SEPW Architecture Inc.

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PROJECT

TBU50 HVAC Replacement
Regina, Saskatchewan

PROJECT No.	SET No.
57/2017	
DATE	
2018-03-31	

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END OF SECTION

Part 1 General

1.1 WORK COVERED BY CONTRACT DOCUMENTS

.1 Work of this Contract comprises of replacing aging HVAC equipment and adding exhaust equipment to an existing building. The AHU equipment is located in a basement mechanical room and requires excavation below a crawlspace to access the mechanical room. The project site is located in Regina, Saskatchewan and further identified as "TBU 50 HVAC Replacement, Regina, SK".

1.2 WORK SEQUENCE

.1 The General Contractor will be responsible for the coordination of all work.

.2 Co-ordinate Progress Schedule and co-ordinate with Departmental Representative's Occupancy during construction.

.3 Construct work in stages to accommodate Departmental Representative's continued use of premises during construction.

.4 Maintain fire access/control.

1.3 CONTRACTOR USE OF PREMISES

.1 Limit use of premises for Work, for access, and for storage, to allow:

.1 Owner occupancy.

.2 Adjacent pedestrian and vehicular movement.

.2 Coordinate use of premises under direction of Departmental Representative.

.3 Obtain and pay for use of additional storage or work areas needed for operations under this Contract.

.4 Cooperate with other contractors employed by the Departmental Representative for other work within the building.

1.4 OWNER OCCUPANCY

.1 Owner will occupy premises during entire construction period for execution of normal operations.

.2 Co-operate with Owner in scheduling operations to minimize conflict and to facilitate Owner usage.

1.5 ALTERATIONS, ADDITIONS OR REPAIRS TO EXISTING BUILDING

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

1.6 EXISTING SERVICES

.1 Notify, Departmental Representative and utility companies of intended interruption of services and obtain required permission.

.2 Work will involve breaking into existing services in the building. Provide Departmental Representative 72 hours of notice for necessary interruption of mechanical and electrical service throughout course of work. Minimize duration of interruptions. Carry out work at times as directed by governing authorities with minimum disturbance to pedestrian, vehicular traffic and tenant operations.

.3 Establish location and extent of service lines in area of work before starting Work. Notify Departmental Representative of findings.

.4 Submit schedule to and obtain approval from Departmental Representative for any shut-down or closure of active service or facility including power and communications services. Adhere to approved schedule and provide notice to affected parties.

.5 Provide temporary services to maintain critical building and tenant systems.

.6 Provide adequate bridging over trenches which cross sidewalks or roads to permit normal traffic.

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

.8 Protect, relocate or maintain existing active services. When inactive services are encountered, cap off in manner approved by authorities having jurisdiction.

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

.10 Construct barriers in accordance with Section 01 56 00 - Temporary Barriers and Enclosures.

1.7 DOCUMENTS REQUIRED

.1 Maintain at job site, one copy each document as follows:

- .1 Contract Drawings.
- .2 Specifications.
- .3 Addenda.
- .4 Reviewed and Outstanding Shop Drawings.
- .5 Change Orders.
- .6 Other Modifications to Contract.
- .7 Field Test Reports.
- .8 Copy of Approved Work Schedule.
- .9 Health and Safety Plan and Other Safety Related Documents.
- .10 Other documents as specified.

END OF SECTION

Part 1 General

1.1 USE OF SITE AND FACILITIES

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

.2 Normal hours of operation are between 08:00 – 16:30, Monday to Friday.

.3 Noise generating activities and access to the occupied spaces are to be coordinated with Departmental Representative and conducted outside of normal hours of operation.

1.2 EXISTING SERVICES AND BUILDING SYSTEMS

.1 Notify, Departmental Representative of intended interruption of services or building mechanical or electrical systems and obtain required permission.

.2 Where Work involves breaking into or connecting to existing services or disruption to electrical or mechanical systems, give Departmental Representative 72 hours of notice for necessary interruption of mechanical or electrical service throughout course of work. Keep duration of interruptions minimal.

.3 Carry out interruptions after normal working hours of occupants, preferably on weekends.

1.3 SPECIAL REQUIREMENTS

.1 Submit schedule in accordance with Section 01 32 16 - Construction Progress Schedules - Bar (GANTT) Chart.

.2 Ensure that Contractor personnel employed on site become familiar with and obey regulations including safety, fire, traffic and security regulations.

.3 Keep within limits of work and avenues of ingress and egress.

