s), occupying 4 R.U. or less

.8 24 Vdc feed from DEM209

.2 Locate paging consoles in areas shown on the contract drawings.

.3 Desk type paging console preferred model 2524-DT-LCD-MIC.

.4 Rack type paging console preferred model 2524-RM-LCD-XLR.

2.7 POWER AMPLIFIERS

.1 Provide power amplifiers to the following specification:

.1 Rack mounted to 19" standard

.2 One or more amplifiers per zone (one amplifier not to serve more than one zone

.3 High efficiency fan cooling complete with dust filter

.4 Solid state

.5 Nominal 70.7 volt output without need for external step-up transformers

.6 Power capacity not to exceed 800 watts per channel continuous rating

.7 Single or dual channel per assembly

.8 Loading not to exceed 65% of rated maximum

.9 Band width 20 Hz to 20 kHz (+0 - 3 dB)

.10 Distortion less than 0.1% THD over bandwidth

.11 Channel separation greater than 90 dB at 1 kHz

.12 Self-restoring output protection circuit

.13 Power saving feature permitting reduced power operation in absence of input signal

.14 Protection circuitry to protect speakers, horns, and amplifiers from effects of EMI, RFI, surge voltages, overloading, d.c. voltages or clipping

.15 Output voltage maximum RMS 92V, peak 130V

.16 Hum and noise less than -105 dBA of rated power

.17 High pass crossover nominally at 250 Hz to protect paging horns from low frequency excursions

.2 Representative amplifier manufacturer and model

.1 Creek CKV series dual channel

.2 Yamaha P2250C

.3 Altec 9444

.4 IBL G260

.5 BGW 7500T

.6 Carrier PM-175

.7 QSC 3500

.8 Bryston 4B

.3 Provide one N-coder handheld programmer for N-cards as required.

.4 Provide report on channel loading with operational manuals.

.5 Install horns using not less than #12 AWG conductor cable.

.6 Install speakers using not less than #16 AWG conductor cable.

.7 Locate amplifiers in equipment racks situated in or near to the zone or zones of speakers to which they are connected or as otherwise shown on the contract drawings.

2.8 TONE SIGNAL GENERATOR

.1 Provide an audio signal and tone generator on a discrete unit or as a functional part of another system component, with the following functional specification:

.1 Solid state modular construction

.2 Digital controls and automatic priority noiseless switching with switching time of 1 msec or less

.3 Control using six discrete and distinct tones within the range of 850 Hz to 1400 Hz

.4 Line level outputs, RCA phono jacks, 600 Ω impedance

.5 Control of tone sequence by programmable controller

.6 Initiation of sequence by manual or automatic input from front panel or external master clock respectively

.7 Output level control to adjust output level from 0 VRMS to 3 VRMS

.2 Tone sequences to be as follows:

.1 Three chimes - 60 Hz - 550 Hz - 440 Hz

.2 500 Hz @ 2 pulses per second

.3 500 Hz @ 8 pulses per second

.4 900 Hz @ 2 pulses per second

.5 900 Hz @ 8 pulses per second

.3 Duration of tones to be individually programmable from 1 to 5 seconds.

2.9 AUDIO SIGNAL PROCESSOR MODULE

.1 Provide an audio signal processor module with the following specification:

.1 Solid state, modular construction, rack mount, 120 VAC

.2 Priority controls using noise less digital switches with switching time of 1 microsecond or less

.3 Line level inputs and outputs, 600 Ω nominal impedance, O dBm nominal input and output level, line level, RCA phone sockets. Auxiliary input jack on front panel

.4 Telephone system interface module to allow voice paging from any non-restricted telephone extension

.5 Signal switching to permit independent operation of up to 16 separate zones plus an "all call" feature

.6 Background music to be enabled/disabled by front panel control switches for each zone independently

.7 Manual control to send any tone signal to any zone output consisting of a minimum of 1 selector switch for each tone source, and each destination zone, a momentary preselect switch and a send switch each with an on-indicator light. Preselection to reset automatically. Duration of tone controlled by tone generator

.2 Representative unit: Epsilon CV9210/EMS.

2.10 AMBIENT NOISE SENSOR

.1 Provide as a minimum one (1) ambient noise sensor per zone, with the following features:

.1 Condenser microphone

.2 D.C. powered amplifier of nominal gain 42 dB

.3 Band width 15 Hz to 18 kHz (+0 - 1 dB)

.4 Output, balanced, line level 600 Ω nominal impedance compatible with input to automatic level controllers

.5 Enclosed in cast aluminum weather resistant enclosure mounted at same height as area speakers or horns by chains or supports with factor of safety of 10

.6 Flexible conduit link between enclosure and conduit enclosing signal cable

.7 Connection to ambient noise sensing controller

.2 Representative unit: Epsilon CV9240/GMC.

2.11 AUTOMATIC LEVEL CONTROLLER

.1 Provide one automatic level controller per zone either as a discrete unit or as a functional part of another unit with the following features:

.1 Rack mounted

.2 Accept inputs from automatic noise sensing controller

.3 Maximum control range 30 dB

.4 Gain expansion adjustable from 0 dB to +20 dB

.5 Microprocessor controlled to compensate for changes in ambient noise level and to adjust overall system gain accordingly

.6 Provide control signal output for connection to variable gain amplifier

.7 Input to accept program signal of line level (+4 dBm), balanced or unbalanced, stereo or mono aural

.8 Automated set up procedure to adjust gain (max and min) sample time, program to noise ratio

.9 Tamper resistant controls plus bypass switch

.2 Representative unit: Protech Ambica 65302

.3 Acceptable manufacturer:

.1 Symetrix

2.12 STEREO PREAMPLIFIER AND MIXER

.1 Provide a stereo preamplifier and mixer as a discrete unit or as a functional part of another unit, with the following features:

.1 Rack mount, 120 VAC

.2 Accept 4 unbalanced stereo line level inputs, RCA phono connections on inputs 1 - 3, screw terminals on input 4

.3 Accept 1 balanced stereo input, switch selectable microphone level/line level, switch selectable

.4 Inputs selectable

.5 Provide 2 independent balanced outputs of line level (+4 dBm) 600 Ω impedance

.6 Frequency response 20 Hz to 20 kHz (+0 - 0.2 dB), THD of less than 0.1%, signal to noise ratio better than 76 dB of +4 dBu output

.7 Input level running range of -10 dBu to +4 dBu for each line level input

.8 Input level trimming range of 0 dB to 40 dB for each microphone level input

.9 Nominal gain of microphone input 60 dB

.10 Microphone gain adjustable from front panel rotary control

.11 Inputs selectable by rotary or push switch

2.13 DIGITAL MESSAGE RECORD/PLAYBACK UNIT

.1 Provide a digital message unit capable of supplying a minimum of 20 distinct messages.

.2 Messages must be capable of being prioritized and of being repeated continuously.

.3 Minimum of 15 minute recording time.

.4 Minimum of 2 hour system operating battery backup.

.5 Representative unit: TOA EV-100R.

2.14 AM/FM TUNER

.1 Provide an AM/FM tuner as a discrete unit or as a functional part of another unit, 120 VAC, rack mounted.

.2 Controls and indicators, on front panel:

.1 AM/FM digital tuning

.2 Power ON/OFF switch

.3 Interchannel mute ON/OFF switch

.4 AM/FM selector switch

.5 Tuning meter for FM/AM

.3 Receptacles on rear of panel:

.1 Audio output jack

.2 AM antenna connection

.3 FM/CATV antenna connection

.4 Acceptable manufacturer or equal:

.1 Inkel PT9107

2.15 ADDITIONAL FEATURES

.1 Leased wire background music source.

2.16 SIGNAL DISTRIBUTION SYSTEM

.1 Provide a signal distribution system based on 70.7V RMS between sound reproducers in positions shown on the contract drawings.

.2 Terminate signal distribution cable in separate cabinet adjacent to the equipment enclosure on barrier strip type terminals where cabinets exist, match new cabinets to existing, otherwise use cabinets to suit areas as follows:

.1 Indoors, utility room, dry, non-corrosive - EEMAC 1.

.2 Indoors, dry, non-corrosive - EEMAC 12.

.3 Indoors, wet, non-corrosive - EEMAC 4.

.4 Outdoors, wet, non-corrosive - EEMAC 4.

.5 Indoors or outdoors, wet or dry, corrosive - EEMAC 4X.

.3 Barrier strip preferred type and manufacturer:

.1 Cinch Jones type 142.

.4 Provide a cable harness between the signal distribution terminals and the amplifier equipment using cables of the same gauge as used for the signal distribution system.

2.17 SOUND REPRODUCERS

.1 Provide horn type loudspeakers of high power capacity with the following features:

.1 High efficiency biaxial horn with minimum 130° x 60° coverage measured @ 2 kHz centre frequency octave band.

.2 Nominal frequency response 350 Hz to 3 kHz.

.3 Maximum low frequency roll off 200 Hz.

.4 Air column approximately 800 mm.

.5 Weatherproof horn, non-resonant construction, moulded structural foam, textured, black.

.6 Mounting bracket with 180° vertical and horizontal range of adjustment. Suitable for steel strap mounting.

.7 Complete with matching driver with built-in 70V matching transformer, and field replaceable diaphragm.

.8 Driver with frequency response of 70 Hz to 12 kHz.

.9 Assembly sensitivity 132 dBA measured at 1.22 m on axis at 60W power input.

.10 Adjustable taps of 2.5, 5, 10, 20, 40 watts.

.11 Maximum power rating 60W RMS, 100W equalized.

.12 Nominal weight of assembly 8 kg.

.13 Nominal size of assembly 530 x 490 x 260 mm.

.14 Nominal size of mounting bracket 100 mm x 150 mm.

.2 Representative units and manufacturers for horn type, high power loudspeakers:

.1 Atlas Sound BIA-100 with PD-10T

.2 Dukan 5A121 with 5A406

.3 Provide weatherproof horn type loudspeakers of medium power capacity with the following features:

.1 High efficiency reentrant horn with minimum 130° x 60° coverage measured @ 2 kHz centre frequency octave band.

.2 Nominal frequency response of 400 Hz to 14 kHz.

.3 Maximum low frequency roll off of 200 Hz.

.4 Weatherproof horn, non resonant construction, moulded ABS plastic and structural aluminum, colour grey.

.5 Mounting bracket with 180° vertical and horizontal range of adjustment. Suitable for box or steel strap mounting.

.6 Complete with 70V matching transformer.

.7 Sensitivity of 116 dBA measured at 1 m on axis at 15W power input.

.8 Adjustable taps of 0.9, 1.8, 3.8, 7.5, 15 watts.

.9 Maximum power rating 15W RMS.

.10 Nominal weight 1.8 kg.

.11 Nominal size of 200 x 220 x 240 mm.

.12 Nominal size of mounting bracket 75 m x 75 m.

.4 Representative unit and manufacturer for horn type, medium power loudspeakers:

.1 Atlas Sound AP-15T

.2 Dukane 5A30

.5 Provide cone type loudspeakers of low power capacity with the following features:

.1 Nominal frequency response 60 Hz to 18 kHz.

.2 Suitable for flush mounting and surface mounting. Flush mounted units complete with metal recessed back box. Nominally 160 mm x 160 mm x 120 mm; of heavy gauge CRS, rust prevention coating and heavy vibration damping undercoat. Surface mounted units complete with surface mount enclosure nominally 180 mm x 180 mm x 120 mm finished white baked enamel, CRS, rust prevention coating and heavy vibration damping undercoat. Provide square metal baffle, finished white baked enamel, nominally 180 mm x 180 mm x 4 mm, CRS material, one-piece construction with speaker mounting studs and gasket.

.3 Complete with 70V matching transformer.

.4 Adjustable taps of 0.5, 1, 2, 4 watts.

.5 Maximum power 10 watts RMS nominal.

.6 Sensitivity of 93 dBA measured at 1.22 m on axis with 1 watt power input.

.7 Nominal size 100 mm diameter.

.6 Representative units and manufacturers of cone type speakers and accessories:

.1 Soundolier

.1 FC104 speaker

.2 HT47 transformer

.3 161-4 baffle

.4 S194-8 enclosure

.5 198-4 back box

2.18 **INTERCOM SYSTEM**

.1 22" touch entry panel with a built in proximity reader and a high definition IP camera wall flush mounted exterior units of corrosion-resistant anodized aluminium

.2 Multiple General Purpose Inputs/Outputs for Door Control.

.3 Multi-language support; French and English allows all text to be translated into other languages equal to Mircom TX3-TOUCH-F15-A

2.19 **INSTALLATION**

.1 Install equipment in accordance with manufacturer's instructions.

.2 Install cable in conduit. Provide conduit necessary to install the system to locations required for satisfactory system operation.

.3 Provide final connection to equipment with wiring installed in flexible conduit, make splices using insulated crimp type sleeves. Make connections to devices having screw terminals with suitable lugs crimped to ends of conductors.

.4 Provide identification for wiring at outlet boxes and at accessible locations.

.5 Make final connections under direct supervision of equipment supplier's engineer.

.6 Use Belden 8451 cable for microphone and line level.

.7 Use #12 gauge cable for loudspeakers in plant and #16 gauge cables for loudspeakers in office areas.

.8 Use wire marker noted in Section 16195, clearly and permanently marked in a numerical fashion at each end. The numbering scheme shall be carried to the wiring diagrams which are part of the as-built drawings.

.9 Care shall be exercised by the Contractor during installation to avoid damage to cables and equipment. Soldered connections shall be made with rosin multi-core solder. Mechanical crimp connectors may be used in loudspeaker wiring only. Wiring shall be executed in strict adherence to professional practice and standards.

.10 Install loudspeakers, amplifiers, etc., with suitable fastenings or supports adequately sized to support their loads with a safety factor of at least 3x. Equipment shall be held firmly in place. This includes cable and wire harnesses. No equipment shall be left sitting loose unless so designated.

.11 Control connectors and custom panels shall be clearly, logically and permanently marked before installation. Suitable means are direct engraving or Brother laminated self-adhesive labels.

.12 Permanently and clearly mark in a descriptive manner all switches, connectors, jacks, receptacles, outlets, terminal blocks and cable terminals if not already required by other parts of this specification.

.13 Take the necessary precautions to prevent and guard against electro-magnetic and electrostatic hum, to supply adequate ventilation and to install equipment so as to provide reasonable safety for the operator.

.14 Exercise care in wiring so as to avoid damage to the cables and to the equipment during and after installation.

.15 Execute wiring in strict adherence to standard NSCA practices. The Contractor shall observe current standards for connecting the shield drain wire of shielded audio cables. Cable shields shall be insulated at their terminated ends with sleeves or heat shrinkable tubing, and shield drain wires shall be protected by a piece of PVC or Teflon tubing from where they exit the jacket of the cable.

.16 Run microphone and line level circuits up to +10 dBm in one conduit. Install loudspeaker circuits (or those above +10 dBm) in separate conduit(s).

.17 Space conduits used for sound reinforcement system away from power conduits by 2 m for circuits less than 10 dBm and 1 m for circuits greater than 10 dBm.

.18 Connect all audio grounds in the equipment rack to a common point on the rack. Connect the rack to a ground point electrically as close as possible to ground.

2.20 **TESTS**

.1 Completely test the system upon completion of the installation. The criteria of this section shall be followed and the results documented.

.2 Identify rattles, buzzes and other noises produced due to improper mounting by connecting a sine wave generator to the sound system and adjusting the output to produce a sound pressure level of 85 dB SPL (average). Slowly sweep a sine wave signal from 300 Hz to 4 kHz to check for resonances and vibrations. Any defects must be corrected.

.3 The gain structure of the completed sound system must be optimized for maximum signal to noise, and minimum distortion. Any residual noise in the completed system shall be of a random nature. The residual noise in the system shall be below audibility when the served area is unoccupied.

.4 Using a one octave bandwidth of pink noise centered at 500 Hz and then 4 kHz, the sound pressure shall be adjusted to a level at least 6 dB above the ambient noise level in the room. Using the pink noise as a source, adjust the system for an average of 90 dB SPL throughout the room. Measure and record reading at ten

locations to verify a deviation throughout the coverage area of no greater than ±2 dB, band limited to 400 to 4 kHz.

.5 Subjective listening tests shall be conducted and shall verify a uniformity of system performance through the room, with clear intelligibility in the spoken word.

.6 Establish and record the normal settings for all level controls on rack and box mounted equipment for optimum signal-to-noise ratios and signal balance.

.7 Perform tests and demonstrate the communication system in accordance with Section 01670.

.8 Verify that all equipment is properly installed and secured in place, ensure that all warning labels, covers, etc. are in place. Verify that all wiring is complete and free of all hazards and unintentional shorts. Ensure that all grounding is complete.

.9 Test all components of the system individually as per suppliers recommendations. Test each individual zone and demonstrate that the features specified are satisfactorily performed. Conduct intelligibility tests and record sound levels obtained. Make adjustments to sound source equipment and properly align and adjust sound signalling appliances for optimum clarity and audibility of messages and music. After each zone is tested and found acceptable conduct an all-call and confirm the same quality of intelligibility is provided to all areas.

.10 Tests shall be conducted while the facility is vacant and repeated when occupied.

.11 In addition allow for testing at 90 days after satisfactory acceptance. At this time any additional adjustment, re-alignment of horns, etc. shall be made at no extra charge.

2.21 **TRAINING**

.1 Provide training to the Owner's personnel. This training shall acquaint Owner with operation of all P.A. equipment located in the Telephone Room as well as equipment located in the Plant. This training shall provide for 2 visits of 1 day each at a time determined by Owner.

END OF SECTION

1 General

1.1 **SUMMARY**

.1 Section includes:

.1 Labour, products, equipment and services necessary to complete all conduit infrastructure to consist of termination boxes, conduits, junction boxes and miscellaneous hardware.