1.4 SECURITY CLEARANCES

.1 Contractor personnel must submit to local law enforcement verification by RCMP, prior to admittance to the facility site. The Client reserves the right to deny access to any facility / site or part thereof to any Contractor personnel, at any time.

.2 All access to the building is to be through a designated entrance. Personnel will be required to pick up a security pass at a separate building on site. At the time of security pass pick up, personnel will be required to hand over a piece of government issued identification complete with photo. Security passes must be worn at all times. Passes are to be returned at end of work shift and at which time identification will be returned.

.3 Security documents are attached at the end of the Section.

1.5 SECURITY ESCORT

.1 Personnel employed on this project must be escorted when executing work in non-public areas during normal working hours. Personnel must be escorted in all areas after normal working hours.

.2 Departmental Representative requires minimum 72 hours' notice to provide escort for personnel.

1.6 BUILDING SMOKING ENVIRONMENT

.1 Comply with smoking restrictions. No smoking will be allowed in or around the building. Smoking is allowed only in areas indicated by Departmental Representative.

.2 Turn off vehicles when they are parked next to building.

1.7 OCCUPIED SPACES

.1 Intent of project schedule is that spaces designated for renovations for the interior work will be vacated in sequence, except for Room 101 and Room 102, to allow Work to proceed within designated unoccupied areas. Corridors and adjacent spaces will remain occupied for the complete duration of work. Prior to commencing work, Contractor to provide proposed Sequencing of Phased Work for review and acceptance by the Departmental Representative.

.2 Room 101 and Room 102 will remain occupied during normal working hours for the complete duration of construction.

.3 Common spaces within the building must remain clear for pedestrian access within building by occupants. Common corridors must remain unencumbered so that access to exits are maintained throughout the construction period.

.4 Spaces adjacent to the renovated areas will be occupied. Full-height demising partitions must be in place prior to Work on the interior fit up commencing. Maintain heat and power to occupied spaces.

.5 Coordinate the work with the occupancy schedule of the building, which will be provided by the Departmental Representative. Schedule work outside of the occupancy schedule within the occupied spaces identified by the Departmental Representative.

1.8 SERVICE DISRUPTIONS

.1 Minimize duration of disruptions of mechanical systems. Sequence work on ductwork to maintain operational mechanical system for as long as possible. Schedule work to take place outside of regular work hours.

.2 Minimize duration of disruptions of electrical systems. Schedule work to take place outside of regular work hours.

END OF SECTION

RCMP Clearance Requirements (Law Enforcement Checks)

.1 All personnel employed on this project will be subject to at a minimum, the RCMP Facilities Access Level 2 clearance requirements by the RCMP.

.2 Prior to the commencement of the on-site activities, all personnel engaged in the execution of the work on the exterior or interior of an RCMP occupied and/or unoccupied building or outside on the grounds, shall have at a minimum, the requisite RCMP Facilities Access Level 2 clearance.

.3 Immediately upon award of the contract, the Contractor shall prepare and submit the attached requisite forms, provided by the Departmental Representative (or failing that the RCMP Project Manager), for each Contractor employee and sub-contractor employee to be engaged in the work on the exterior or interior of an occupied and/or unoccupied building or outside on the grounds. In addition, Contractor's employees and sub-contractor employees must include with their requisite forms, government issued documents (driver's license/photo identification and birth certificate), for each Contractor employee and sub-contractor employee engaged in the work at the RCMP as noted above.

To eliminate delays in the clearance process, all clearance documents completed by the Contractor's employees and sub-contractor employees must be reviewed by the Contractor to ensure that all requested information has been provided, prior to submitting documents to the RCMP. Incomplete forms will be returned to the Contractor.

The Contractor's employees and sub-contractor employees shall only mobilize on site, once the requisite RCMP clearance has been granted.

.4 The Contractor should batch the fully completed submissions, based on priority work on site and allow for a minimum twenty (20) working days processing time in the project schedule for the review to occur (from the date the completed documents are received by the RCMP). The inability to submit the fully completed requisite forms and documents will not be reason for an extension to the project schedule or additional compensation.

.5 The Contractor's employees and subcontractor employees must be escorted at all times by a designate of the RCMP. This designate will be at no cost to the Contractor.

.6 The Contractor shall give the RCMP 72 hours notice for work to be carried out during periods outside of the normal working hours of Monday to Friday, from 06:00 to 18:00 hours.