2 Products

2.1 **MATERIALS**

.1 Raceways: Minimum 21mm EMT factory green larger sizes as indicated on drawing.

.2 Each length of conduit to be new and bear the CSA Stamp of Approval. Refer to section 26 05 00 for factory supplied color coding.

.3 Bushings and Connectors:Insulated type, with the insulation an integral part of the fitting.

.4 Conduit Fastening:

One hole malleable iron straps to secure surface conduits. Two hole straps for conduits larger than 50mm (2").

Beam clamps to secure conduits to exposed steel work.

Channel type supports for two or more conduits.

.5 Pull Cord:

Polypropylene cord in empty conduit.

.6 Unless specifically called for on the drawings, do not use flexible conduits but it is recognized that there may be applications where this material will be useful, such as equipment connections, etc. In such cases, obtain permission for its use from the NRC Departmental Representative. For tender purposes, assume that flexible conduits will not be permitted unless specifically called for on the drawings or equipment specifications. All flexible conduits for vapour-tight applications shall be liquid-tight flexible conduits (seal-tight).

2.2 **SYSTEM OPERATION**

.1 Card Access System

.1 Card access system shall consist of conduit infrastructure for access control to specific doors as indicated on drawings and details.

.2 Door Monitoring

.1 Doors with door monitoring switches as indicated on Drawings shall be monitored by the security system in emt conuit.

.2 Secure or free access mode of operation of each door shall be set from the security console.

.3 CCTV System

.1 CCTV system shall consist of 100mm x 100mm outlet box and conduit infrastructure to specific areas as indicated on drawings and details.

3

4 Execution

4.1 **EQUIPMENT INSTALLATION**

.1 Consuit shall be installed to conform with the requirements of the Canadian Electrical Code, Part 1 and applicable Provincial Codes. Wiring shall be sized in accordance with Class 2 requirements, but shall be protected from mechanical injury or other injurious conditions such as moisture, excessive heat or corrosive action in accordance with Class 1 requirements. Conductors shall be by client.

END OF SECTION

Part 1 General

1.1 RELATED WORK SPECIFIED ELSEWHERE

.1 Common Work Results - Electrical Section 26 05 00

1.2 MATERIALS

.1 Provide only new equipment and materials to match existing, without blemish or defect, bearing Canadian Standards Association or Authorized Electrical Inspection Department labels, and subject to the approval of the NRC Departmental Representative.

.2 After a contract is awarded, utilize alternative methods and/or materials only after receiving the NRC Departmental Representative's approval.

1.3 SHOP DRAWINGS AND PRODUCT DATA

.1 Submit shop drawings and product data in accordance with Section 00 10 00.

1.4 SCOPE OF WORK

.1 Supply and install all required material, equipment and labour to provide the fire alarm changes and additions as shown on the drawings and indicated by this section of the specification.

1.5 CONTRACTOR QULIFICATION

.1 The contractor must ensure the supervisor, site foreman and electrician working on site hold valid fire alarm certificate.

1.6 REFERENCES

.1 Government of Canada

.1 TB OSH Chapter 3-03, latest edition, Treasury Board of Canada, Occupational Safety and Health, Chapter 3-03, Standard for Fire protection Electronic Data Processing Equipment.

.2 TB OSH Chapter 3-04, latest edition, Treasury Board of Canada, Occupational Safety and Health, Chapter 3-04, Standard for Fire Alarm Systems.

.2 Treasury Board: Fire Protection Standard effective April 1, 2010

.3 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

.4 Underwriter's Laboratories of Canada (ULC)

.1 CAN/ULC-S524-latest edition, Standard for the Installation of Fire Alarm Systems.

.2 CAN/ULC-S525-latest edition, Audible Signal Device for Fire Alarm Systems.

.3 CAN/ULC-S526-latest edition, Visual Signal Devices for Fire Alarm Systems.

.4 CAN/ULC-S527-latest edition, Control Units.

.5 CAN/ULC-S528-latest edition, Manual Pull Stations for Fire Alarm Systems.

.6 CAN/ULC-S529-latest edition, Smoke Detectors for Fire Alarm Systems.

.7 CAN/ULC-S530-latest edition, Heat Actuated Fire Detectors for Fire Alarm Systems.

.8 CAN/ULC-S531-latest edition, Standard for Smoke Alarms.

.9 CAN/ULC-S536-S537-latest edition, Burglar and Fire Alarm Systems and Components.

.5 National Fire Protection Agency

.1 NFPA 72-latest edition, National Fire Alarm Code.

.2 NFPA 90A-latest edition, Installation of Air Conditioning and Ventilating Systems.

Part 2 Products

2.1 AUTOMATIC ALARM INITIATING DEVICES

.1 Combination Fixed temperature and rate-of-rise addressable thermal fire detector, self-restoring, rated 57°C (135°F) with 9°C (15°F) rate-of-rise and having one normally open contact rated for 3.0 A @ 120VAC and 1.0 A @ 24VDC, to match existing Edwards system.

.2 Photoelectric addressable smoke detector, field adjustable, non-polarized, visual indication of alarm, sensitivity test switch and rated for 24VDC. to match existing Edwards system.

2.2 MANUAL ALARM STATIONS

.1 Pull lever, breakglass, wall mounted, addressable, red, bilingual and having one normally open contact rated for 30VDC, 3.0 A where indicated, to match existing Edwards system.

2.3 AUDIBLE, VISUAL DEVICES

.1 Fire bell DC polarized vibrating type, 150 mm (6") size, red and rated for 24VDC, 0.15 A, 92db at 3 m (10'). Edwards, to match existing system.

.2 Visual Device:

.1 Fire alarm strobe only, red in colour.
.2 Adjustable cd output of 15, 20, 75 & 110.
.3 Red with red trim ring.
.4 Include Synchronization module to synchronize strobes.
.5 Standard of acceptance: Chubb Edwards G1R-VM to match existing system.

2.4 CONDUIT AND WIRING

.1 Raceway to be 21mm factory painted EMT unless indicated otherwise on the drawings. Wiring between junction box on underside of slab and heat detector junction box in T-bar ceiling to be 21mm flexible conduit.

.2 All wiring is to be FAS 105 and is to be of stranded copper.

.3 Zone wiring is to be #16 TEW colour coded stranded copper.

.4 Signal wiring to be sized to take into account voltage drop and is not to be smaller than #12 TW colour coded stranded copper.

.5 Provide factory painted red conduits of fire alarm system. Provide painted red covers for junction boxes and pull boxes.

Part 3 Execution

3.1 MOUNTING OF EQUIPMENT

.1 Recess mount equipment in all areas except where specified in unfinished areas.

.1 Fire alarm stations 1.2m (3'-11") to centreline.
.2 Fire alarm bells 2.1m (7'-0") to centreline.

.2 Mounting heights from floor level to centerline of equipment are as follows:

.1 Fire alarm stations 1.2m (3'-11") to centreline.
.2 Fire alarm bells, horns, strobes 2.1m (7'-0") to centreline.

3.2 CONDUIT AND WIRING

.1 All fire alarm initiating device circuits wiring to be class "A" using #18 minimum FAS-105 red jacketed twisted shielded pairs cable, and in accordance with manufacturer’s requirements. Run each pair of wire in separate conduit to make it true class ‘A’.

.2 All fire alarm signal circuits wiring to be R90/ T90 #16 minimum, and in accordance with manufacturer’s requirements.

.3 All signal circuit wiring to be class "A" using 4#16 TW (or larger) colour coded stranded copper wires. Where series 6 VAC series bells are used, two #12 TW

colour coded stranded copper wires are to be used and the bells are to be connected in series.

.4 All conduit to include a #16 TW stranded copper green ground wire.

.5 Use only uninsulated ring-type STA-KON lugs on screw connections.

.6 Run conduit tight along underside of ceiling slab or roof deck, unless noted otherwise on drawings.

.7 In rooms having false ceilings, each fire detection device is to have one junction box secured to the underside of the ceiling slab or roof deck and another firmly supported to the false ceiling tile. The junction box connected to the fire alarm device is not to be used as a raceway for connection to other devices. All splices and routing to other fire alarm devices is to be from the junction box mounted on the underside of the ceiling slab or roof deck.

.8 Use Tee bar electrical box hangers (Caddy #51224 for 610mm T-bar spacing) to mount heat detectors on T-bar ceiling tiles.

.9 Install a maximum of 1.5 m (5'-0") 3/4" (21mm) flexible conduit where a heat detector is installed on T-bar ceiling tiles. This is to allow the ceiling tile, having the device, to be shifted two feet either direction for access above the ceiling.

.10 Leave 6 inch loops of wire in all junction boxes.

.11 For new installations, no splicing of wires is to be made.

.12 For renovations, splices may be made in junction boxes other than those at heat detectors after receiving approval of the NRC Departmental Representative. All splices must be soldered and taped.

.13 Upon awarding of the contract, the NRC Departmental Representative shall provide the contractor with the standard wiring diagram for detection devices, A-7481.

.14 Prior to installing raceways, submit to the NRC Departmental Representative a proposed method and layout of conduit for approval.

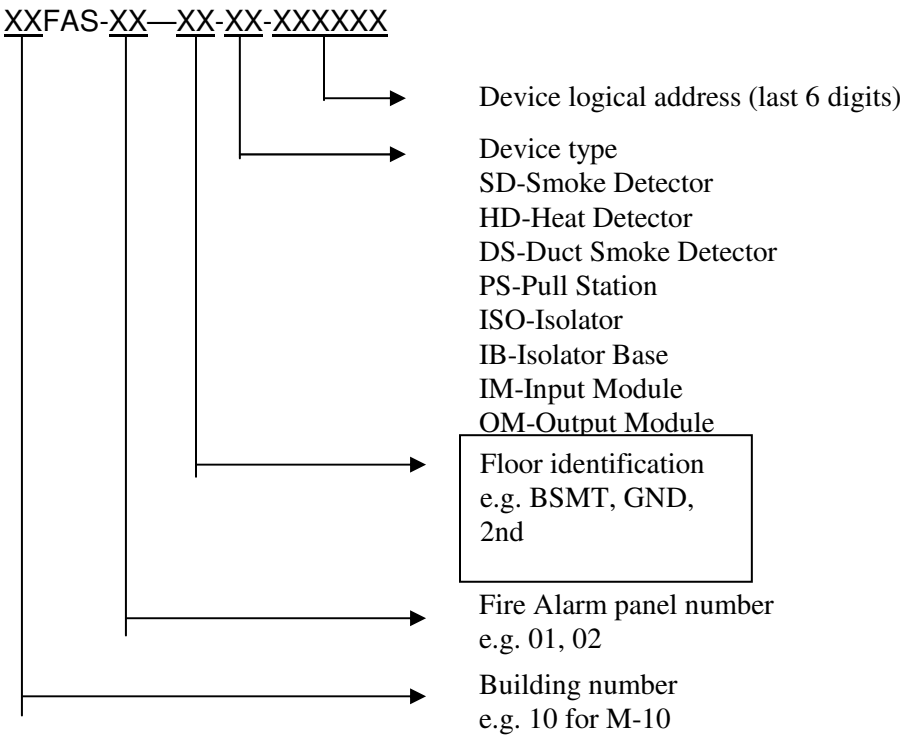
3.3 EQUIPMENT IDENTIFICATION

.1 Label each manual alarm station and each audible signal device with its unique identification number as per drawings. Use lamicoid nameplates as per Section 26 05 00.

.2 Label each initiating device use P-Touch type as per Section 26 05 00. Devices are to be numbered per the format shown below.

Example M-10 fire alarm #1 Heat detector 000001

10FAS-01-GND-HD-000001



.3 Apply red paint to the covers of junction boxes of fire alarm conduit.

.4 Label wires as per drawing and as per Section. 26 05 00.

.5 Update remote annunciator panels and fire alarm panel zone directories if new zones are added to the system.

3.4 SCHEDULING OF SHUTDOWNS

.1 Make written shutdown request to the NRC Departmental Representative at least 48 hours in advance. Acceptance of shutdown request will be determined by the NRC Departmental Representative based on building user needs. Fire alarm systems are to be shut down by NRC staff only. **Contractor is not to shutdown system on their own.**

3.5 INTEGRATION INTO SYSTEM MONITORING AT BUILDING M-1

Presently all NRC buildings in Ottawa report back their fire alarm status to the M1 building central monitoring station. The monitoring station consists of a computer

graphics terminal showing building layouts of each building, and is linked on an internal NRC network. The new fire alarm system under this contract must communicate all addressable input points to the existing computer graphics monitoring station, Fireworks by Chubb Edwards. All required modifications to the existing Fireworks station are to be included in this tender.

.1 Addressable devices:

.1 Integrate any new addressable devices installed as part of this project into the monitoring system at building M-1.

.2 Remove from the monitoring system at building M-1 any addressable devices removed as part of this project.

.3 Make appropriate changes to the monitoring system at building M-1 to reflect any relocated addressable devices.

.4 All work on the monitoring system at building M-1 is to be done by factory trained technician.

.2 Conventional (non-addressable) devices:

.1 Integrate any new zones installed as part of this project into the monitoring system at building M-1. This is to be done by factory trained technician.

.2 Remove from the monitoring system at building M-1 any zones removed as part of this project.

.3 Make appropriate changes to the monitoring system at building M-1 to reflect any zone location changes as appropriate.

.4 All work on the monitoring system at building M-1 is to be done by factory trained technician.

3.6 ACCEPTANCE TEST

.1 Perform tests in accordance with the latest regulations and in the presence of the NRC Departmental Representative and the representative of the regulating authority.

.2 Test each device and alarm circuit to ensure manual alarm stations, thermal and smoke detectors transmit alarms to control panel and actuate alarm.

.3 Check annunciator panels to ensure that the correct zones are activated.

.4 Simulate grounds and breaks on alarm and signalling circuits to ensure proper operation of trouble signals.

.5 Record amperage drawn by audible signal device circuits if new audible signal devices have been added to the circuit.

.6 Give the NRC Departmental Representative one set of marked in red prints labelled "As Built".

.7 Provide the NRC Departmental Representative with a letter of verification from the manufacturer of the equipment stating that the equipment supplied under this

contract has been installed as per the latest CAN/ULC S537 and CAN/ULC-S524 standards and as per the latest edition of the Ontario Building Code.

.8 For new fire alarm systems provide the NRC Departmental Representative with a certificate of verification stating that the equipment has been installed as per the latest CAN/ULC-S537 and CAN/ULC-S524 standards and as per the latest edition of the National Building Code.

END OF SECTION

PART - 1 GENERAL

1.1 SUMMARY

.1 This Section specifies fill materials, excavation, backfilling, and grading.

1.2 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CSA-A23.1/A23.2-04, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.

.2 The designation OPSS refers to Ontario Provincial Standard Specifications.

1.3 TESTS AND INSPECTIONS

.1 Do not begin backfilling or filling operations until material has been approved for use by NRC Representative.

.2 Not later than 48 hours before backfilling or filling with approved material, notify the NRC Representative so that compaction tests can be carried out by designated testing agency.

1.4 BURIED SERVICES

.1 Before commencing work verify the location of all buried services on and adjacent to the site.

.2 Arrange with appropriate authority for relocation of buried services that interfere with execution of work.

1.5 PROTECTION

.1 Protect excavations from freezing.

.2 Keep excavations clean, free of standing water, and loose soil.

.3 Protect buried services that are required to remain undisturbed.

PART – 2 PRODUCTS

2.1 MATERIALS

.1 Granular A, B Type II, Select Subgrade to OPSS.MUNI 1010.

PART – 3 EXECUTION

3.1 SITE PREPARATION

.1 Remove obstructions, ice and snow, from surfaces to be excavated within limits indicated.

.2 Cut pavement or sidewalk neatly along limits of proposed excavation in order that surface may break evenly and cleanly.

3.3 EXCAVATION

.1 Topsoil stripping:

.1 Do not handle topsoil while in wet or frozen condition or in any manner in which soil structure is adversely affected.

.2 Strip topsoil to full depth or as directed by NRC Representative.

.3 Dispose of topsoil off site.

.2 Excavate trenches to provide uniform continuous bearing and support for 150 mm thickness of pipe bedding material on solid and undisturbed ground. Trench widths below point 150 mm above pipe not to exceed diameter of pipe plus 600 mm.

.3 Excavate for slabs and paving to subgrade levels. In addition, remove all topsoil, organic matter, debris and other loose and harmful matter encountered at subgrade level.

3.4 BACKFILLING

.1 Inspection: do not commence backfilling until fill material and spaces to be filled have been inspected and approved by NRC Representative.

.2 Remove snow, ice, construction debris, organic soil and standing water from spaces to be filled.

.3 Lateral support: maintain even levels of backfill around structures as work progresses, to equalize earth pressures.

.4 Compaction of subgrade: compact existing subgrade under walks, paving, and slabs on grade, to same compaction as specified for fill. Fill excavated areas with selected subgrade material compacted as specified for fill.

.5 Placing:

.1 Place backfill, fill and base course material in 150 mm lifts. Add water as required to achieve specified density.

.2 Up to 300 mm above pipe or conduit: sand placed by hand.

.3 Over 300 mm above pipe or conduit native material approved by NRC Representative.

.6 Under seeded and sodded areas: use site excavated material to bottom of topsoil except in trenches and within 600 mm of foundations.

.7 Blown rock material, not capable of fine grading, is not acceptable, imported material must be placed on this type of material.

.8 Against foundations (except as applicable to trenches and under slabs and paving): excavated material or imported material with no stones larger than 200 mm diameter within 600 mm of structures.

3.5 GRADING

.1 Grade so that water will drain away from buildings, walls and paved areas, to catch basins and other disposal areas approved by NRC Representative. Grade to be gradual between finished spot elevations shown on drawings.

3.6 SHORTAGE AND SURPLUS

.1 Supply all necessary fill to meet backfilling and grading requirements and with minimum and maximum rough grade variance.

.2 Dispose of surplus material off site.

3.7 MEASUREMENT PROCEDURES

.1 Payment for the Work under this Section shall be deemed included in the Contract Lump Sum Bid Price, no separate payment will be made for Labour, Equipment, or Materials, and all work associated with this Section.

END OF SECTION

PART – 1 GENERAL

.1 This section specifies requirements for supplying, producing and placing gravel or quarried stone as a granular sub-base to lines, grades and typical cross sections indicated on plans or as directed by NRC Representative.

1.2 REFERENCES

.1 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-8.1-88, Sieves, Testing, Woven Wire, Inch Series.

.2 CAN/CGSB-8.2-M88, Sieves, Testing, Woven Wire, Metric.

1.3 MEASUREMENT AND PAYMENT

.1 Payment for the Work under this Section shall be **deemed included in the Contract Lump Sum Bid Price**, no separate payment will be made for Labour, Equipment, or Materials, and all work associated with this Section.

1.4 MATERIALS

.1 Gradations to be within limits specified in OPSS.MUNI 1010 Granular B Type II

PART – 2 EXECUTION

2.1 PLACING

.1 Place granular sub-base after subgrade is inspected and approved by NRC Representative.

.2 Construct granular sub-base to depth and grade in areas indicated.

.3 Ensure no frozen material is placed.

.4 Place material only on clean unfrozen surface, free from snow or ice.

.5 Place granular sub-base materials using methods which do not lead to segregation or degradation.

.6 Place material to full width in uniform layers not exceeding 150 mm compacted thickness

.7 Shape each layer to smooth contour and compact to specified density before succeeding layer is placed.

.8 Remove and replace portion of layer in which material has become segregated during spreading.

2.2 COMPACTION

.1 Without taking any section of this provision to the contrary, OPSS.MUNI 501 shall apply.

.2 Shape and roll alternately to obtain smooth, even and uniformly compacted sub-base.

.3 Apply water as necessary during compaction to obtain specified density.

.4 In areas not accessible to rolling equipment, compact to specified density with mechanical tampers approved by NRC Representative.

.5 Correct surface irregularities by loosening and adding or removing material until surface is within specified tolerance.

2.3 PROOF ROLLING

.1 For proof rolling use self- propelled, vibratory Single Pad foot Drum roller of 6000 kg gross mass Obtain approval from NRC Representative to use non- standard proof rolling equipment.

.2 Proof roll at level in sub-base as indicated.

.3 Make sufficient passes with proof roller to subject every point on surface to three separate passes of loaded tire.

.4 Where proof rolling reveals areas of defective subgrade:

.1 Remove sub-base and subgrade material to depth and extent as directed by NRC Representative.

.2 Backfill excavated subgrade with sub-base material and compact in accordance with this section.

.3 Replace sub-base material and compact.

.5 Where proof rolling reveals areas of defective sub-base, remove and replace in accordance with this section at no extra cost.

2.4 SITE TOLERANCES

.1 Finished sub-base surface shall not deviate more than 15 mm at any place as measured in any direction with a 3 m straight edge

2.5 PROTECTION

.1 Maintain finished sub-base in condition conforming to this section until succeeding base is constructed, or until granular sub-base is accepted by NRC Representative.

END OF SECTION

1 GENERAL

This section specifies requirements for scarifying and reshaping of existing granular roadbed with addition of new granular base material where required to lines and grades as indicated on the construction drawings or as directed by NRC Representative.

1.1 MEASUREMENT PROCEDURES

Payment for the work under this Section shall be **deemed included in the Contract Lump Sum Bid Price.** No separate payment will be made for Labour, Equipment, Materials and all work associated with this Section.

2 PRODUCTS

2.1 MATERIALS

Granular base material shall meet the requirements of OPSS.MUNI 1010 for Granular A.

3 EXECUTION

3.1 SEQUENCE OF OPERATIONS

.1 Remove existing boulders, pillars, wood fencing, concrete walks and asphalt surfaces to the limits shown on the drawings.

.2 Scarifying and reshaping: Scarify roadbed to width as indicated unless directed otherwise by Consultant.

- .1 Blade and trim pulverized material to the elevation specified on the construction drawings.
- .2 Where deficiency of material exists, add and blend in new granular base material as directed by Consultant. Ensure no frozen material is used.

.3 Compaction equipment: Compaction equipment capable of obtaining required material densities.

.4 Compacting: Compact to minimum 95% corrected maximum dry density.

- .1 Apply water as necessary during compaction to obtain specified density.
- .2 Use mechanical tampers approved by NRC Representative to compact areas not accessible to rolling equipment to specified density.

.5 Repair of soft areas:

- .1 Correct soft areas by removing defective material to depth and extent directed by NRC Representative. Replace with material acceptable to NRC Representative and compact to specified density.
- .2 Maintain reshaped surface in condition conforming to this section until succeeding material is applied or until acceptance by NRC Representative.

3.2 **SITE TOLERANCE**

Reshaped compacted surface within plus or minus 10 mm of elevation as indicated

END OF SECTION

PART – 1 GENERAL

This section specifies requirements for supplying, producing and placing crushed gravel or quarried stone as a granular base to lines, and grades indicated, or as directed by NRC Representative.

1.1 MEASUREMENT AND PAYMENT

.1 Payment for the Work under this Section shall be **deemed included in the Contract Lump Sum Bid Price**, no separate payment will be made for Labour, Equipment, or Materials, and all work associated with this Section.

PART – 2 PRODUCTS

2.1 MATERIALS

.1 Gradations to be within limits specified in OPSS.MUNI 1010 for Granular A

PART – 3 EXECUTION

3.1 SEQUENCE OF OPERATION

.1 Place granular base after sub-base surface is inspected and approved by NRC Representative.

.2 Placing

.1 Construct granular base to depth and grade in areas indicated.

.2 Ensure no frozen material is placed.

.3 Place material only on clean unfrozen surface, free from snow and ice.

.4 Place material using methods which do not lead to segregation or degradation of aggregate.

.5 Place material to full width in uniform layers not exceeding 150 mm compacted thickness.

.6 Shape each layer to smooth contour and compact to the specified density before succeeding layer is placed.

.7 Remove and replace that portion of layer in which material becomes segregated during spreading.

.3 Compaction Equipment

.1 Compaction equipment to be capable of obtaining required material densities.

.4 Compacting

.1 Compact to density not less than 100% corrected maximum dry density.

.2 Shape and roll alternately to obtain smooth, even and uniformly compacted base.

.3 Apply water as necessary during compacting to obtain specified density.

.4 In areas not accessible to rolling equipment, compact to specified density with mechanical tampers approved by NRC Representative.

.5 Correct surface irregularities by loosening and adding or removing material until surface is within specified tolerance.

3.2 SITE TOLERANCES

.1 Finished base surface shall not deviate more than 15 mm at any place as measured in any direction with a 3 m straight edge

3.3 PROTECTION

.1 Maintain finished base in condition conforming to this Section until succeeding material is applied or until acceptance by NRC Representative.

END OF SECTION

PART 1 GENERAL

1.1 SCOPE OF WORK

.1 This section covers the asphalt pavement surfaces on the proposed lane, loading dock ramp and other disturbed asphalt pavement areas.

1.2 SAMPLES – ASPHALT MIX DESIGN

.1 Submit Asphalt Mix Design to Contract Administrator for review, at least **two weeks** before proposed paving work.

.2 Pavement Lifts:

.1 Performance Graded Superpave 19mm (BASE COURSE ASPHALT) - 40mm LIFT.
.2 Performance Graded Superpave 19mm (BASE COURSE ASPHALT) – 40mm LIFT.
.3 Performance Graded Superpave 12.5mm (SURFACE COURSE ASPHALT) – 40mm LIFT

1.3 REFERENCE

.1 OPSS 310 Construction Specification for Hot Mix Asphalt

1.4 DEFINITIONS

.1 OPSS: means Ontario Provincial Standard Specification

PART 2 PRODUCTS

2.1 MATERIALS

.1 Asphalt Cement to conform to OPSS 1150

.2 Anionic emulsified asphalt (Tack Coat) shall consist of SS-1 emulsified asphalt diluted with an equal amount of water. The undiluted material shall be according to OPSS 1103.

PART 3 EXECUTION

3.1 PAVEMENT CONSTRUCTION

.1 Construction of asphalt concrete: OPSS 310.07.

3.2 MEASUREMENT FOR PAYMENT AND BASIS OF PAYMENT

.1 Payment for the Asphaltic Concrete Paving shall be **deemed to be included in the Contract Lump Sum Bid Price** and no separate payment will be made for tack coating. All labour, Equipment, and Materials to do the work shall be deemed to be included in the Contract Lump Sum Bid Price.

END OF SECTION

PART - 1 GENERAL

This Section specifies requirements for Constructing concrete walks, curbs and gutters to lines and grades as specified on the construction drawings or as directed by the construction supervisor.

1.1 RELATED REQUIREMENTS

Ontario provincial Standard Specification OPSS 351 and OPSS 353

1.2 REFERENCES

Canadian General Standards Board (CGSB)

CAN/CGSB-3.3-[99(March 2004)], Kerosene, Amend. No. 1, National Standard of Canada.

CAN/CGSB-8.1-[88], Sieves, Testing, Woven Wire, Inch Series. Canadian Standards Association (CSA International)

CSA-A23.1-[04]/A23.2-[04], Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.

1.3 MEASUREMENT PROCEDURES

Payment for the Work under this Section shall be **deemed included in the Contract Lump Sum Bid Price**, no separate payment will be made for Labour, Equipment, or Materials, and all work associated with this Section.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

The contractor shall submit the proposed source of materials with the concrete mix design for the specified concrete at least 2 weeks prior to commencing work.

PART – 2 PRODUCTS

2.1 MATERIALS

Concrete mixes and materials: in accordance with Ontario provincial Standard Specification OPSS 351 and 353

PART – 3 EXECUTION

The construction of the concrete curb and sidewalks shall be in accordance with the Ontario provincial Standard Specification OPSS 351 and OPSS 353

3.1 GRANULAR BASE

Obtain NRC Representative's approval of subgrade before placing granular base.

Place granular base material to lines, widths, and depths as indicated.

Compact granular base in maximum 150 mm layers to at least 95% of maximum dry density.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 ASTM International

.1 ASTM C1372, Segmental Retaining wall Units

.2 CSA International

.1 CAN/CSA-A23.1-14/A23.2-14, Concrete Materials and Methods of Concrete Construction / Test Methods and Standard Practices for Concrete

.3 Ontario Provincial Standard Specifications

.1 OPSS 1860, Material Specification for Geotextiles

.4 Health Canada / Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

1.2 ACTION AND INFORMATION SUBMITTALS

.1 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for concrete wall units and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Submit 2 copies of WHMIS MSDS for all products supplied for the construction of the retaining wall.

.2 Shop Drawings:

.1 Submit shop / installation drawings for the actual retaining wall being supplied including layout of units, unit sizes, unit texture, typical sections, tiebacks / reinforcement if required, material grades etc. The design of the wall shall be performed by a qualified professional engineer on behalf of the contractor and / or manufacturer. The design drawing shall be signed and sealed by the design engineer.

.2 Submit samples for review and acceptance for typical wall units (showing texture and colour).

1.3 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance 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 products from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

.4 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials.

Part 2 Products

2.1 PRE-CAST CONCRETE WALL UNITS

.1 Standard concrete block units:

.1 Individual unit sizes: as indicated on the contract drawings.

.2 Special shapes: provide shapes as required by the manufacturer to complete the wall as indicated on the contract drawings (per the requirements of the individual manufacturer's wall system).

.3 Class of concrete: exposure Class F-1

.4 Service life for wall: 50 years

2.2 REINFORCEMENT

.1 The wall depicted on the contract drawings is a gravity wall. Should a specific manufacturer require his wall system to be tied back to comply with the requirements of the contract drawings, the type and grade of reinforcement shall be clearly stated and these materials shall follow the most recent CSA, ASTM and / or OPSS standards as applicable. The reinforcement shall conform to the same durability requirements as the wall units (50 years).

2.3 GEOTEXTILE

.1 Geotextile shall conform to OPSS 1860.

Part 3 Execution

3.1 EXAMINATION

.1 Verification of conditions: verify that conditions of work areas and foundations are acceptable for product installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate in presence of NRC Departmental Representative.

.2 Inform NRC 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 NRC Departmental Representative.

.2 Geotechnical conditions: The wall is expected to be installed on sound bedrock or engineered granular backfill, however the exact foundation conditions for the wall at the ramp are unknown. The contractor / wall designer will be responsible for verifying the existing foundation conditions (after excavation for the ramp) and ensuring that the capacities required for the installation of the wall are satisfactory.

3.2 INSTALLATION

.1 Install the wall as indicated on the contract drawings and as follows:

.1 Bond: running stretcher bond with vertical joints in perpendicular alignment and centred on adjacent stretchers above and below.

.2 Layout coursing and bond to achieve correct coursing heights.

.3 Step wall as required to suit ramp slope and maintain minimum embedment depths shown on the contract drawings.

.4 Batter wall as indicated on the contract drawings.

.5 Each individual block placed shall be pushed forward to engage shear keys prior to backfilling.

3.3 EXCAVATION, BACKFILLING, PAVING AND SODDING

.1 Perform all excavation, backfilling, compaction, paving, sodding and site restoration (of all areas affected by the construction of the retaining wall) as indicated on the contract drawings and elsewhere in the specifications.

3.4 STEEL BEAM GUIDERAIL AND PEDESTRIAN GUARDRAIL

.1 Install steel beam guiderail and pedestrian guardrail as indicated elsewhere in the contract documents.

3.5 FIELD QUALITY CONTROL

.1 Inspection and testing will be carried out by Testing Laboratory designated by NRC Departmental Representative and paid by Contractor.

3.6 CLEANING

.1 Progress Cleaning:

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.

3.7 PROTECTION

.1 Protect concrete units and other work from marking and other damage. Use non-staining coverings.

.2 Repair damage to adjacent materials caused by the installation of the wall.

END OF SECTION

1 GENERAL

This specification covers the requirements for stockpiling, supplying, and placing topsoil.

1.1 RELATED REQUIREMENTS

.1 Ontario Provincial Standard Specification (OPSS) 802.

1.2 BASIS OF PAYMENT

Payment for the work under this Section shall be **deemed included in the Contract Lump Sum Bid Price.** No separate payment will be made for Labour, Equipment, Materials and all work associated with this Section.

END OF SECTION

1 GENERAL

This specification covers the requirements for sodding.

1.1 RELATED REQUIREMENTS

.1 Ontario Provincial Standard Specification (OPSS) 803.

1.2 BASIS OF PAYMENT

Payment for the work under this Section shall be **deemed included in the Contract Lump Sum Bid Price.** No separate payment will be made for Labour, Equipment, Materials and all work associated with this Section.

END OF SECTION

PART – 1 GENERAL

This Section specifies requirements for supplying and installing storm sewer with bedding material.

1.1 RELATED REQUIREMENTS

.1 Ontario Provincial Standard Specifications (OPSS) 407, 409, 410

.2 The supply and installation of manholes and catchbasins shall be conform to the requirements of OPSS 407.

.3 The supply and installation of the storm sewers shall be conform to the requirements of OPSS 410.

.4 The Close Circuit Television Inspection shall conform to OPSS 409.

1.2 MEASUREMENT PROCEDURES

.1 Payment for the Work under this Section shall be **deemed included in the Contract Lump Sum Bid Price**, no separate payment will be made for Labour, Equipment, or Materials, and all work associated with this Section.

1.3 REFERENCES

1.4 DEFINITIONS

1.5 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit manufacturer's test data and certification at least 2 weeks prior to beginning Work.

.2 Certification to be marked on pipe.

.3 Submit to Consultant a copy of manufacturer's installation instructions.

PART – 2 PRODUCTS

.1 The storm sewer and manholes shall conform to OPSS 410 and OPSS 407

PART – 3 EXECUTION

3.1 FIELD TESTING

.1 Upon completion of installation of the sanitary sewer a CCTV inspection shall be done per the requirements of OPSS 409.

END OF SECTION

TP1 Amount Payable – General

1.1 Subject to any other provisions of the contract, Her Majesty shall pay the Contractor, at the times and in the manner hereinafter set out, the amount by which

1.1.1 the aggregate of the amounts described in TP2 exceeds

1.1.2 the aggregate of the amounts described in TP3

and the Contractor shall accept that amount as payment in full satisfaction for everything furnished and done by him in respect of the work to which the payment relates.

TP2 Amounts Payable to the Contractor

2.1 The amounts referred to in TP1.1.1 are the aggregate of

2.1.1 the amounts referred to in the Articles of Agreement, and

2.1.2 the amounts, if any, that are payable to the Contractor pursuant to the General Conditions.

TP3 Amounts Payable to Her Majesty

3.1 The amounts referred to in TP1.1.2 are the aggregate of the amounts, in any, that the Contractor is liable to pay Her Majesty pursuant to the contract.

3.2 When making any payments to the Contractor, the failure of Her Majesty to deduct an amount referred to in TP3.1 from an amount referred to in TP2 shall not be constitute a waiver of the right to do so, or an admission of lack of entitlement to do so in any subsequent payment to the Contractor.

TP4 Time of Payment

4.1 In these Terms of Payment

4.1.1 The "payment period" means a period of 30 consecutive days or such other longer period as is agreed between the Contractor and the Departmental Representative.

4.1.2 An amount is "due and payable" when it is due and payable by Her Majesty to the Contractor according to TP4.4, TP4.7 or TP4.10.

4.1.3 An amount is overdue when it is unpaid on the first day following the day upon which it is due and payable.

4.1.4 The "date of payment" means the date of the negotiable instrument of an amount due and payable by the Receiver General for Canada and given for payment.