.7 At the request of the Departmental Representative (or failing that the RCMP Project Manager), Contractor's employees and sub-contractor employees may be requested to undertake additional clearance requirements, to obtain the RCMP Reliability Status clearance. Additional clearance requirements would include submission of the completed TBS 330-60 form and Security Pre-Interview Questionnaire form, fingerprints for verification purposes (at no cost to the Contractor) and undertaking of an interview. This would enable the Contractor's employees or sub-contractor employees, whom have been granted the RCMP Reliability Status clearance, unescorted access to some occupied and/or unoccupied RCMP buildings, or outside on the grounds. Additional processing time (approximately forty working days) will be required for this clearance.

RCMP NORTH WEST REGION
DEPARTMENTAL SECURITY SECTION
Contractor/Consultant Information Sheet
DEPOT CONSTRUCTION SITES

PLEASE PRINT LEGIBLY / ALL INFORMATION MUST BE PROVIDED

CONTRACTORS / CONSULTANTS TO COMPLETE

Contractors/Consultants to provide the requested information below.
This completed form must be returned with the attached clearance forms and 2 copies of personal identification (driver's license/photo identification & Birth Certificate, Passport, Firearms License) to:

RCMP Depot Security Administration
Attention: Security Clearances
Fort Dufferin Dorm, 5600 – 11 Avenue
Regina, SK S4P 3J7

1. Your Complete Legal Name: *(First/Middle or "no Middle Name"/ Last Name)*	
2. Name of Company That You Work For:	
3. Company Telephone Number:	
4. Project That You Are Working On: (*Name of Project/Building/City/Province*)	
5. Access Period (Start & End Dates): *(If exact dates unknown, estimate start &end dates)*	

CONTRACTORS / CONSULTANTS - PLEASE NOTE THE FOLLOWING:

Should an RCMP Access tag/card be issued to you, please note the following;

1) You are the sole user of the access tag and it must be visibly worn while working on the site.
2) The access tag is non-transferrable / cannot be used while working on projects other than the RCMP projects it was issued for.
3) The access tag must be returned to the RCMP issuing office or site foreman (if approved) at the end of each day.
4) Please park in designated areas only, as outlined by the RCMP Project Manager.
5) Contractors/Consultants must abide by the RCMP Smoking Policy: *Smoking is not permitted anywhere at Depot except in the designated smoking area within the work site, as approved by the RCMP.*
6) PLEASE NOTE CONTRACTORS ARE NOT PERMITTED TO OBTAIN FOOD AND/OR DRINK IN THE RCMP DIVISION MESS.
7) NO ACCESS TO AREAS THAT YOU HAVE NOT BEEN CLEARED WILL BE ALLOWED AND IF FOUND IN THESE AREAS YOUR CLEARANCE MAY BE REVOKED AND YOU MAY BE REMOVED FROM THE SITE.

Employee Signature:	Signed on Date:

EMPLOYER TO REVIEW (not employee applicant of this form), COMPLETE AND SIGN:

In order to comply with Federal Government and RCMP policies and guidelines, in relation to the collection of personal information, the employer requesting the security checks must be satisfied that he/she can confirm the identity of the applicant.

The employer MUST ("employer" is your supervisor or a colleague of the company that you are employed by):

1) Request that their employees attend in person and provided two pieces of Identification.
2) ID MUST include full date of birth and name of the individual (ie. Drivers Licence - Birth Certificate, Passport, Firearms Licence). (One piece of ID must include the photograph and if using the Drivers Licence copy both the photo portion as well as the signature portion.)
3) If the employee has changed his/her name, ID MUST BE provided with both the current as well as past names.

Type of ID PROVIDED: **1)**_____**Number**_____

2)_____**Number**_____

Employers Name: _____
(First Name and Last Name)

Employers Signature: _____

Date of signature: _____

…/2

Facilities Access Level 2 (FA2) clearance Applicants:

Documents noted in the box below must be provided with your FA2 clearance application
(Facilities Access Level 2 Clearance Forms to be completed for FA2 clearances:

1. Contractor/ Consultant Information Sheet *AND*
2. Form TBS 330-23E):

CONTRACTORS/CONSULTANTS MUST PROVIDE PHOTOCOPIES OF:	
I HAVE ATTACHED THE FOLLOWING DOCUMENTS TO THE ABOVE NOTED FORMS:	**YES / NO**
1. Driver's License (a clear copy of both the front and back of the document on the same page, certified to be a true copy by their supervisor or colleague). ***Note:*** **1.** If you do not have a Driver's License, please provide other government issued photo identification (passport, treaty card). **2.** The photo must be clear.	
2. Birth Certificate (a clear copy of both the front and back of the document on one page, certified to be a true copy by their supervisor or colleague). ***Note:*** **1.** If you do not have a Birth Certificate, please provide other government issued identification (ie. Health Card Card, passport, treaty card).	