4.1.5 The "Bank Rate" means the discount rate of interest set by the Bank of Canada in effect at the opening of business on the date of payment.

4.2 The Contractor shall, on the expiration of a payment period, deliver to the Departmental Representative in respect of that payment period a written progress claim that fully describes any part of the work that has been completed, and any material that was delivered to the work site but not incorporated into the work during that payment period.

4.3 The Departmental Representative shall, not later than ten days after receipt by him of a progress claim referred to in TP4.2,

4.3.1 inspect the part of the work and the material described in the progress claim; and

4.3.2 issue a progress report, a copy of which the Departmental Representative will give to the Contractor, that indicates the value of the part of the work and the material described in the progress claim that, in the opinion of the Departmental Representative,

4.3.2.1 is in accordance with the contract, and

4.3.2.2 was not included in any other progress report relating to the contract.

4.4 Subject to TP1 and TP4.5 Her Majesty shall, not later than 30 days after receipt by the Departmental Representative of a progress claim referred to in TP4.2, pay the Contractor

4.4.1 an amount that is equal to 95% of the value that is indicated in the progress report referred to in TP4.3.2 if a labour and material payment bond has been furnished by the Contractor, or

4.4.2 an amount that is equal to 90% of the value that is indicated in the progress report referred to in TP4.3.2 if a labour and material payment bond has not been furnished by the Contractor.

4.5 It is a condition precedent to Her Majesty's obligation under TP4.4 that the Contractor has made and delivered to the Departmental Representative,

4.5.1 a statutory declaration described in TP4.6 in respect of a progress claim referred to in TP4.2,

4.5.2 in the case of the Contractor's first progress claim, a construction schedule in accordance with the relevant sections of the Specifications, and

4.5.3 if the requirement for a schedule is specified, an update of the said schedule at the times identified in the relevant sections of the Specifications.

4.6 A statutory declaration referred to in TP4.5 shall contain a deposition by the Contractor that

4.6.1 up to the date of the Contractor's progress claim, the Contractor has complied with all his lawful obligations with respect to the Labour Conditions; and

4.6.2 up to the date of the Contractor's immediately preceding progress claim, all lawful obligations of the Contractor to subcontractors and suppliers of material in respect of the

work under the contract have been fully discharged.

4.7 Subject to TP1 and TP4.8, Her Majesty shall, not later than 30 days after the date of issue of an Interim Certificate of Completion referred to in GC44.2, pay the Contractor the amount referred to in TP1 less the aggregate of

4.7.1 the sum of all payments that were made pursuant to TP4.4;

4.7.2 an amount that is equal to the Departmental Representative's estimate of the cost to Her Majesty or rectifying defects described in the Interim Certificate of Completion; and

4.7.3 an amount that is equal to the Departmental Representative's estimate of the cost to Her Majesty of completing the parts of the work described in the Interim Certificate of Completion other than the defects referred to in TP4.7.2.

4.8 It is a condition precedent to Her Majesty's obligation under TP4.7 that the Contractor has made and delivered to the Departmental Representative,

4.8.1 a statutory declaration described in TP4.9 in respect of an Interim Certificate of Completion referred to in GC44.2, and

4.8.2 if so specified in the relevant sections of the Specifications, and update of the construction schedule referred to in TP4.5.2 and the updated schedule shall, in addition to the specified requirements, clearly show a detailed timetable that is acceptable to the Departmental Representative for the completion of any unfinished work and the correction of all defects.

4.9 A statutory declaration referred to in TP4.8 shall contain a deposition by the contractor that up to the date of the Interim Certificate of Completion the Contractor has

4.9.1 complied with all of the Contractor's lawful obligations with respect to the Labour Conditions;

4.9.2 discharged all of the Contractor's lawful obligations to the subcontractors and suppliers of material in respect of the work under the contract; and

4.9.3 discharged the Contractor's lawful obligations referred to in GC14.6.

4.10 Subject to TP1 and TP4.11, Her Majesty shall, not later than 60 days after the date of issue of a Final Certificate of Completion referred to in GC44.1, pay the Contractor the amount referred to in TP1 less the aggregate of

4.10.1 the sum of all payments that were made pursuant to TP4.4; and

4.10.2 the sum of all payments that were made pursuant to TP4.7.

4.11 It is a condition precedent to Her Majesty's obligation under TP4.10 that the Contractor has made and delivered a statutory declaration described in TP4.12 to the Departmental Representative.

4.12 A statutory declaration referred to in TP4.11 shall, in addition to the depositions described in TP4.9, contain a deposition by the Contractor that all of the Contractor's lawful obligations and any lawful claims against the Contractor that arose out of the performance of the contract have been discharged and satisfied.

TP5 Progress Report and Payment Thereunder Not Binding on Her Majesty

5.1 Neither a progress report referred to in TP4.3 nor any payment made by Her Majesty pursuant to these Terms of Payment shall be construed as an admission by Her Majesty that the work, material or any part thereof is complete, is satisfactory or is in accordance with the contract.

TP6 Delay in Making Payment

6.1 Nothwithstanding GC7 any delay by Her Majesty in making any payment when it is due pursuant to these Terms of Payment shall not be a breach of the contract by Her Majesty.

6.2 Her Majesty shall pay, without demand from the Contractor, simple interest at the Bank Rate plus 1 -1/4 per centum on any amount which is overdue pursuant to TP4.1.3, and the interest shall apply from and include the day such amount became overdue until the day prior to the date of payment except that

6.2.1 interest shall not be payable or paid unless the amount referred to in TP6.2 has been overdue for more that 15 days following

6.2.1.1 the date the said amount became due and payable, or

6.2.1.2 the receipt by the Departmental Representative of the Statutory Declaration referred to in TP4.5, TP4.8 or TP4.11,

whichever is the later, and

6.6.2 interest shall not be payable or paid on overdue advance payments if any.

TP7 Right of Set-off

7.1 Without limiting any right of set-off or deduction given or implied by law or elsewhere in the contract, Her Majesty may set off any amount payable to Her Majesty by the Contractor under this contract or under any current contract against any amount payable to the Contractor under this contract.

7.2 For the purposes of TP7.1, "current contract" means a contract between Her Majesty and the Contractor

7.2.1 under which the Contractor has an undischarged obligation to perform or supply work, labour or material, or

7.2.2 in respect of which Her Majesty has, since the date of which the Articles of Agreement were made, exercised any right to take the work that is the subject of the contract out of the Contractor's hands.

TP8 Payment in Event of Termination

8.1 If the contract is terminated pursuant to GC41, Her Majesty shall pay the Contractor any amount that is lawfully due and payable to the Contractor as soon as is practicable under the circumstances.

TP9 Interest on Settled Claims

9.1 Her Majesty shall pay to the Contractor simple interest on the amount of a settled claim at an average Bank Rate plus 1 ¼ per centum from the date the settled claim was outstanding until the day prior to the date of payment.

9.2 For the purposes of TP9.1,

9.2.1 a claim is deemed to have been settled when an agreement in writing is signed by the Departmental Representative and the Contractor setting out the amount of the claim to be paid by Her Majesty and the items or work for which the said amount is to be paid.

9.2.2 an "average Bank Rate" means the discount rate of interest set by the Bank of Canada in effect at the end of each calendar month averaged over the period the settled claim was outstanding.

9.2.3 a settled claim is deemed to be outstanding from the day immediately following the date the said claim would have been due and payable under the contract had it not been disputed.

9.3 For the purposes of TP9 a claim means a disputed amount subject to negotiation between Her Majesty and the Contractor under the contract.

GC1 Interpretation

1.1 In the contract

1.1.1 where reference is made to a part of the contract by means of numbers preceded by letters, the reference shall be construed to be a reference to the particular part of the contract that is identified by that combination of letters and numbers and to any other part of the contract referred to therein;

1.1.2 "contract" means the contract document referred to in the Articles of Agreement;

1.1.3 "contract security" means any security given by the Contractor to Her Majesty in accordance with the contract;

1.1.4 "Departmental Representative" means the officer or employee or Her Majesty who is designated pursuant to the Articles of Agreement and includes a person specially authorized by him to perform, on his behalf, any of his functions under the contract and is so designated in writing to the Contractor;

1.1.5 "material" includes all commodities, articles and things required to be furnished by or for the Contractor under the contract for incorporation into the work;

1.1.6 "Minister" includes a person acting for, or if the office is vacant, in place of the Minister and his successors in the office, and his or their lawful deputy and any of his or their representatives appointed for the purposes of the contract;

1.1.7 "person" includes, unless the context otherwise requires, a partnership, proprietorship, firm, joint venture, consortium and a corporation;

1.1.8 "plant" includes all animals, tools, implements, machinery, vehicles, buildings, structures, equipment and commodities, articles and things other than material, that are necessary for the due performance of the contract;

1.1.9 "subcontractor' means a person to whom the Contractor has, subject to GC4, subcontracted the whole or any part of the work;

1.1.10 "superintendant" means the employee of the Contractor who is designated by the Contractor to act pursuant to GC19;

1.1.11 "work includes, subject only to any express stipulation in the contract to the contrary, everything that is necessary to be done, furnished or delivered by the Contractor to perform the contract.

1.2 The headings in the contract documents, other than in the Plans and Specifications, form no part of the contract but are inserted for convenience of reference only.

1.3 In interpreting the contract, in the event of discrepancies or conflicts between anything in the Plans and Specifications and the General Conditions, the General Conditions govern.

1.4 In interpreting the Plans and Specifications, in the event of discrepancies or conflicts between

1.4.1 the Plans and Specifications, the Specifications govern;

1.4.2 the Plans, the Plans drawn with the largest scale govern; and

1.4.3 figured dimensions and scaled dimensions, the figured dimensions govern.

GC2 Successors and Assigns

2.1 The contract shall inure to the benefit of and be binding upon the parties hereto and their lawful heirs, executors, administrators, successors and assigns.

GC3 Assignment of Contract

3.1 The contract may not be assigned by the Contractor, either in whole or in part, without the written consent of the Minister.

GC4 Subcontracting by Contractor

4.1 Subject to this General Condition, the Contractor may subcontract any part of the work.

4.2 The Contractor shall notify the Departmental Representative in writing of his intention to subcontract.

4.3 A notification referred to in GC4.2 shall identify the part of the work, and the subcontractor with whom it is intended to subcontract.

4.4 The Departmental Representative may object to the intended subcontracting by notifying the Contractor in writing within six days of receipt by the Departmental Representative of a notification referred to in GC4.2.

4.5 If the Departmental Representative objects to a subcontracting pursuant to GC4.4, the Contractor shall not enter into the intended subcontract.

4.6 The contractor shall not, without the written consent of the Departmental Representative, change a subcontractor who has been engaged by him in accordance with this General Condition.

4.7 Every subcontract entered into by the Contractor shall adopt all of the terms and conditions of ths contract that are of general application.

4.8 Neither a subcontracting nor the Departmental Representative's consent to a subcontracting by the Contractor shall be construed to relieve the Contractor from any obligation under the contract or to impose any liability upon Her Majesty.

GC5 Amendments

5.1 No amendment or change in any of the provisions of the contract shall have any force or effect until it is reduced to writing.

GC6 No Implied Obligations

6.1 No implied terms or obligations of any kind by or on behalf of Her Majesty shall arise from anything in the contract and the express covenants and agreements therein contained and made by Her Majesty are the only covenants and agreements upon which any rights against Her Majesty are to be founded.

6.2 The contract supersedes all communications, negotiations and agreements, either written or oral, relating to the work that were made prior to the date of the contract.

GC7 Time of Essence

7.1 Time is of the essence of the contract.

GC8 Indemnification by Contractor

8.1 The Contractor shall indemnify and save Her Majesty harmless from and against all claims, demand, losses, costs, damages, actions, suits, or proceedings by whomever made, brought or prosecuted and in any manner based upon, arising out of, related to, occasioned by or attributable to the activities of the Contractor, his servants, agents, subcontractors and sub-subcontractors in performing the work including an infringement or an alleged infringement of a patent of invention or any other kind of intellectual property.

8.2 For the purpose of GC8.1, "activities" includes any act improperly carried out, any omission to carry out an act and any delay in carrying out an act.

GC9 Indemnification by Her Majesty

9.1 Her Majesty shall, subject to the Crown Liability Act, the Patent Act, and any other law that affects Her Majesty's rights, powers, privileges or obligations, indemnify and save the Contractor harmless from and against all claims, demands, losses, costs, damage, actions, suits or proceedings arising out of his activities under the contract that are directly attributable to

9.1.1 lack of or a defect in Her Majesty's title to the work site whether real or alleged; or

9.1.2 an infringement or an alleged infringement by the Contractor of any patent of invention or any other kind of intellectual property occurring while the Contractor was performing any act for the purposes of the contract employing a model, plan or design or any other thing related to the work that was supplied by Her Majesty to the Contractor.

GC10 Members of House of Commons Not to Benefit

10.1 As required by the Parliament of Canada Act, it is an express condition of the contract that no member of the House of Commons shall be admitted to any share of part of the contract or to any benefit arising therefrom.

GC11 Notices

11.1 Any notice, consent, order, decision, direction or other communication, other than a notice referred to in GC11.4, that may be given to the Contractor pursuant to the contract may be given in any manner.

11.2 Any notice, consent, order, decision, direction or other communication required to be given in writing, to any party pursuant to the contract shall, subject to GC11.4, be deemed to have been effectively given

11.2.1 to the Contractor, if delivered personally to the Contractor or the Contractor's superintendent, or forwarded by mail, telex or facsimile to the Contractor at the address set out in A4.1, or

11.2.2 to Her Majesty, if delivered personally to the Departmental Representative, or forwarded by mail, telex or facsimile to the Departmental Representative at the address set out in A1.2.1.

11.3 Any such notice, consent, order, decision, direction or other communication given in accordance with GC11.2 shall be deemed to have been received by either party

11.3.1 if delivered personally, on the day that it was delivered,

11.3.2 if forwarded by mail, on the earlier of the day it was received and the sixth day after it was mailed, and

11.3.3 if forwarded by telex or facsimile, 24 hours after it was transmitted.

11.4 A notice given under GC38.1.1, GC40 and GC41, if delivered personally, shall be delivered to the Contractor if the Contractor is doing business as sole proprietor or, if the Contractor is a partnership or corporation, to an officer thereof.

GC12 Material, Plant and Real Property Supplied by Her Majesty

12.1 Subject to GC12.2, the Contractor is liable to Her Majesty for any loss of or damage to material, plant or real property that is supplied or placed in the care, custody and control of the Contractor by Her Majesty for use in connection with the contract, whether or not that loss or damage is attributable to causes beyond the Contractor's control.

12.2 The Contractor is not liable to Her Majesty for any loss or damage to material, plant or real property referred to in GC12.1 if that loss or damage results from and is directly attributable to reasonable wear and tear.

12.3 The Contractor shall not use any material, plant or real property referred to in GC12.1 except for

the purpose of performing this contract.

12.4 When the Contractor fails to make good any loss or damage for which he is liable under GC12.1 within a reasonable time after being required to do so by the Departmental Representative, the Departmental Representative may cause the loss or damage to be made good at the Contractor's expense, and the Contractor shall thereupon be liable to Her Majesty for the cost thereof and shall, on demand, pay to Her Majesty an amount equal to that cost.

12.5 The Contractor shall keep such records of all material, plant and real property referred to in GC12.1 as the Departmental Representative from time to time requires and shall satisfy the Departmental Representative, when requested, that such material, plant and real property are at the place and in the condition which they ought to be.

GC13 Material, Plant and Real Property Become Property of Her Majesty

13.1 Subject to GC14.7 all material and plant and the interest of the Contractor in all real property, licenses, powers and privileges purchased, used or consumed by the Contractor for the contract shall, after the time of their purchase, use or consumption be the property of Her Majesty for the purposes of the work and they shall continue to be the property of Her Majesty.

13.1.1 in the case of material, until the Departmental Representative indicates that he is satisfied that it will not be required for the work, and

13.1.2 in the case of plant, real property, licenses, powers and privileges, until the Departmental Representative indicates that he is satisfied that the interest vested in Her Majesty therein is no longer required for the purposes of the work.

13.2 Material or plant that is the property of Her Majesty by virtue of GC13.1 shall not be taken away from the work site or used or disposed of except for the purposes of the work without the written consent of the Departmental Representative.

13.3 Her Majesty is not liable for loss of or damage from any cause to the material or plant referred to in GC13.1 and the Contractor is liable for such loss or damage notwithstanding that the material or plant is the property of Her Majesty.

GC14 Permits and Taxes Payable

14.1 The Contractor shall, within 30 days after the date of the contract, tender to a municipal authority an amount equal to all fees and charges that would be lawfully payable to that municipal authority in respect of building permits as if the work were being performed for a person other than Her Majesty.

14.2 Within 10 days of making a tender pursuant to GC14.1, the Contractor shall notify the Departmental Representative of his action and of the amount tendered and whether or not the municipal authority has accepted that amount.

14.3 If the municipal authority does not accept the amount tendered pursuant to GC14.1 the Contractor shall pay that amount to Her Majesty within 6 days after the time stipulated in GC14.2.

14.4 For the purposes of GC14.1 to GC14.3 "municipal authority" means any authority that would have jurisdiction respecting permission to perform the work if the owner were not Her Majesty.

14.5 Notwithstanding the residency of the Contractor, the Contractor shall pay any applicable tax arising from or related to the performance of the work under the contract.

14.6 In accordance with the Statutory Declaration referred to in TP4.9, a Contractor who has neither residence nor place of business in the province in which work under the contract is being performed shall provide Her Majesty with proof of registration with the provincial sales tax authorities in the said province.

14.7 For the purpose of the payment of any applicable tax or the furnishing of security for the payment of any applicable tax arising from or related to the performance of the work under the contract, the Contractor shall, notwithstanding the fact that all material, plant and interest of the Contractor in all real property, licenses, powers and privileges, have become the property of Her Majesty after the time of purchase, be liable, as a user or consumer, for the payment or for the furnishing of security for the payment of any applicable tax payable, at the time of the use or consumption of that material, plant or interest of the Contractor in accordance with the relevant legislation.

GC15 Performance of Work under Direction of Departmental Representative

15.1 The Contractor shall

15.1.1 permit the Departmental Representative to have access to the work and its site at all times during the performance of the contract;

15.1.2 furnish the Departmental Representative with such information respecting the performance of the contract as he may require; and

15.1.3 give the Departmental Representative every possible assistance to enable the Departmental Representative to carry out his duty to see that the work is performed in accordance with the contract and to carry out any other duties and exercise any powers specially imposed or conferred on the Departmental Representative under the contract.

CG16 Cooperation with Other Contractors

16.1 Where, in the opinion of the Departmental Representative, it is necessary that other contractors or workers with or without plant and material, be sent onto the work or its site, the Contractor shall, to the satisfaction of the Departmental Representative, allow them access and cooperate with them in the carrying out of their duties and obligation.

16.2 If

16.2.1 the sending onto the work or its site of other contractors or workers pursuant to GC16.1 could not have been reasonably foreseen or anticipated by the Contractor when entering into the contract, and

16.2.2 the Contractor incurs, in the opinion of the Departmental Representative, extra expense in complying with GC16.1, and

16.2.3 The Contractor has given the Departmental Representative written notice of his claim for the extra expense referred to in GC16.2.2 within 30 days of the date that the other contractors or workers were sent onto the work or its site,

Her Majesty shall pay the Contractor the cost, calculated in accordance with GC48 to GC50, of the extra labour, plant and material that was necessarily incurred.

GC17 Examination of Work

17.1 If, at any time after the commencement of the work but prior to the expiry of the warranty or guarantee period, the Departmental Representative has reason to believe that the work or any part thereof has not been performed in accordance with the contract, the Departmental Representative may have that work examined by an expert of his choice.

17.2 If, as a result of an examination of the work referred to in GC17.1, it is established that the work was not performed in accordance with the contract, then, in addition to and without limiting or otherwise affecting any of Her Majesty's rights and remedies under the contract either at law or in equity, the Contractor shall pay Her Majesty, on demand, all reasonable costs and expenses that were incurred by Her Majesty in having that examination performed.

GC18 Clearing of Site

18.1 The Contractor shall maintain the work and its site in a tidy condition and free from the accumulation of waste material and debris, in accordance with any directions of the Departmental Representative.

18.2 Before the issue of an interim certificate referred to in GC44.2, the Contractor shall remove all the plant and material not required for the performance of the remaining work, and all waste material and other debris, and shall cause the work and its site to be clean and suitable for occupancy by Her Majesty's servants, unless otherwise stipulated in the contract.

18.3 Before the issue of a final certificate referred to in GC44.1, the Contractor, shall remove from the work and its site all of the surplus plant and material and any waste material and other debris.

18.4 The Contractor's obligations described in GC18.1 to GC18.3 do not extend to waste material and other debris caused by Her Majesty's servants or contractors and workers referred to in GC16.1.

GC19 Contractor's Superintendent

19.1 The Contractor shall, forthwith upon the award of the contract, designate a superintendent.

19.2 The Contractor shall forthwith notify the Departmental Representative of the name, address and telephone number of a superintendent designate pursuant to GC19.1.

19.3 A superintendent designated pursuant to GC19.1 shall be in full charge of the operations of the Contractor in the performance of the work and is authorized to accept any notice, consent, order, direction, decision or other communication on behalf of the Contractor that may be given to the superintendent under the contract.

19.4 The Contractor shall, until the work has been completed, keep a competent superintendent at the work site during working hours.

19.5 The Contractor shall, upon the request of the Departmental Representative, remove any superintendent who, in the opinion of the Departmental Representative, is incompetent or has been conducting himself improperly and shall forthwith designate another superintendent who is acceptable to the Departmental Representative.

19.6 Subject to GC19.5, the Contractor shall not substitute a superintendent without the written consent of the Departmental Representative.

19.7 A breach by the Contractor of GC19.6 entitles the Departmental Representative to refuse to issue any certificate referred to in GC44 until the superintendent has returned to the work site or another superintendent who is acceptable to the Departmental Representative has been substituted.

GC20 National Security

20.1 If the Minister is of the opinion that the work is of a class or kind that involves the national security, he may order the Contractor

20.1.1 to provide him with any information concerning persons employed or to be employed by him for purposes of the contract; and

20.1.2 to remove any person from the work and its site if, in the opinion of the Minister, that person may be a risk to the national security.

20.2 The Contractor shall, in all contracts with persons who are to be employed in the performance of the contract, make provision for his performance of any obligation that may be imposed upon him under GC19 to GC21.

20.3 The Contractor shall comply with an order of the Minister under GC20.1

GC21 Unsuitable Workers

21.1 The Contractor shall, upon the request of the Departmental Representative, remove any person employed by him for purposes of the contract who, in the opinion of the Departmental Representative, is incompetent or has conducted himself improperly, and the Contractor shall not permit a person who has been removed to return to the work site.

GC22 Increased or Decreased Costs

22.1 The amount set out in the Articles of Agreement shall not be increased or decreased by reason of any increase or decrease in the cost of the work that is brought about by an increase or decrease in the cost of labour, plant or material or any wage adjustment arising pursuant to the Labour Conditions.

22.2 Notwithstanding GC22.1 and GC35, an amount set out in the Articles of Agreement shall be adjusted in the manner provided in GC22.3, if any change in a tax imposed under the Excise Act, the Excise Tax Act, the Old Age Security Act, the Customs Act, the Customs Tariff or any provincial sales tax legislation imposing a retail sales tax on the purchase of tangible personal property incorporated into Real Property

22.2.1 occurs after the date of the submission by the Contractor of his tender for the contract,

22.2.2 applies to material, and

22.2.3 affects the cost to the Contractor of that material.

22.3 If a change referred to in GC22.2 occurs, the appropriate amount set out in the Articles of Agreement shall be increased or decreased by an amount equal to the amount that is established by an examination of the relevant records of the Contractor referred to in GC51 to be the increase or decrease in the cost incurred that is directly attributable to that change.

22.4 For the purpose of GC22.2, where a tax is changed after the date of submission of the tender but public notice of the change has been given by the Minister of Finance before that date, the change shall be deemed to have occurred before the date of submission of the tender.

GC23 Canadian Labour and Material

23.1 The Contractor shall use Canadian labour and material in the performance of the work to the full extent to which they are procurable, consistent with proper economy and expeditious carrying out of the work.

23.2 Subject to GC23.1, the Contractor shall, in the performance of the work, employ labour from the locality where the work is being performed to the extent to which it is available, and shall use the offices of the Canada Employment Centres for the recruitment of workers wherever practicable.

23.3 Subject to GC23.1 and GC23.2, the Contractor shall, in the performance of the work, employ a reasonable proportion of persons who have been on active service with the armed forces of Canada and have been honourably discharged therefrom.

GC24 Protection of Work and Documents

24.1 The Contractor shall guard or otherwise protect the work and its site, and protect the contract, specifications, plans, drawings, information, material, plant and real property, whether or not they are supplied by Her Majesty to the Contractor, against loss or damage from any cause, and he shall not use, issue, disclose or dispose of them without the written consent of the Minister, except as may be essential for the performance of the work.

24.2 If any document or information given or disclosed to the Contractor is assigned a security rating by the person who gave or disclosed it, the Contractor shall take all measures directed by the Departmental Representative to be taken to ensure the maintenance of the degree of security that is ascribed to that rating.

24.3 The Contractor shall provide all facilities necessary for the purpose of maintaining security, and shall assist any person authorized by the Minister to inspect or to take security measures in respect of the work and its site.

24.4 The Departmental Representative may direct the Contractor to do such things and to perform such additional work as the Departmental Representative considers reasonable and necessary to ensure compliance with or to remedy a breach of GC24.1 to GC24.3.

GC25 Public Ceremonies and Signs

25.1 The Contractor shall not permit any public ceremony in connection with the work without the prior consent of the Minister.

25.2 The Contractor shall not erect or permit the erection of any sign or advertising on the work or its site without the prior consent of the Departmental Representative.

GC26 Precautions against Damage, Infringement of Rights, Fire, and Other Hazards

26.1 The Contractor shall, at his own expense, do whatever is necessary to ensure that

26.1.1 no person, property, right, easement or privilege is injured, damaged or infringed by reasons of the Contractor's activities in performing the contract;

26.1.2 pedestrian and other traffic on any public or private road or waterway is not unduly impeded, interrupted or endangered by the performance or existence of the work or plant;

26.1.3 fire hazards in or about the work or its site are eliminated and, subject to any direction that may be given by the Departmental Representative, any fire is promptly extinguished;

26.1.4 the health and safety of all persons employed in the performance of the work is not endangered by the method or means of its performance;

26.1.5 adequate medical services are available to all persons employed on the work or its site at all times during the performance of the work;

26.1.6 adequate sanitation measures are taken in respect of the work and its site; and

26.1.7 all stakes, buoys and marks placed on the work or its site by or under the authority of the Departmental Representative are protected and are not removed, defaced, altered or destroyed.

26.2 The Departmental Representative may direct the Contractor to do such things and to perform such additional work as the Departmental Representative considers reasonable and necessary to ensure

compliance with or to remedy a breach of GC26.1.

26.3 The Contractor shall, at his own expense, comply with a direction of the Departmental Representative made under GC26.2.

GC27 Insurance

27.1 The Contractor shall, at his own expense, obtain and maintain insurance contracts in respect of the work and shall provide evidence thereof to the Departmental Representative in accordance with the requirements of the Insurance Conditions "E".

27.2 The insurance contracts referred to in GC27.1 shall

27.2.1 be in a form, of the nature, in the amounts, for the periods and containing the terms and conditions specified in Insurance Conditions "E", and

27.2.2 provide for the payment of claims under such insurance contracts in accordance with GC28.

GC28 Insurance Proceeds

28.1 In the case of a claim payable under a Builders Risk/Installation (All Risks) insurance contract maintained by the Contractor pursuant to GC27, the proceeds of the claim shall be paid directly to Her Majesty, and

28.1.1 the monies so paid shall be held by Her Majesty for the purposes of the contract, or

28.1.2 if Her Majesty elects, shall be retained by Her Majesty, in which event they vest in Her Majesty absolutely.

28.2 In the case of a claim payable under a General Liability insurance contract maintained by the Contractor pursuant to GC27, the proceeds of the claim shall be paid by the insurer directly to the claimant.

28.3 If an election is made pursuant to GC28.1, the Minister may cause an audit to be made of the accounts of the Contractor and of Her Majesty in respect of the part of the work that was lost, damaged or destroyed for the purpose of establishing the difference, if any, between

28.3.1 the aggregate of the amount of the loss or damage suffered or sustained by Her Majesty, including any cost incurred in respect of the clearing and cleaning of the work and its site and any other amount that is payable by the Contractor to Her Majesty under the contract, minus any monies retained pursuant to GC28.12, and

28.3.2 the aggregate of the amounts payable by Her Majesty to the Contractor pursuant to the contract up to the date of the loss or damage.

28.4 A difference that is established pursuant to GC28.3 shall be paid forthwith by the party who is determined by the audit to be the debtor to the party who is determined by the audit to be the

creditor.

28.5 When payment of a deficiency has been made pursuant to GC28.4, all rights and obligations of Her Majesty and the Contractor under the contract shall, with respect only to the part of the work that was the subject of the audit referred to in GC28.3, be deemed to have been expended and discharged.

28.6 If an election is not made pursuant to GC28.1.2 the Contractor shall, subject to GC28.7, clear and clean the work and its site and restore and replace the part of the work that was lost, damaged or destroyed at his own expense as if that part of the work had not yet been performed.

28.7 When the Contractor clears and cleans the work and its site and restores and replaces the work referred to in GC 28.6, Her Majesty shall pay him out of the monies referred to in GC28.1 so far as they will thereunto extend.

28.8 Subject to GC28.7, payment by Her Majesty pursuant to GC28.7 shall be made in accordance with the contract but the amount of each payment shall be 100% of the amount claimed notwithstanding TP4.4.1 and TP4.4.2.

GC29 Contract Security

29.1 The Contractor shall obtain and deliver contract security to the Departmental Representative in accordance with the provisions of the Contract Security Conditions.

29.2 If the whole or a part of the contract security referred to in GC29.1 is in the form of a security deposit, it shall be held and disposed of in accordance with GC43 and GC45.

29.3 If a part of the contract security referred to in GC29.1 is in the form of a labour and material payment bond, the Contractor shall post a copy of that bond on the work site.

GC30 Changes in the Work

30.1 Subject o GC5, the Departmental Representative may, at any time before he issues his Final Certificate of Completion,

30.1.1 order work or material in addition to that provided for in the Plans and Specifications; and

30.1.2 delete or change the dimensions, character, quantity, quality, description, location or position of the whole or any part of the work or material proved for in the Plans and Specifications or in any order made pursuant to GC30.1.1,

if that additional work or material, deletion, or change is, in his opinion, consistent with the general intent of the original contract.

30.2 The Contractor shall perform the work in accordance with such orders, deletions and changes that are made by the Departmental Representative pursuant to GC30.1 from time to time as if they had appeared in and been part of the Plans and Specifications.

30.3 The Departmental Representative shall determine whether or not anything done or omitted by the Contractor pursuant to an order, deletion or change referred to in GC30.1 increased or decreased the cost of the work to the Contractor.

30.4 If the Departmental Representative determines pursuant to GC30.3 that the cost of the work to the Contractor has been increased, Her Majesty shall pay the Contractor the increased cost that the Contractor necessarily incurred for the additional work calculated in accordance with GC49 or GC50.

30.5 If the Departmental Representative determines pursuant to GC303.3 that the cost of the work to the Contractor has been decreased, Her Majesty shall reduce the amount payable to the Contractor under the contract by an amount equal to the decrease in the cost caused by the deletion or change referred to in GC30.1.2 and calculated in accordance with GC49.

30.6 GC30.3 to GC30.5 are applicable only to a contract or a portion of a contract for which a Fixed Price Arrangement is stipulated in the contract.

30.7 An order, deletion or change referred to in GC30.1 shall be in writing, signed by the Departmental Representative and given to the Contractor in accordance with GC11.

GC31 Interpretation of Contract by Departmental Representative

31.1 If, ar any time before the Departmental Representative has issued a Final Certificate of Completion referred to in GC44.1, any question arises between the parties about whether anything has been done as required by the contract or about what the Contractor is required by the contract to do, and, in particular but without limiting the generality of the foregoing, about

31.1.1 the meaning of anything in the Plans and Specification,

31.1.2 the meaning to be given to the Plans and Specifications in case of any error therein, omission therefrom, or obscurity or discrepancy in their working or intention,

31.1.3 whether or not the quality or quantity of any material or workmanship supplied or proposed to be supplied by the Contractor meets the requirements of the contract,

31.1.4 whether or not the labour, plant or material provided by the Contractor for performing the work and carrying out the contract are adequate to ensure that the work will be performed in accordance with the contract and that the contract will be carried out in accordance with its terms,

31.1.5 what quantity of any kind of work has been completed by the Contractor, or

31.1.6 the timing and scheduling of the various phases of the performance of the work,

the question shall be decided by the Departmental Representative whose decision shall be final and conclusive in respect of the work.

31.2 The Contractor shall perform the work in accordance with any decisions of the Departmental

Representative that are made under GC31.1 and in accordance with any consequential directions given by the Departmental Representative.

GC32 Warranty and Rectification of Defects in Work

32.1 Without restricting any warranty or guarantee implied or imposed by law or contained in the contract documents, the Contractor shall, at his own expense,

32.1.1 rectify and make good any defect or fault that appears in the work or comes to the attention of the Minister with respect to those parts of the work accepted in connection with the Interim Certificate of Completion referred to GC44.2 within 12 months from the date of the Interim Certificate of Completion;

32.1.2 rectify and make good any defect or fault that appears in or comes to the attention of the Minister in connection with those parts of the work described in the Interim Certificate of Completion referred to in GC44.2 within 12 months from the date of the Final Certificate of Completion referred to in GC44.1.

32.2 The Departmental Representative may direct the Contractor to rectify and make good any defect or fault referred to in GC32.1 or covered by any other expressed or implied warranty or guarantee.

32.3 A direction referred to in GC32.2 shall be in writing, may include a stipulation in respect of the time within which a defect or fault is required to be rectified and made good by the Contractor, and shall be given to the Contractor in accordance with GC11.

32.4 The Contractor shall rectify and make good any defect or fault described in a direction given pursuant to GC32.2 within the time stipulated therein.

GC33 Non-Compliance by Contractor

33.1 If the Contractor fails to comply with any decision or direction given by the Departmental Representative pursuant to GC18, GC24, GC26, GC31 or GC32, the Departmental Representative may employ such methods as he deems advisable to do that which the Contractor failed to do.

33.2 The Contractor shall, on demand, pay Her Majesty an amount that is equal to the aggregate of all cost, expenses and damage incurred or sustained by Her Majesty by reason of the Contractor's failure to comply with any decision or direction referred to in GC33.1, including the cost of any methods employed by the Departmental Representative pursuant to GC33.1.

GC34 Protesting Departmental Representative's Decisions

34.1 The Contractor may, within ten days after the communication to him of any decision or direction referred to in GC30.3 or GC33.1, protest that decision or direction.

34.2 A protest referred to in GC34.1 shall be in writing, contain full reasons for the protest, be signed

by the Contractor and be given to Her Majesty by delivery to the Departmental Representative.