RCMP Reliability Status (RRS) clearance Applicants:

Documents noted in the box below must be provided with your RRS clearance application
RRS Clearance Forms to be completed for RRS clearances:

1. Contractor/ Consultant Information Sheet
2. Form TBS 330-23E
3. Form TBS 330-60E *AND*
4. Security/Reliability Pre-Interview Questionnaire:

CONTRACTORS/CONSULTANTS MUST PROVIDE PHOTOCOPIES OF:	
I HAVE ATTACHED THE FOLLOWING DOCUMENTS TO THE ABOVE NOTED FORMS:	**YES / NO**
1. Driver's License (a clear copy of both the front and back of the document on the same page, certified to be a true copy by their supervisor or colleague). ***Note:*** 1. If you do not have a Driver's License, please provide other government issued photo identification (passport, treaty card). 2. The photo must be clear.	
1. Birth Certificate (a clear copy of both the front and back of the document on one page, certified to be a true copy by their supervisor or colleague). **DOCUMENT MUST BE PROVIDED FOR RRS CLEARANCES – NO ALTERNATE DOCUMENTS IN LIEU OF BIRTH CERTIFICATE.**	
2. Two current Passport Style Photographs (do not have to be certified)	
3. Two sets of Fingerprints ("Roll and Ink" style) – must be obtained from a Corp of Commissionaires office.	

PLEASE CHECK WITH THE GENERAL CONTRACTOR IF YOU ARE UNSURE WHAT LEVEL OF SECURITY CLEARANCE YOU SHOULD BE APPLYING FOR.

Government of Canada / Gouvernement du Canada

PROTECTED (when completed)

PERSONNEL SCREENING, CONSENT AND AUTHORIZATION FORM

OFFICE USE ONLY		
Reference number	Department/Organization number	File number

NOTE: For *Privacy Act* Statement refer to Section C of this form and for completion instructions refer to attached instructions.
Please typewrite or print in block letters.

A ADMINISTRATIVE INFORMATION (To be completed by the Authorized Departmental/Agency/Organizational Official)

☐ **New** ☐ **Update** ☐ **Upgrade** ☐ **Transfer** ☐ **Supplemental** ☐ **Re-activation**

The requested level of reliability/security check(s)

☐ Reliability Status ☐ Level I (CONFIDENTIAL) ☐ Level II (SECRET) ☐ Level III (TOP SECRET)

☐ Other _____

PARTICULARS OF APPOINTMENT/ASSIGNMENT/CONTRACT

☐ Indeterminate ☐ Term ☐ Contract ☐ Industry ☐ Other (specify secondment, assignment, etc.) _____

Justification for security screening requirement

Position/Competition/Contract number	Title		Group/Level (Rank if applicable)
Employee ID number/PRI/Rank and Service number (if applicable)	If term or contract, indicate duration period ▶	From	To
Name and address of department / organization / agency	Name of official	Telephone number ( )	Facsimile number ( )

B BIOGRAPHICAL INFORMATION (To be completed by the applicant)

Surname (Last name)	Full given names (no initials) underline or circle usual name used	Family name at birth

All other names used (i.e. Nickname)	Sex ☐ Male ☐ Female	Date of birth Y M D	Country of birth	Date of entry into Canada if born outside Canada Y M D

RESIDENCE (provide addresses for the last five years, starting with the most current) Home address	Daytime telephone number ( )	E-mail address

	Apartment number	Street number	Street name	Civic number (if applicable)	From Y M	To present
1	City	Province or state	Postal code	Country	Telephone number ( )	
2	Apartment number	Street number	Street name	Civic number (if applicable)	From Y M	To Y M
	City	Province or state	Postal code	Country	Telephone number ( )	

Have you previously completed a Government of Canada security screening form? ☐ Yes ☐ No	If yes, give name of employer, level and year of screening. Y

CRIMINAL CONVICTIONS IN AND OUTSIDE OF CANADA (see instructions)

Have you ever been convicted of a criminal offence for which you have not been granted a pardon? ☐ Yes ☐ No	If yes, give details. (charge(s), name of police force, city, province/state, country and date of conviction) ▼	
Charge(s)	Name of police force	City
Province/State	Country	Date of conviction ▶ Y M D

Government of Canada / Gouvernement du Canada

PERSONNEL SCREENING, CONSENT AND AUTHORIZATION FORM

PROTECTED (when completed)

Surname and full given names	Date of birth Y M D

C CONSENT AND VERIFICATION (To be completed by the applicant and authorized Departmental/Agency/Organizational Official)

Checks Required (See Instructions)	Applicant's initials	Name of official (print)	Official's initials	Official's Telephone number
1. ☐ Date of birth, address, education, professional qualifications, employment history, personal character references				( )
2. ☐ Criminal record check				( )
3. ☐ Credit check (financial assessment, including credit records check)				( )
4. ☐ Loyalty (security assessment only)				
5. ☐ Other (specify, see instructions) Law Enforcement Records Checks				( )

The Privacy Act Statement
The information on this form is required for the purpose of providing a security screening assessment. It is collected under the authority of subsection 7(1) of the *Financial Administration Act* and the Government Security Policy (GSP) of the Government of Canada, and is protected by the provisions of the *Privacy Act* in institutions that are covered by the *Privacy Act*. Its collection is mandatory. A refusal to provide information will lead to a review of whether the person is eligible to hold the position or perform the contract that is associated with this Personnel Screening Request. Depending on the level of security screening required, the information collected by the government institution may be disclosed to the Royal Canadian Mounted Police (RCMP) and the Canadian Security Intelligence Service (CSIS), which conduct the requisite checks and/or investigation in accordance with the GSP and to entities outside the federal government (e.g. credit bureaus). It is used to support decisions on individuals working or applying to work through appointment, assignment or contract, transfers or promotions. It may also be used in the context of updating, or reviewing for cause, the reliability status, security clearance or site access, all of which may lead to a re-assessment of the applicable type of security screening. Information collected by the government institution, and information gathered from the requisite checks and/or investigation, may be used to support decisions, which may lead to discipline and/or termination of employment or contractual agreements. The personal information collected is described in Standard PIB PSU 917 (Personnel Security Screening) which is used by all government agencies, except the Department of National Defence PIB DND/PPE 834 (Personnel Security Investigation File), RCMP PIB CMP PPU 065 (Security/Reliability Screening Records), CSIS PIB SIS PPE 815 (Employee Security), and PWGSC PIB PWGSC PPU 015 (Personnel Clearance and Reliability Records) used for Canadian Industry Personnel. Personal information related to security assessments is also described in the CSIS PIB SIS PPU 005 (Security Assessments/Advice).

I, the undersigned, do consent to the disclosure of the preceding information including my photograph for its subsequent verification and/or use in an investigation for the purpose of providing a security screening assessment. By consenting to the above, I acknowledge that the verification and/or use in an investigation of the preceding information may also occur when the reliability status, security clearance or site access are updated or otherwise reviewed for cause under the Government Security Policy. My consent will remain valid until I no longer require a reliability status, a security clearance or a site access clearance, my employment or contract is terminated, or until I otherwise revoke my consent, in writing, to the authorized security official.

Signature _____ Date (Y/M/D) _____

D REVIEW (To be completed by the authorized Departmental/Agency/Organizational Official responsible for ensuring the completion of sections A, B and C)

Name and title	Telephone number
Address	Facsimile number

E APPROVAL (To be completed by authorized Departmental/Agency/Organizational Security Official only)

I, the undersigned, as the authorized security official, do hereby approve the following level of screening.

Reliability Status

☐ Approved Reliability Status ☐ Not approved

Name and title _____

Signature _____ Date (Y/M/D) _____

Security Clearance (if applicable)

☐ Level I ☐ Level II ☐ Level III ☐ Not recommended

Name and title _____

Signature _____ Date (Y/M/D) _____

Comments

PHOTO (for Level III T.S., and/or upon request - see instructions)

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INSTRUCTIONS FOR PERSONNEL SCREENING CONSENT AND AUTHORIZATION FORM TBS/SCT 330-23E (Rev. 2002/02)
Once completed, this form shall be safeguarded and handled at the level of Protected A.

General:
If space allotted in any portion is insufficient please use separate sheet using same format.

1. Section A (Administrative Information) Authorized Departmental/Agency/Organizational Official
The Official, based on instructions issued by the Departmental Security Officer, may be responsible for determining, based on five year background history, what constitutes sufficient verification of personal data, educational and professional qualifications, and employment history. References are to be limited to those provided on the application for employment or equivalent forms.