34.3 If the Contractor gives a protest pursuant to GC34.2, any compliance by the Contractor with the decision or direction that was protested shall not be construed as an admission by the Contractor of the correctness of that decision or direction, or prevent the Contractor from taking whatever action he considers appropriate in the circumstances.

34.4 The giving of a protest by the Contractor pursuant to GC34.2 shall not relieve him from complying with the decision or direction that is the subject of the protest.

34.5 Subject to GC34.6, the Contractor shall take any action referred to in GC34.3 within three months after the date that a Final Certificate of Completion is issued under GC44.1 and not afterwards.

34.6 The Contractor shall take any action referred to in GC34.3 resulting from a direction under GC32 within three months after the expiry of a warranty or guarantee period and not afterwards.

34.7 Subject to GC34.8, if Her Majesty determines that the Contractor's protest is justified, Her Majesty shall pay the Contractor the cost of the additional labour, plant and material necessarily incurred by the Contractor in carrying out the protested decision or direction.

34.8 Costs referred to in GC34.7 shall be calculated in accordance with GC48 to GC50.

GC35 Changes in Soil Conditions and Neglect or Delay by Her Majesty

35.1 Subject to GC35.2 no payment, other than a payment that is expressly stipulated in the contract, shall be made by Her Majesty to the Contractor for any extra expense or any loss or damage incurred or sustained by the Contractor.

35.2 If the Contractor incurs or sustains any extra expense or any loss or damage that is directly attributable to

35.2.1 a substantial difference between the information relating to soil conditions at the work site that is contained in the Plans and Specifications or other documents supplied to the Contractor for his use in preparing his tender or a reasonable assumption of fact based thereon made by the Contractor, and the actual soil conditions encountered by the Contractor at the work site during the performance of the contract, or

35.2.2 any neglect or delay that occurs after the date of the contract on the part of Her Majesty in providing any information or in doing any act that the contract either expressly requires Her Majesty to do or that would ordinarily be done by an owner in accordance with the usage of the trade,

he shall, within ten days of the date the actual soil conditions described in GC35.2.1 were encountered or the neglect or delay described in GC35.2.2 occurred, give the Departmental Representative written notice of his intention to claim for that extra expense or that loss or damage.

35.3 When the Contractor has given a notice referred to in GC35.2, he shall give the Departmental Representative a written claim for extra expense or loss or damage within 30 days of the date that

a Final Certificate of Completion referred to in GC44.1 is issued and not afterwards.

35.4 A written claim referred to in GC35.3 shall contain a sufficient description of the facts and circumstances of the occurrence that is the subject of the claim to enable the Departmental Representative to determine whether or not the claim is justified and the Contractor shall supply such further and other information for that purpose as the Departmental Representative requires from time to time.

35.5 If the Departmental Representative determines that a claim referred to in GC35.3 is justified, Her Majesty shall make an extra payment to the Contractor in an amount that is calculated in accordance with GC47 to GC50.

35.6 If, in the opinion of the Departmental Representative, an occurrence described in GC35.2.1 results in a savings of expenditure by the Contractor in performing the contract, the amount set out in the Articles of Agreement shall, subject to GC35.7, be reduced by an amount that is equal to the saving.

35.7 The amount of the saving referred to in GC35.6 shall be determined in accordance with GC47 to GC49.

35.8 If the Contractor fails to give a notice referred to in GC35.2 and a claim referred to in GC35.3 within the times stipulated, an extra payment shall not be made to him in respect of the occurrence.

GC36 Extension of Time

36.1 Subject to GC36.2, the Departmental Representative may, on the application of the Contractor made before the day fixed by the Articles of Agreement for completion of the work or before any other date previously fixed under this General Condition, extend the time for its completion by fixing a new date if, in the opinion of the Departmental Representative, causes beyond the control of the Contractor have delayed its completion.

36.2 An application referred to in GC36.1 shall be accompanied by the written consent of the bonding company whose bond forms part of the contract security.

GC37 Assessments and Damages for Late Completion

37.1 For the purposes of this General Condition

37.1.1 the work shall be deemed to be completed on the date that an Interim Certificate of Completion referred to in GC44.2 is issued, and

37.1.2 "period of delay" means the number of days commencing on the day fixed by the Articles of Agreement for completion of the work and ending on the day immediately preceding the day on which the work is completed but does not include any day within a period of extension granted pursuant to GC36.1, and any other day on which, in the opinion of the Departmental Representative, completion of the work was delayed for reasons beyond the control of the Contractor.

37.2 If the Contractor does not complete the work by the day fixed for its completion by the Articles of Agreement but completes it thereafter, the Contractor shall pay Her Majesty an amount equal to the aggregate of

37.2.1 all salaries, wages and travelling expenses incurred by Her Majesty in respect of persons overseeing the performance of the work during the period of delay;

37.2.2 the cost incurred by Her Majesty as a result of the inability to use the completed work for the period of delay; and

37.2.3 all other expenses and damages incurred or sustained by Her Majesty during the period of delay as a result of the work not being completed by the day fixed for its completion.

37.3 The Minister may waive the right of Her Majesty to the whole or any part of the amount payable by the Contractor pursuant to GC37.2 I , in the opinion of the Minister, it is in the public interest to do so.

GC38 Taking the Work Out of the Contractor's Hands

38.1 The Minister may, at his sole discretion, by giving a notice in writing to the Contractor in accordance with GC11, take all or any part of the work out of the Contractor's hands, and may employ such means as he sees fit to have the work completed if the Contractor

38.1.1 Has not, within six days of the Minister or the Departmental Representative giving notice to the Contractor in writing in accordance with GC11, remedied any delay in the commencement or any default in the diligent performance of the work to the satisfaction of the Departmental Representative;

38.1.2 has defaulted in the completion of any part of the work within the time fixed for its completion by the contract;

38.1.3 has become insolvent;

38.1.4 has committed an act of bankruptcy;

38.1.5 has abandoned the work;

38.1.6 has made an assignment of the contract without the consent required by GC3.1; or

38.1.7 has otherwise failed to observe or perform any of the provisions of the contract.

38.2 If the whole or any part of the work is taken out of the Contractor's hands pursuant to GC38.1,

38.2.1 the Contractor's right to any further payment that is due or accruing due under the contract is, subject only to GC38.4, extinguished, and

38.2.2 the Contractor is liable to pay Her Majesty, upon demand, an amount that is equal to the amount of all loss and damage incurred or sustained by Her Majesty in respect of the

Contractor's failure to complete the work.

38.3 If the whole or any part of the work that is taken out of the Contractor's hands pursuant to GC38.1 is completed by Her Majesty, the Departmental Representative shall determine the amount, if any, of the holdback or a progress claim that had accrued and was due prior to the date on which the work was taken out of the Contractor's hands and that is not required for the purposes of having the work performed or of compensating Her Majesty for any other loss or damage incurred or sustained by reason of the Contractor's default.

38.4 Her Majesty may pay the Contractor the amount determined not to be required pursuant to GC38.3.

GC39 Effect of Taking the Work Out of the Contractor's Hands

39.1 The taking of the work or any part thereof out of the Contractor's hands pursuant to GC38 does not operate so as to relieve or discharge him from any obligation under the contract or imposed upon him by law except the obligation to complete the performance of that part of the work that was taken out of his hands.

39.2 If the work or any part thereof is taken out of the Contractor's hands pursuant to GC38, all plant and material and the interest of the Contractor is all real property, licenses, powers and privileges acquired, used or provided by the Contractor under the contract shall continue to be the property of Her Majesty without compensation to the Contractor.

39.3 When the Departmental Representative certifies that any plant, material, or any interest of the Contractor referred to in GC39.2 is no longer required for the purposes of the work, or that it is not in the interest of Her Majesty to retain that plant, material or interest, it shall revert to the Contractor.

G40 Suspension of Work by Minister

40.1 The Minister may, when in his opinion it is in the public interest to do so, require the Contractor to suspend performance of the work either for a specified or an unspecified period by giving a notice of suspension in wiring to the Contractor in accordance with GC11.

40.2 When a notice referred to in GC40.1 is received by the Contractor in accordance with GC11, he shall suspend all operations in respect of the work except those that, in the opinion of the Departmental Representative, are necessary for the care and preservation of the work, plant and material.

40.3 The Contractor shall not, during a period of suspension, remove any part of the work, plant or material from its site without the consent of the Departmental Representative.

40.4 If a period of suspension is 30 days or less, the Contractor shall, upon the expiration of that period, resume the performance of the work and he is entitled to be paid the extra cost, calculated in accordance with GC48 to GC50, of any labour, plant and material necessarily incurred by him as a result of the suspension.

40.5 If, upon the expiration of a period of suspension of more than 30 days, the Minister and the Contractor agree that the performance of the work will be continued by the Contractor, the Contractor shall resume performance of the work subject to any terms and conditions agreed upon by the Minister and the Contractor.

40.6 If, upon the expiration of a period of suspension of more than 30 days, the Minister and the Contractor do not agree that performance of the work will be continued by the Contractor or upon the terms and conditions under which the Contractor will continue the work, the notice of suspension shall be deemed to be a notice of termination pursuant to GC41.

GC41 Termination of Contract

41.1 The Minister may terminate the contract at any time by giving a notice of termination in writing to the Contractor in accordance with GC11.

41.2 When a notice referred to in GC41.1 is received by the Contractor in accordance with GC11, he shall, subject to any conditions stipulated in the notice, forthwith cease all operations in performance of the contract.

41.3 If the contract is terminated pursuant to GC41.1, Her Majesty shall pay the Contractor, subject to GC41.4, an amount equal to

41.3.1 the cost to the contractor of all labour, plant and material supplied by him under the contract up to the date of termination in respect of a contract or part thereof for which a Unit Price Arrangement is stipulated in the contract, or

41.3.2 the lesser of

41.3.2.1 an amount, calculated in accordance with the Terms and Payment, that would have been payable to the Contractor had he completed the work, and

41.3.2.2 an amount that is determined to be due to the Contractor pursuant to GC49 in respect of a contract or part thereof for which a Fixed Price Arrangement is stipulated in the contract

less the aggregate of all amounts that were paid to the Contractor by Her Majesty and all amounts that are due to Her Majesty from the Contractor pursuant to the contract.

41.4 If Her Majesty and the Contractor are unable to agree about an amount referred to in GC41.3 that amount shall be determined by the method referred to in GC50.

GC42 Claims Against and Obligations of the Contractor or Subcontractor

42.1 Her Majesty may, in order to discharge lawful obligations of and satisfy claims against the Contractor or a subcontractor arising out of the performance of the contract, pay any amount that is due and payable to the Contractor pursuant to the contract directly to the obligees of and the claimants against the Contractor or the subcontractor but such amount if any, as is paid by Her Majesty, shall not exceed that amount which the Contractor would have been obliged to pay to

such claimant had the provisions of the Provincial or Territorial lien legislation, or, in the Province of Quebec, the law relating to privileges, been applicable to the work. Any such claimant need not comply with the provisions of such legislation setting out the steps by way of notice, registration or otherwise as might have been necessary to preserve or perfect any claim for lien or privilege which claimant might have had;

42.2 Her Majesty will not make any payment as described in GC42.1 unless and until that claimant shall have delivered to Her Majesty:

42.2.1 a binding and enforceable Judgment or Order of a court of competent jurisdiction setting forth such amount as would have been payable by the Contractor to the claimant pursuant to the provisions of the applicable Provincial or Territorial lien legislation, or, in the Province of Quebec, the law relating to privileges, had such legislation been applicable to the work; or

42.2.2 a final and enforceable award of an arbitrator setting forth such amount as would have been payable by the Contractor to the claimant pursuant to the provisions of the applicable Provincial or Territorial lien legislation, or, in the Province of Quebec, the law relating to privileges, had such legislation been applicable to the work; or

42.2.3 the consent of the Contractor authorizing a payment.

For the purposes of determining the entitlement of a claimant pursuant to GC42.2.1 and GC42.2.2, the notice required by GC42.8 shall be deemed to replace the registration or provision of notice after the performance of work as required by any applicable legislation and no claim shall be deemed to have expired, become void or unenforceable by reason of the claimant not commencing any action within the time prescribed by any applicable legislation.

42.3 The Contractor shall, by the execution of his contract, be deemed to have consented to submit to binding arbitration at the request of any claimant those questions that need be answered to establish the entitlement of the claimant to payment pursuant to the provisions of GC42.1 and such arbitration shall have as parties to it any subcontractor to whom the claimant supplied material, performed work or rented equipment should such subcontractor wish to be adjoined and the Crown shall not be a party to such arbitration and, subject to any agreement between the Contractor and the claimant to the contrary, the arbitration shall be conducted in accordance with the Provincial or Territorial legislation governing arbitration applicable in the Province or Territory in which the work is located.

42.4 A payment made pursuant to GC42.1 is, to the extent of the payment, a discharge of Her Majesty's liability to the Contractor under the contract and may be deducted from any amount payable to the Contractor under the contract.

42.5 To the extent that the circumstances of the work being performed for Her Majesty permit, the Contractor shall comply with all laws in force in the Province or Territory where the work is being performed relating to payment period, mandatory holdbacks, and creation and enforcement of mechanics' liens, builders' liens or similar legislation or in the Province of Quebec, the law relating to privileges.

42.6 The Contractor shall discharge all his lawful obligations and shall satisfy all lawful claims against him arising out of the performance of the work at least as often as the contract requires Her

Majesty to pay the Contractor.

42.7 The Contractor shall, whenever requested to do so by the Departmental Representative, make a statutory declaration deposing to the existence and condition of any obligations and claims referred to in GC42.6.

42.8 GC42.1 shall only apply to claims and obligations

42.8.1 the notification of which has been received by the Departmental Representative in writing before payment is made to the Contractor pursuant to TP4.10 and within 120 days of the date on which the claimant

42.8.1.1 should have been paid in full under the claimant's contract with the Contractor or subcontractor where the claim is for money that was lawfully required to be held back from the claimant; or

42.8.1.2 performed the last of the services, work or labour, or furnished the last of the material pursuant to the claimant's contract with the Contractor or subcontractor where the claim is not for money referred to in GC42.8.1.1, and

42.8.2 the proceedings to determine the right to payment of which, pursuant to GC42.2. shall have commenced within one year from the date that the notice referred to in GC42.8.1 was received by the Departmental Representative, and

the notification required by GC42.8.1 shall set forth the amount claimed to be owing and the person who by contract is primarily liable.

42.9 Her Majesty may, upon receipt of a notice of claim under GC42.8.1, withhold from any amount that is due and payable to the Contractor pursuant to the contract the full amount of the claim or any portion thereof.

42.10 The Departmental Representative shall notify the Contractor in writing of receipt of any claim referred to in GC42.8.1 and of the intention of Her Majesty to withhold funds pursuant to GC42.9 and the Contractor may, at any time thereafter and until payment is made to the claimant, be entitled to post, with Her Majesty, security in a form acceptable to Her Majesty in an amount equal to the value of the claim, the notice of which is received by the Departmental Representative and upon receipt of such security Her Majesty shall release to the Contractor any funds which would be otherwise payable to the Contractor, that were withheld pursuant to the provisions of GC42.9 in respect of the claim of any claimant for whom the security stands.

GC43 Security Deposit – Forfeiture or Return

43.1 If

43.1.1 the work is taken out of the Contractor's hands pursuant to GC38,

43.1.2 the contract is terminated pursuant to GC41, or

43.1.3 the Contractor is in breach of or in default under the contract,

Her Majesty may convert the security deposit, if any, to Her own use.

43.2 If Her Majesty converts the contract security pursuant to GC43.1, the amount realized shall be deemed to be an amount due from Her Majesty to the Contractor under the contract.

43.3 Any balance of an amount referred to in GC43.2 that remains after payment of all losses, damage and claims of Her Majesty and others shall be paid by Her Majesty to the Contractor if, in the opinion of the Departmental Representative, it is not required for the purposes of the contract.

GC44 Departmental Representative's Certificates

44.1 On the date that

44.1.1 the work has been completed, and

44.1.2 the Contractor has complied with the contract and all orders and directions made pursuant thereto,

both to the satisfaction of the Departmental Representative, the Departmental Representative shall issue a Final Certificate of Completion to the Contractor.

44.2 If the Departmental Representative is satisfied that the work is substantially complete he shall, at any time before he issues a certificate referred to in GC44.1, issue an Interim Certificate of Completion to the Contractor, and

44.2.1 for the purposes of GC44.2 the work will be considered to be substantially complete,

44.2.1.1 when the work under the contract or a substantial part thereof is, in the opinion of the Departmental Representative, ready for use by Her Majesty or is being used for the purpose intended; and

44.2.1.2 when the work remaining to be done under the contract is, in the opinion of the Departmental Representative, capable of completion or correction at accost of not more that

44.2.1.2.1 -3% of the first $500,000, and

44.2.1.2.2 -2% of the next $500,000, and

44.2.1.2.3 -1% of the balance

of the value of the contract at the time this cost is calculated.

44.3 For the sole purpose of GC44.2.1.2, where the work or a substantial part thereof is ready for use or is being used for the purposes intended and the remainder of the work or a part thereof cannot be completed by the time specified in A2.1, or as amended pursuant to GC36, for reasons beyond the control of the Contractor or where the Departmental Representative and the Contractor agree not to complete a part of the work within the specified time, the cost of that part of the work

which was either beyond the control of the Contractor to complete or the Departmental Representative and the Contractor have agreed not to complete by the time specified shall be deducted from the value of the contract referred to GC44.2.1.2 and the said cost shall not form part of the cost of the work remaining to be done in determining substantial completion.

44.4 An Interim Certificate of Completion referred to in GC44.2 shall describe the parts of the work not completed to the satisfaction of the Departmental Representative and all things that must be done by the Contractor

44.4.1 before a Final Certificate of Completion referred to in GC44.1 will be issued, and

44.4.2 before the 12-month period referred to in GC32.1.2 shall commence for the said parts and all the said things.