SUPPLEMENTAL INFORMATION REQUIREMENTS
Persons who presently hold a SECURITY CLEARANCE and subsequently marry, remarry or commence a common-law partnership, in addition to having to update sections of the *Security Clearance Form (TBS/SCT 330-60)*, are required to submit an original *Personnel Screening, Consent and Authorization Form*, with the following parts completed:

Part A - As set forth in each question
Part B - As set forth in each question, excluding CRIMINAL CONVICTIONS IN AND OUTSIDE OF CANADA.
Part C - Applicant's signature and date only are required

"Other". This should be used to identify if the security screening is for Site Access, NATO, SIGINT etc.

2. Section B (Biographical Information)
To be completed by the ***applicant***. If more space is required use a separate sheet of paper. Each sheet must be signed.

Country of Birth - For "NEW" requests, if born abroad of Canadian parents, please provide a copy of your Certificate of Registration of Birth Abroad. If you arrived in Canada less than five years ago, provide a copy of the Immigration Visa, Record of Landing document or a copy of passport.

- List only criminal convictions for which a pardon has NOT been granted. Include on a separate attached sheet of paper, if more than one conviction. Applicant must include those convictions outside Canada.
- Offences under the *National Defence Act* are to be included as well as convictions by courts-martial are to be recorded.

3. Section C (Consent and Verification)
A copy of Section "C" may be released to institutions to provide acknowledgement of consent.

Criminal record checks (fingerprints may be required) and credit checks are to be arranged through the Departmental Security Office or the delegated Officer.

Consent: may be given only by an applicant who has reached the age of majority, otherwise, the signature of a parent or guardian is mandatory.

The age of majority is:
19 years in NFLD., N.S., N.B., B.C., Yukon, Norhwest Territories and Nunavut;
18 years in P.E.I., Que., Ont., Man., Sask. and Alta.

The applicant will provide initials in the " applicant's initials box".

The official who carried out the verification of the information will print their name, insert their initials and telephone number in the required space.
- Reliability Screening (for all types of screening identified within Section A): complete numbers 1 and 2 and 3 if applicable.
- Security Clearance (for all types of screening identified within Section A): complete numbers 1 to 4 and 5 where applicable.
- Other: number 5 is used only where prior Treasury Board of Canada Secretariat approval has been obtained.

4. Section D (Review)
To be completed by authorized Departmental/Agency/Organizational Official who is responsible for ensuring the completion of sections A to C as requested.

5. Section E (Approval)
Authorized Departmental/Agency/Organizational Security Official refers to the individuals as determined by departments, agencies, and organizations that may verify reliability information and/or approve/not approve reliability status and/or security clearances. Approved Reliability Status and Level I, II and III, as well as the signature of the authorized security official or manager are added for Government of Canada use only. Applicants are to be briefed, acknowledge, and be provided with a copy of the "Security Screening Certificate and Briefing Form (TBS/SCT 330-47)". **Note**: Private sector organizations do not have the authority to approve any level of security screening.

Photographs: Departments/Agencies/Organizations are responsible for ensuring that three colour photographs of passport size are attached to the form for the investigating agency. Maximum dimensions are 50mm x 70mm and minimum are 43mm x 54mm. The face length from chin to crown of head must be between 25mm x 35mm. The photographs must be signed by the applicant and an authorized security official. The photographs must have been taken within the last six months. It is required for new or upgrade Level III security clearances for identification of the applicant during the security screening investigation by the investigating agency. The investigating agency may in specific incidents request a photograph for a Level I or II clearances when an investigation is required.

Surname	Date of birth

RESIDENCE (Additional Information)