44.5 The Departmental Representative may, in addition to the parts of the work described in an Interim Certificate of Completion referred to in GC44.2, require the Contractor to rectify any other parts of the work not completed to his satisfaction and to do any other things that are necessary for the satisfactory completion of the work.

44.6 If the contract or a part thereof is subject to a Unit Price Arrangement, the Departmental Representative shall measure and record the quantities of labour, plant and material, performed, used and supplied by the Contractor in performing the work and shall, at the request of the Contractor, inform him of those measurements.

44.7 The Contractor shall assist and co-operate with the Departmental Representative in the performance of his duties referred to in GC44.6 and shall be entitled to inspect any record made by the Departmental Representative pursuant to GC44.6.

44.8 After the Departmental Representative has issued a Final Certificate of Completion referred to in GC44.1, he shall, if GC44.6 applies, issue a Final Certificate of Measurement.

44.9 A Final Certificate of Measurement referred to in GC44.8 shall

44.9.1 contain the aggregate of all measurements of quantities referred to in GC44.6, and

44.9.2 be binding upon and conclusive between Her Majesty and the Contractor as to the quantities referred to therein.

GC45 Return of Security Deposit

45.1 After an Interim Certificate of Completion referred to in GC44.2 has been issued, Her Majesty shall, if the Contractor is not in breach of or in default under the contract, return to the Contractor all or any part of the security deposit that, in the opinion of the Departmental Representative, is not required for the purposes of the contract.

45.2 After a Final Certificate of Completion referred to in GC44.1 has been issued, Her Majesty shall return to the Contractor the remainder of any security deposit unless the contract stipulates otherwise.

45.3 If the security deposit was paid into the Consolidated Revenue Fund of Canada, Her Majesty shall pay interest thereon to the Contractor at a rate established from time to time pursuant to section 21(2) of the Financial Administration Act.

GC46 Clarification of Terms in GC47 to GC50

46.1 For the purposes of GC47 to GC50,

46.1.1 "Unit Price Table" means the table set out in the Articles of Agreement, and

46.1.2 "plant" does not include tools customarily provided by a tradesman in practicing his trade.

GC47 Additions or Amendments to Unit Price Table

47.1 Where a Unit Price Arrangement applies to the contract or a part thereof the Departmental Representative and the Contractor may, by an agreement in writing,

47.1.1 add classes of labour or material, and units of measurement, prices per unit and estimated quantities to the Unit Price Table if any labour, plant or material that is to be included in the Final Certificate of Measurement referred to in GC44.8 is not included in any class of labour, plant or material set out in the Unit Price Table; or

47.1.2 subject to GC47.2 and GC47.3, amend a price set out in the Unit Price Table for any class of labour, plant or material included therein if the Final Certificate of Measurement referred to in GC44.8 shows or is expected to show that the total quantity of that class of labour, plant or material actually performed, used or supplied by the Contractor in performing the work is

47.1.2.1 less than 85% of that estimated total quantity, or

47.1.2.2 in excess of 115% of that estimated total quantity.

47.2 In no event shall the total cost of an item set out in the Unit Price Table that has been amended pursuant to GC47.1.2.1 exceed the amount that would have been payable to the Contractor had the estimated total quantity actually been performed, used or supplied.

47.3 An amendment that is made necessary by GC47.1.2.2 shall apply only to the quantities that are in excess of 115%.

47.4 If the Departmental Representative and the Contractor do not agree as contemplated in GC47.1, the Departmental Representative shall determine the class and the unit of measurement of the labour, plant or material and, subject to GC47.2 and GC47.3, the price per unit therefore shall be determined in accordance with GC50.

GC48 Determination of Cost – Unit Price Table

48.1 Whenever, for the purposes of the contract, it is necessary to determine the cost of labour, plant or material, it shall be determined by multiplying the quantity of that labour, plant or material expressed in the unit set out in column 3 of the Unit Price Table by the price of that unit set out in column 5 of the Unit Price Table.

GC49 Determination of Cost – Negotiation

49.1 If the method described in GC48 cannot be used because the labour, plant or material is of a kind or class that is not set out in the Unit Price Table, the cost of that labour, plant or material for the purposes of the contract shall be the amount agreed upon from time to time by the Contractor and the Departmental Representative.

49.2 For the purposes of GC49.1, the Contractor shall submit to the Departmental Representative any necessary cost information requested by the Departmental Representative in respect of the labour, plant and material referred to in GC49.1

GC50 Determination of Cost – Failing Negotiation

50.1 If the methods described in GC47, GC48 or GC49 fail for any reason to achieve a determination of the cost of labour, plant and material for the purposes referred to therein, that cost shall be equal to the aggregate of

50.1.1 all reasonable and proper amounts actually expended or legally payable by the Contractor in respect of the labour, plant and material that falls within one of the classes of expenditure described in GC50.2 that are directly attributable to the performance of the contract,

50.1.2 an allowance for profit and all other expenditures or costs, including overhead, general administration cost, financing and interest charges, and every other cost, charge and expenses, but not including those referred to in GC50.1.1 or GC50.1.3 or a class referred to in GC50.2, in an amount that is equal to 10% of the sum of the expenses referred to in GC50.1.1, and

50.1.3 interest on the cost determined under GC50.1.1 and GC50.1.2, which interest shall be calculated in accordance with TP9,

provide that the total cost of an item set out n the Unit Price Table that is subject to the provisions of GC47.1.2.1 does not exceed the amount that would have been payable to the Contractor had the estimated total quantity of the said item actually be performed, used or supplied.

50.2 For purposes of GC50.1.1 the classes of expenditure that may be taken into account in determining the cost of labour, plant and material are,

50.2.1 payments to subcontractors;

50.2.2 wages, salaries and travelling expenses of employees of the Contractor while they are actually and properly engaged on the work, other than wages, salaries, bonuses, living

and travelling expenses of personnel of the Contractor generally employed at the head office or at a general office of the Contractor unless they are engaged at the work site with the approval of the Departmental Representative,

50.2.3 assessments payable under any statutory authority relating to workmen's compensation, unemployment insurance, pension plan or holidays with pay;

50.2.4 rent that is paid for plant or an amount equivalent of the said rent if the plant is owned by the Contractor that is necessary for and used in the performance of the work, if the rent of the equivalent amount is reasonable and use of that plant has been approved by the Departmental Representative;

50.2.5 payments for maintaining and operating plant necessary for and used in the performance of the work, and payments for effecting such repairs thereto as, in the opinion of the Departmental Representative, are necessary to the proper performance of the contract other than payments for any repairs to the plant arising out of defects existing before its allocation to the work;

50.2.6 payments for material that is necessary for and incorporated in the work, or that is necessary for and consumed in the performance of the contract;

50.2.7 payments for preparation, delivery, handling, erection, installation, inspection protection and removal of the plant and material necessary for and used in the performance of the contract; and

50.2.8 any other payments made by the Contractor with the approval of the Departmental Representative that are necessary for the performance of the contract.

GC51 Records to be kept by Contractor

51.1 The Contractor shall

51.1.1 maintain full records of his estimated and actual cost of the work together with all tender calls, quotations, contracts, correspondence, invoices, receipts and vouchers relating thereto.

51.1.2 make all records and material referred to in GC5.1.1 available to audit and inspection by the Minister and the Deputy Receiver General for Canada or by persons acting on behalf of either of both of them, when requested;

51.1.3 allow any of the person referred to in GC51.1.2 to make copies of and to take extracts from any of the records and material referred to in GC51.1.1; and

51.1.4 furnish any person referred to in GC51.1.2 with any information he may require from time to time in connection with such records and material.

51.2 The records maintained by the Contractor pursuant to GC51.1.1 shall be kept intact by the Contractor until the expiration of two years after the date that a Final Certificate of Completion referred to in GC44.1 was issued or until the expiration of such other period of time as the

Minister may direct.

51.3 The Contractor shall cause all subcontractors and all other persons directly or indirectly controlled by or affiliated with the Contractor and all persons directly or indirectly having control of the Contractor to comply with GC51.1 and GC51.2 as if they were the Contractor.

GC52 Conflict of Interest

52.1 It is a term of this contract that no former public office holder who is not in compliance with the Conflict of Interest and Post-Employment Code for Public Office Holders shall derive a direct benefit from this contract.

GC53 Contractor Status

53.1 The Contractor shall be engaged under the contract as an independent contractor.

53.2 The Contractor and any employee of the said Contractor is not engaged by the contract as an employee, servant or agent of Her Majesty.

53.3 For the purposes of GC53.1 and GC53.2 the Contractor shall be solely responsible for any and all payments and deductions required to be made by law including those required for Canada or Quebec Pension Plans, Unemployment Insurance, Worker's Compensation or Income Tax.

GENERAL CONDITONS

IC 1 Proof of Insurance
IC 2 Risk Management
IC 3 Payment of Deductible
IC 4 Insurance Coverage

GENERAL INSUANCE COVERAGES

GCI 1 Insured
GIC 2 Period of Insurance
GIC 3 Proof of Insurance
GIC 4 Notification

COMMERCIAL GENERAL LIABILITY

CGL 1 Scope of Policy
CGL 2 Coverages/Provisions
CGL 3 Additional Exposures
CGL 4 Insurance Proceeds
CGL 5 Deductible

BUILDER'S RISK – INSTALLATION FLOATER – ALL RISKS

BR 1 Scope of Policy
BR 2 Property Insured
BR 3 Insurance Proceeds
BR 4 Amount of Insurance
BR 5 Deductible
BR 6 Subrogation
BR 7 Exclusion Qualifications

INSURER'S CERTIFICATE OF INSURANCE

General Conditions

IC 1 Proof of Insurance
(02/12/03)

Within thirty (30) days after acceptance of the Contractor's tender, the Contractor shall, unless otherwise directed in writing by the Contracting Officer, deposit with the Contracting Officer an Insurer's Certificate of Insurance in the form displayed in this document and, if requested by the Contracting Officer, the originals or certified true copies of all contracts of insurance maintained by the Contractor pursuant to the Insurance Coverage Requirements shown hereunder.

IC 2 Risk Management
(01/10/94)

The provisions of the Insurance Coverage Requirements contained hereunder are not intended to cover all of the Contractor's obligations under GC8 of the General Conditions "C" of the contract. Any additional risk management measures or additional insurance coverages the Contractor may deem necessary to fulfill its obligations under GC8 shall be at its own discretion and expense.

IC 3 Payment of Deductible
(01/10/94)

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

IC 4 Insurance Coverage
(02/12/03)

The Contractor has represented that it has in place and effect the appropriate and usual liability insurance coverage as required by these Insurance Conditions and the Contractor has warranted that it shall obtain, in a timely manner and prior to commencement of the Work, the appropriate and usual property insurance coverage as required by these Insurance Conditions and, further, that it shall maintain all required insurance policies in place and effect as required by these Insurance Conditions.

INSURANCE COVERAGE REQUIREMENTS

PART I
GENERAL INSUANCE COVERAGES (GIC)

GCI 1 Insured
(02/12/03)

Each insurance policy shall insure the Contractor, and shall include, as an Additional Named Insured, Her Majesty the Queen in right of Canada, represented by the National Research Council Canada.

GIC 2 Period of Insurance
(02/12/03)

Unless otherwise directed in writing by the Contracting Officer or otherwise stipulated elsewhere in these Insurance Conditions, the policies required hereunder shall be in force and be maintained from the date of the contract award until the day of issue of the Departmental Representative's Final Certificate of Completion.

GIC 3 Proof of Insurance
(01/10/94)

Within twenty five (25) days after acceptance of the Contractor's tender, the Insurer shall, unless otherwise directed by the Contractor, deposit with the Contractor an Insurer's Certificate of Insurance in the form displayed in the document and, if requested, the originals or certified true copies of all contracts of insurance maintained by the Contractor pursuant to the requirements of these Insurance Coverages.

GIC 4 Notification
(01/10/94)

Each Insurance policy shall contain a provision that (30) days prior written notice shall be given by the Insurer to Her Majesty in the event of any material change in or cancellation of coverage. Any such notice received by the Contractor shall be transmitted forthwith to Her Majesty.

PART II
COMMERCIAL GENERAL LIABILITY

CGL 1 Scope of Policy
(01/10/94)

The policy shall be written on a form similar to that known and referred to in the insurance industry as IBC 2100 – Commercial General Liability policy (Occurrence form) and shall provide for limit of liability of not less than $2,000,000 inclusive for Bodily Injury and Property Damage for any one occurrence or series of occurrences arising out of one cause. Legal or defence cost incurred in respect of a claim or claims shall not operate to decrease the limit of liability.

CGL 2 Coverages/Provisions
(01/10/94)

The policy shall include but not necessarily be limited to the following coverages/provisions.

2.1 Liability arising out of or resulting from the ownership, existence, maintenance or use of premises by the Contractor and operations necessary or incidental to the performance of this contract.

2.2 "Broad Form" Property Damage including the loss of use of property.

2.3 Removal or weakening of support of any building or land whether such support be natural or otherwise.

2.4 Elevator liability (including escalators, hoists and similar devices).

2.5 Contractor's Protective Liability

2.6 Contractual and Assumed Liabilities un this contact.

2.7 Completed Operations Liability – The insurance, including all aspects of this Part II of these Insurance Conditions shall continue for a period of at least one (1) year beyond the date of the Departmental Representative's Final Certificate of Completion for the Completed Operations.

2.8 Cross Liability – The Clause shall be written as follows:

Cross Liability – The insurance as is afforded by this policy shall apply in respect to any claim or action brought against any one Insured by any other Insured. The coverage shall apply in the same manner and to the same extent as though a separate policy had been issued to each Insured. The inclusion herein of more than one Insured shall not increase the limit of the Insurer's liability.

2.9 Severability of Interests – The Clause shall be written as follows:

Severability of Interests – This policy, subject to the limits of liability stated herein, shall apply separately to each Insured in the same manner and to the same extent as if a separate policy had been issued to each. The inclusion herein of more than one insured shall not increase the limit of the Insurer's liability.

CGL 3 Additional Exposures
(02/12/03)

The policy shall either include or be endorsed to include the following exposures of hazards if the Work is subject thereto:

3.1 Blasting

3.2 Pile driving and calsson work

3.3 Underpinning

3.4 Risks associated with the activities of the Contractor on an active airport

3.5 Radioactive contamination resulting from the use of commercial isotopes

3.6 Damage to the portion of an existing building beyond that directly associated with an addition, renovation or installation contract.

3.7 Marine risks associated with the contraction of piers, wharves and docks.

CGL 4 Insurance Proceeds
(01/10/94)

Insurance Proceeds from this policy are usually payable directly to a Claimant/Third Party.

CGL 5 Deductible
(02/12/03)

This policy shall be issued with a deductible amount of not more than $10,000 per occurrence applying to Property Damage claims only.

PART III
BUILDER'S RISK – INSTALLATION FLOATER – ALL RISKS

BR 1 Scope of Policy
(01/10/94)

The policy shall be written on an "All Risks" basis granting coverages similar to those provided by the forms known and referred to in the insurance industry as "Builder's Risk Comprehensive Form" or "Installation Floater – All Risks".

BR 2 Property Insured
(01/10/94)

The property insured shall include:

2.1 The Work and all property, equipment and materials intended to become part of the finished Work at the site of the project while awaiting, during and after installation, erection or construction including testing.

2.2 Expenses incurred in the removal from the construction site of debris of the property insured, including demolition of damaged property, de-icing and dewatering, occasioned by loss, destruction or damage to such property and in respect of which insurance is provided by this policy.

BR 3 Insurance Proceeds
(01/10/94)

3.1 Insurance proceeds from this policy are payable in accordance with GC28 of the General Conditions "C" of the contract.

3.2 This policy shall provide that the proceeds thereof are payable to Her Majesty or as the Minister may direct.

3.3 The Contractor shall do such things and execute such documents as are necessary to effect payment of the proceeds.

BR 4 Amount of Insurance
(01/10/94)

The amount of insurance shall not be 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 Her Majesty at the site of the project to be incorporated into and form part of the finished Work.

BR 5 Deductible
(02/12/03)

The Policy shall be issued with a deductible amount of not more than $10,000.

BR 6 Subrogation
(01/10/94)

The following Clause shall be included in the policy:

"All rights of subrogation or transfer of rights are hereby waived against any corporation, firm, individual or other interest, with respect to which, insurance is provided by this policy".

BR 7 Exclusion Qualifications
(01/10/94)

The policy may be subject to the standard exclusions but the following qualifications shall apply:

7.1 Faulty materials, workmanship or design may be excluded only to the extent of the cost of making good thereof and shall not apply to loss or damage resulting therefrom.

7.2 Loss or damage caused by contamination by radioactive material may be excluded except for loss or damage resulting from commercial isotopes used for industrial measurements, inspection, quality control radiographic or photographic use.

7.3 Use and occupancy of the project or any part of section thereof shall be permitted where such use and occupancy is for the purpose for which the project is intended upon completion.