	Apartment number	Street Number	Street Name	Civic Numb er (if applicable)	From Y M	To Y M
3	City	Province or state	Postal code	Country	Telephone number	
4	Apartment number	Street Number	Street Name	Civic Numb er (if applicable)	From Y M	To Y M
	City	Province or state	Postal code	Country	Telephone number	
5	Apartment number	Street Number	Street Name	Civic Numb er (if applicable)	From Y M	To Y M
	City	Province or state	Postal code	Country	Telephone number	
6	Apartment number	Street Number	Street Name	Civic Numb er (if applicable)	From Y M	To Y M
	City	Province or state	Postal code	Country	Telephone number	
7	Apartment number	Street Number	Street Name	Civic Numb er (if applicable)	From Y M	To Y M
	City	Province or state	Postal code	Country	Telephone number	
8	Apartment number	Street Number	Street Name	Civic Numb er (if applicable)	From Y M	To Y M
	City	Province or state	Postal code	Country	Telephone number	
9	Apartment number	Street Number	Street Name	Civic Numb er (if applicable)	From Y M	To Y M
	City	Province or state	Postal code	Country	Telephone number	
10	Apartment number	Street Number	Street Name	Civic Numb er (if applicable)	From Y M	To Y M
	City	Province or state	Postal code	Country	Telephone number	
11	Apartment number	Street Number	Street Name	Civic Numb er (if applicable)	From Y M	To Y M
	City	Province or state	Postal code	Country	Telephone number	
12	Apartment number	Street Number	Street Name	Civic Numb er (if applicable)	From Y M	To Y M
	City	Province or state	Postal code	Country	Telephone number	
13	Apartment number	Street Number	Street Name	Civic Numb er (if applicable)	From Y M	To Y M
	City	Province or state	Postal code	Country	Telephone number	

ADDITIONAL INSTRUCTIONS FOR COMPLETION OF GOVERNMENT OF CANADA PERSONNEL SCREENING, CONSENT AND AUTHORIZATION FORM (Form No. TBS 330-23E)

NOTE:

All information requested on TBS 330-23E MUST be provided (do not leave any "blanks", provide partial information, and do not use any abbreviations - ie. CA for Canada).
Failure to provide requested information will result in forms being returned to applicants.

Page 1 of Form:

Section A. Administrative Information.: Do not complete (completed by the RCMP).

Section B. Biographical Info.: ***To be completed by applicant***:

1. Surname: Your Last Name that you currently use – ie. "Smith"

2. Full Given Names (no initials):
   a. Your First Name and Middle Name (s) ie. "Cameron John"
   **If you do not have a middle name, state "no middle name" on the form.
   **Circle or underline your usual name used (whether you go by your first name or middle name).

3. Family Name at Birth: Your Last Name when you were born - ie. "Smith" (do not include "Same")

4. All other names used: Abbreviation(s) of name(s) used (ie."Dave"/David, "Charlie"/Charles) or nicknames.

5. Sex: Place "x" in box beside male or female.

6. Date of Birth: provide the Year, Month and Day you were born ie. 2012-01-01 (must provide all in this format)

7. Country of Birth: - the Country that you were born in ie. Canada (no abbreviations such as "CA")

8. Date of entry into Canada if born outside Canada: - ie. 2012-01-01 (Year, Month, Day format)

9. Daytime telephone number: Your telephone number that the RCMP can reach you at in the daytime, including your area code.

10. E-mail address: Your e-mail address at work, or if you do not have one at work, your home e-mail address.

11. Residence(s): provide addresses where you have permanently or temporarily resided for the last **five years**, starting with the most current home address. Must be consecutive dates – no breaks in time periods.
    **Do not fill in address in grey/shaded area beside "Home address"; fill in current address in the boxes under "Home address".
    a. Apartment Number - fill in if you have one; if you do not live in an apartment, leave blank.

    b. Street Number – your house number ie. "421"

    c. Street Name – ie. "Smith Street/George Avenue; or "4th Street" if no name (no abbreviations)
    If you do not have a street address or you live on a farm/acreage, please provide your legal land descriptions (ie. SW-30-23-45-W4th) – **NO POST OFFICE BOX NUMBERS.

ADDITIONAL INSTRUCTIONS FOR COMPLETION OF GOVERNMENT OF CANADA PERSONNEL SCREENING, CONSENT AND AUTHORIZATION FORM (Form No. TBS 330-23E)

d. From – the year and month that you moved to your current / previous residence(s);
**If you cannot recall the month, please state above the M – "unknown"

e. To – "Present" or the year and month that you moved/vacated your previous residences (not current residence).

f. City – the name of the city or town that you currently and previously resided in.

g. Province or State – the name of the province or state that you currently and previously resided in (no abbreviations ie. "AB" or "SK").

h. Postal Code – your current and previous postal codes.

i. Country – the name of the country that you currently and previously resided in (no abbreviations).

j. Telephone Number – your current and previous home telephone numbers, including area code.

Note: i. If you do not have enough space on the attached form to list all addresses for the last five years, please use the attached form titled "TBS 330-23E Residence Additional Info".

ii. You must include your "Surname" and Date of Birth at the top of the page as requested.

NO POST OFFICE BOX NUMBERS;

DATES MUST BE CONSECUTIVE–NO BREAKS IN TIME PERIODS (as stated in 11.)