INSURER'S CERTIFICATE OF INSURANCE

(TO BE COMPLETED BY INSURER (NOT BOKER) AND DELIVERD TO NATIONAL RESEARCH COUNCIL CANADA WITH 30 DAYS FOLLOWING ACCEPTANCE OF TENDER)

CONTRACT

DESCRIPTION OF WORK	CONTRACT NUMBER	AWARD DATE
LOCATION		

INSURER

NAME
ADDRESS

BROKER

NAME
ADDRESS

INSURED

NAME OF CONTRACTOR
ADDRESS

ADDITIONAL INSURED

HER MAJESTY THE QUEEN IN RIGHT OF CANADA AS REPRESENTED BY THE NATIONAL RESEARCH COUNCIL CANADA

THIS DOCUENT CERTIFIES THAT THE FOLLOWING POLICES OF INSURANCE ARE AT PRESENT IN FORCE COVERING ALL OPERATIONS OF THE INSURE IN CONNECTION WITH THE CONTRACT MADE BETWEEN THE NAMED INSURED AND THE NATIONAL RESEARCH COUNCIL CANADA AND IN ACCORDANCE WITH THE INSURANCE CONDITIONS "E"

POLICY					
TYPE	NUMBER	INCEPTION DATE	EXPIRY DATE	LIMITS OF LIABILITY	DEDUCTIBLE
COMMERCIAL GENERAL LIABILITY					
BUILDERS RISK "AL RISKS"					
INSTALLATION FLOATER "ALL RISKS"					

THE INSURER AGREES TO NOTIFY THE NATIONAL RESEARCH COUNCIL CANADA IN WRITING 30 DAYS PRIOR TO ANY MATERIAL CHANGE IN OR CANCELLATION OF ANY POLICY OR COVERAGE SPECIFICALLY RELATED TO THE CONTRACT

NAME OF INSURER'S OFFICER OR AUTHORIZED EMPLOYEE	SIGNATURE	DATE:
		TELEPHONE NUMBER:

ISSUANCE OF THIS CERTIFIATE SHALL NOT LIMIT OR RESTRICT THE RIGHT OF THE NATIONAL RESEARCH COUNCIL CANADA TO REQUEST AT ANY TIME DUPLICATE COPIES OF SAID INSURANCE POLICIES

CS1 Obligation to provide Contract Security

1.1 The Contractor shall, at the Contractor's own expense, provide one or more of the forms of contract security prescribed in CS2.

1.2 The Contractor shall deliver to the Departmental Representative the contract security referred to in CS1.1 within 14 days after the date that the Contractor receives notice that the Contractor's tender or offer was accepted by Her Majesty.

CS2 Prescribed Types and Amounts of Contract Security

2.1 The Contractor shall deliver to the Departmental Representative pursuant to CS1

2.1.1 a performance bond and a labour and material payment bond each in an amount that is equal to not less than 50% of the contract amount referred to in the Articles of Agreement, or

2.1.2 a labour and material payment bond in an amount that is equal to not less than 50% of the contract amount referred to in the Articles of Agreement, and a security deposit in an amount that is equal to

2.1.2.1 not less than 10% of the contract amount referred to in the Articles of Agreement where that amount does not exceed $250,000, or

2.1.2.2 $25,000 plus 5% of the part of the contract amount referred to in the Articles of Agreement that exceeds $250,000, or

2.1.3 a security deposit in an amount prescribed by CS2.12 plus an additional amount that is equal to 10% of the contract amount referred to in the Articles of Agreement.

2.2 A performance bond and a labour and material payment bond referred to in CS2.1 shall be in a form and be issued by a bonding or surety company that is approved by Her Majesty.

2.3 The amount of a security deposit referred to in CS2.1.2 shall not exceed $250,000 regardless of the contract amount referred to in the Articles of Agreement.

2.4 A security deposit referred to in CS2.1.2 and CS2.1.3 shall be in the form of

2.4.1 a bill of exchange made payable to the Receiver General of Canada and certified by an approved financial institution or drawn by an approved financial institution on itself, or

2.4.2 bonds of or unconditionally guaranteed as to principal and interest by the Government of Canada.

2.5 For the purposes of CS2.4

2.5.1 a bill of exchange is an unconditional order in writing signed by the Contractor and addressed to an approved financial institution, requiring the said institution to pay, on demand, at a fixed or determinable future time a sum certain of money to, or to the order

of, the Receiver General for Canada, and

2.5.2 If a bill of exchange is certified by a financial institution other than a chartered bank then it must be accompanied by a letter or stamped certification confirming that the financial institution is in a t least one of the categories referred to in CS2.5.3

2.5.3 an approved financial institution is

2.5.3.1 any corporation or institution that is a member of the Canadian Payments Association,

2.5.3.2 a corporation that accepts deposits that are insured by the Canada Deposit Insurance Corporation or the Régie de l'assurance-dépôts du Québec to the maximum permitted by law,

2.5.3.3 a credit union as defined in paragraph 137(6)(b) of the *Income Tax Act*,

2.5.3.4 a corporation that accepts deposits from the public, if repayment of the deposit is guaranteed by Her Majesty in right of a province, or

2.5.3.5 The Canada Post Corporation.

2.5.4 the bonds referred to in CS2.4.2 shall be

2.5.4.1 made payable to bearer, or

2.5.4.2 accompanied by a duly executed instrument of transfer of the bonds to the Receiver General for Canada in the form prescribed by the Domestic Bonds of Canada Regulations, or

2.5.4.3 registered, as to principal or as to principal and interest in the name of the Receiver General for Canada pursuant to the Domestic Bonds of Canada Regulations, and

2.5.4.4 provided on the basis of their market value current at the date of the contract.

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Contract Number / Numéro du contrat	
Security Classification / Classification de sécurité	

SECURITY REQUIREMENTS CHECK LIST (SRCL)
LISTE DE VÉRIFICATION DES EXIGENCES RELATIVES À LA SÉCURITÉ (LVERS)

PART A - CONTRACT INFORMATION / PARTIE A - INFORMATION CONTRACTUELLE

1. Originating Government Department or Organization / Ministère ou organisme gouvernemental d'origine	2. Branch or Directorate / Direction générale ou Direction
National Research Council	ASPM

3. a) Subcontract Number / Numéro du contrat de sous-traitance	3. b) Name and Address of Subcontractor / Nom et adresse du sous-traitant

4. Brief Description of Work / Brève description du travail
Construct an aircaft Cabin Comfort & Environment Research Facility in M22.

5. a) Will the supplier require access to Controlled Goods? Le fournisseur aura-t-il accès à des marchandises contrôlées?	☒ No Non	☐ Yes Oui
5. b) Will the supplier require access to unclassified military technical data subject to the provisions of the Technical Data Control Regulations? Le fournisseur aura-t-il accès à des données techniques militaires non classifiées qui sont assujetties aux dispositions du Règlement sur le contrôle des données techniques?	☒ No Non	☐ Yes Oui
6. Indicate the type of access required / Indiquer le type d'accès requis		
6. a) Will the supplier and its employees require access to PROTECTED and/or CLASSIFIED information or assets? Le fournisseur ainsi que les employés auront-ils accès à des renseignements ou à des biens PROTÉGÉS et/ou CLASSIFIÉS? (Specify the level of access using the chart in Question 7. c) (Préciser le niveau d'accès en utilisant le tableau qui se trouve à la question 7. c)	☒ No Non	☐ Yes Oui
6. b) Will the supplier and its employees (e.g. cleaners, maintenance personnel) require access to restricted access areas? No access to PROTECTED and/or CLASSIFIED information or assets is permitted. Le fournisseur et ses employés (p. ex. nettoyeurs, personnel d'entretien) auront-ils accès à des zones d'accès restreintes? L'accès à des renseignements ou à des biens PROTÉGÉS et/ou CLASSIFIÉS n'est pas autorisé.	☐ No Non	☒ Yes Oui
6. c) Is this a commercial courier or delivery requirement with **no** overnight storage? S'agit-il d'un contrat de messagerie ou de livraison commerciale **sans** entreposage de nuit?	☒ No Non	☐ Yes Oui

7. a) Indicate the type of information that the supplier will be required to access / Indiquer le type d'information auquel le fournisseur devra avoir accès

Canada ☒	NATO / OTAN ☐	Foreign / Étranger ☐

7. b) Release restrictions / Restrictions relatives à la diffusion

Canada	NATO / OTAN	Foreign / Étranger
No release restrictions / Aucune restriction relative à la diffusion ☒	All NATO countries / Tous les pays de l'OTAN ☐	No release restrictions / Aucune restriction relative à la diffusion ☐
Not releasable / À ne pas diffuser ☐		
Restricted to: / Limité à : Specify country(ies): / Préciser le(s) pays : ☐	Restricted to: / Limité à : Specify country(ies): / Préciser le(s) pays : ☐	Restricted to: / Limité à : Specify country(ies): / Préciser le(s) pays : ☐

7. c) Level of information / Niveau d'information

Canada	NATO	Foreign / Étranger
PROTECTED A / PROTÉGÉ A ☐	NATO UNCLASSIFIED / NATO NON CLASSIFIÉ ☐	PROTECTED A / PROTÉGÉ A ☐
PROTECTED B / PROTÉGÉ B ☐	NATO RESTRICTED / NATO DIFFUSION RESTREINTE ☐	PROTECTED B / PROTÉGÉ B ☐
PROTECTED C / PROTÉGÉ C ☐	NATO CONFIDENTIAL / NATO CONFIDENTIEL ☐	PROTECTED C / PROTÉGÉ C ☐
CONFIDENTIAL / CONFIDENTIEL ☐	NATO SECRET / NATO SECRET ☐	CONFIDENTIAL / CONFIDENTIEL ☐
SECRET / SECRET ☐	COSMIC TOP SECRET / COSMIC TRÈS SECRET ☐	SECRET / SECRET ☐
TOP SECRET / TRÈS SECRET ☐		TOP SECRET / TRÈS SECRET ☐
TOP SECRET (SIGINT) / TRÈS SECRET (SIGINT) ☐		TOP SECRET (SIGINT) / TRÈS SECRET (SIGINT) ☐

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PART A *(continued)* / PARTIE A *(suite)*

8. Will the supplier require access to PROTECTED and/or CLASSIFIED COMSEC information or assets? ☒ No / Non ☐ Yes / Oui
Le fournisseur aura-t-il accès à des renseignements ou à des biens COMSEC désignés PROTÉGÉS et/ou CLASSIFIÉS?
If Yes, indicate the level of sensitivity:
Dans l'affirmative, indiquer le niveau de sensibilité :

9. Will the supplier require access to extremely sensitive INFOSEC information or assets? ☒ No / Non ☐ Yes / Oui
Le fournisseur aura-t-il accès à des renseignements ou à des biens INFOSEC de nature extrêmement délicate?

Short Title(s) of material / Titre(s) abrégé(s) du matériel :
Document Number / Numéro du document :

PART B - PERSONNEL (SUPPLIER) / PARTIE B - PERSONNEL (FOURNISSEUR)

10. a) Personnel security screening level required / Niveau de contrôle de la sécurité du personnel requis

☒ RELIABILITY STATUS COTE DE FIABILITÉ	☐ CONFIDENTIAL CONFIDENTIEL	☐ SECRET SECRET	☐ TOP SECRET TRÈS SECRET
☐ TOP SECRET– SIGINT TRÈS SECRET – SIGINT	☐ NATO CONFIDENTIAL NATO CONFIDENTIEL	☐ NATO SECRET NATO SECRET	☐ COSMIC TOP SECRET COSMIC TRÈS SECRET
☐ SITE ACCESS ACCÈS AUX EMPLACEMENTS			

Special comments:
Commentaires spéciaux : _____

NOTE: If multiple levels of screening are identified, a Security Classification Guide must be provided.
REMARQUE : Si plusieurs niveaux de contrôle de sécurité sont requis, un guide de classification de la sécurité doit être fourni.

10. b) May unscreened personnel be used for portions of the work? ☒ No / Non ☐ Yes / Oui
Du personnel sans autorisation sécuritaire peut-il se voir confier des parties du travail?
If Yes, will unscreened personnel be escorted? ☐ No / Non ☐ Yes / Oui
Dans l'affirmative, le personnel en question sera-t-il escorté?

PART C - SAFEGUARDS (SUPPLIER) / PARTIE C - MESURES DE PROTECTION (FOURNISSEUR)

INFORMATION / ASSETS / RENSEIGNEMENTS / BIENS

11. a) Will the supplier be required to receive and store PROTECTED and/or CLASSIFIED information or assets on its site or premises? ☒ No / Non ☐ Yes / Oui
Le fournisseur sera-t-il tenu de recevoir et d'entreposer sur place des renseignements ou des biens PROTÉGÉS et/ou CLASSIFIÉS?

11. b) Will the supplier be required to safeguard COMSEC information or assets? ☒ No / Non ☐ Yes / Oui
Le fournisseur sera-t-il tenu de protéger des renseignements ou des biens COMSEC?

PRODUCTION

11. c) Will the production (manufacture, and/or repair and/or modification) of PROTECTED and/or CLASSIFIED material or equipment occur at the supplier's site or premises? ☒ No / Non ☐ Yes / Oui
Les installations du fournisseur serviront-elles à la production (fabrication et/ou réparation et/ou modification) de matériel PROTÉGÉ et/ou CLASSIFIÉ?

INFORMATION TECHNOLOGY (IT) MEDIA / SUPPORT RELATIF À LA TECHNOLOGIE DE L'INFORMATION (TI)

11. d) Will the supplier be required to use its IT systems to electronically process, produce or store PROTECTED and/or CLASSIFIED information or data? ☒ No / Non ☐ Yes / Oui
Le fournisseur sera-t-il tenu d'utiliser ses propres systèmes informatiques pour traiter, produire ou stocker électroniquement des renseignements ou des données PROTÉGÉS et/ou CLASSIFIÉS?

11. e) Will there be an electronic link between the supplier's IT systems and the government department or agency? ☒ No / Non ☐ Yes / Oui
Disposera-t-on d'un lien électronique entre le système informatique du fournisseur et celui du ministère ou de l'agence gouvernementale?

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PART C - *(continued)* / PARTIE C - *(suite)*

For users completing the form **manually** use the summary chart below to indicate the category(ies) and level(s) of safeguarding required at the supplier's site(s) or premises.
Les utilisateurs qui remplissent le formulaire **manuellement** doivent utiliser le tableau récapitulatif ci-dessous pour indiquer, pour chaque catégorie, les niveaux de sauvegarde requis aux installations du fournisseur.

For users completing the form **online** (via the Internet), the summary chart is automatically populated by your responses to previous questions.
Dans le cas des utilisateurs qui remplissent le formulaire **en ligne** (par Internet), les réponses aux questions précédentes sont automatiquement saisies dans le tableau récapitulatif.

SUMMARY CHART / TABLEAU RÉCAPITULATIF

Category Catégorie	PROTECTED PROTÉGÉ			CLASSIFIED CLASSIFIÉ			NATO				COMSEC					
	A	B	C	CONFIDENTIAL CONFIDENTIEL	SECRET	TOP SECRET TRÈS SECRET	NATO RESTRICTED NATO DIFFUSION RESTREINTE	NATO CONFIDENTIAL NATO CONFIDENTIEL	NATO SECRET	COSMIC TOP SECRET COSMIC TRÈS SECRET	PROTECTED PROTÉGÉ A	 B	 C	CONFIDENTIAL CONFIDENTIEL	SECRET	TOP SECRET TRES SECRET
Information / Assets Renseignements / Biens	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Production	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
IT Media / Support TI	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
IT Link / Lien électronique	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

12. a) Is the description of the work contained within this SRCL PROTECTED and/or CLASSIFIED?
La description du travail visé par la présente LVERS est-elle de nature PROTÉGÉE et/ou CLASSIFIÉE?

☒ No / Non ☐ Yes / Oui

If Yes, classify this form by annotating the top and bottom in the area entitled "Security Classification".
Dans l'affirmative, classifier le présent formulaire en indiquant le niveau de sécurité dans la case intitulée « Classification de sécurité » au haut et au bas du formulaire.

12. b) Will the documentation attached to this SRCL be PROTECTED and/or CLASSIFIED?
La documentation associée à la présente LVERS sera-t-elle PROTÉGÉE et/ou CLASSIFIÉE?

☒ No / Non ☐ Yes / Oui

If Yes, classify this form by annotating the top and bottom in the area entitled "Security Classification" and indicate with attachments (e.g. SECRET with Attachments).
Dans l'affirmative, classifier le présent formulaire en indiquant le niveau de sécurité dans la case intitulée « Classification de sécurité » au haut et au bas du formulaire et indiquer qu'il y a des pièces jointes (p. ex. SECRET avec des pièces jointes).

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PART D - AUTHORIZATION / PARTIE D - AUTORISATION

13. Organization Project Authority / Chargé de projet de l'organisme

Name (print) - Nom (en lettres moulées)	Title – Titre	Signature
Robin Craig	Construction Project Manager	

Telephone No. - N° de téléphone	Facsimile No. - N° de télécopieur	E-mail address - Adresse courriel	Date
613-993-6869	613-957-9828	Robin.Craig@nrc-cnrc.gc.ca	2015 April 14

14. Organization Security Authority / Responsable de la sécurité de l'organisme

Name (print) - Nom (en lettres moulées)	Title – Titre	Signature
Charlotte Carrier	Controlled Goods and Contracts Security Coordinator	

Telephone No. - N° de téléphone	Facsimile No. - N° de télécopieur	E-mail address - Adresse courriel	Date
601-993-8956	613-990-0946	Charlotte.Carrier@nrc-cnrc.gc.ca	2015 April 15

15. Are there additional instructions (e.g. Security Guide, Security Classification Guide) attached?
Des instructions supplémentaires (p. ex. Guide de sécurité, Guide de classification de la sécurité) sont-elles jointes?

☒ No / Non ☐ Yes / Oui

16. Procurement Officer / Agent d'approvisionnement

Name (print) - Nom (en lettres moulées)	Title – Titre	Signature
M. BEDARD	Senior Contracts Officer	

Telephone No. - N° de téléphone	Facsimile No. - N° de télécopieur	E-mail address - Adresse courriel	Date
613 993-2274			17/4/15

17. Contracting Security Authority / Autorité contractante en matière de sécurité

Name (print) - Nom (en lettres moulées)	Title – Titre	Signature

Telephone No. - N° de téléphone	Facsimile No. - N° de télécopieur	E-mail address - Adresse courriel	Date