12. Have you previously completed a Government of Canada security screening form?:
    a. "No" or
    b. "Yes" – if "Yes", please provide details. If you cannot recall some or all of the details (ie. year of screening, state "cannot recall").

13. Criminal Convictions:
    a. "No" OR
    b. "Yes" - if "Yes", please provide details. If you cannot recall some or all of the details (ie. date of conviction, state "cannot recall").

Page 2 of Form:

Top of Page 2: *To be completed by applicant*:

1. Surname (your last name) followed by a comma – ie. Smith,

2. Full given names – your first name and then your middle name
   **If you do not have a middle name, state "no middle name" on the form.
   **Circle or underline your usual name used (ie. whether you go by your first name or middle name).

3. Date of birth - provide – Year, Month, Day ie. 2012-01-01 (must provide all in this format / no blanks)

Section C. Consent and Verification: *To be completed by applicant*:

1. a.) Place a "Checkmark" in Boxes 1. to 5; *then:*
   b.) Initial under "Applicant's Initials" column – **numbers 1. to 5. (you must initial all boxes-1 to 5).**

2. Read the Privacy Act Statement and sign above "Signature" and "Date (Y/M/D)"

Section D. Review: do not complete (completed by RCMP)

Section E. Approval: do not complete (completed by RCMP)

NOTE: RCMP FACILITIES ACCESS LEVEL 2 CLEARANCE – Photographs ARE NOT required.
RCMP "RELIABILITY STATUS CLEARANCES" – Photographs ARE required.

SAMPLE OF COMPLETED DOCUMENT.

Government of Canada / Gouvernement du Canada

PROTECTED (when completed)

PERSONNEL SCREENING, CONSENT AND AUTHORIZATION FORM

Reference number	Department/Organization number	File number

NOTE: For *Privacy Act* Statement refer to Section C of this form and for completion instructions refer to attached instructions. Please typewrite or print in block letters.

A ADMINISTRATIVE INFORMATION (To be completed by the Authorized Departmental/Agency/Organizational Official)

☐ New ☐ Update ☐ Upgrade ☐ Transfer ☐ Supplemental ☐ Re-activation

The requested level of reliability/security check(s)

☐ Reliability Status ☐ Level I (CONFIDENTIAL) ☐ Level II (SECRET) ☐ Level III (TOP SECRET)

☐ Other _____

PARTICULARS OF APPOINTMENT/ASSIGNMENT/CONTRACT

☐ Indeterminate ☐ Term ☐ Contract ☐ Industry ☐ Other (specify secondment, assignment, etc.) _____

Justification for security screening requirement

Position/Competition/Contract number	Title		Group/Level (Rank if applicable)
Employee ID number/PRI/Rank and Service number (if applicable)	If term or contract, indicate duration period ▶	From	To
Name and address of department / organization / agency	Name of official	Telephone number ( )	Facsimile number ( )

B BIOGRAPHICAL INFORMATION (To be completed by the applicant)

Surname (Last name)	Full given names (no initials) underline or circle usual name used	Family name at birth
SMITH	(John) (nomiddle name)	SMITH

All other names used (i.e. Nickname)	Sex	Date of birth (Y M D)	Country of birth	Date of entry into Canada if born outside Canada (Y M D)
Johnny	☒ Male ☐ Female	1960 01 27	CANADA	

RESIDENCE (provide addresses for the last five years, starting with the most current) Home address	Daytime telephone number	E-mail address
	(306) 201-1433	JSmith@telus.net

	Apartment number	Street number	Street name	Civic number (if applicable)	From (Y M)	To present
1		1257	Cooper Avenue		2001 01	

City	Province or state	Postal code	Country	Telephone number
PEACE RIVER	ALBERTA	T63 2X9	CANADA	(780) 261-1493

	Apartment number	Street number	Street name	Civic number (if applicable)	From (Y M)	To (Y M)
2			12-13-57-W2		2009 03	2001 01

City	Province or state	Postal code	Country	Telephone number
GRAND CACHE	ALBERTA	TOG 7X3	CANADA	(780) 234-2102

Have you previously completed a Government of Canada security screening form? ☒ Yes ☐ No

If yes, give name of employer, level and year of screening. CORRECTIONAL SERVICES CANADA 2001 (Y)

CRIMINAL CONVICTIONS IN AND OUTSIDE OF CANADA (see instructions)

Have you ever been convicted of a criminal offence for which you have not been granted a pardon? ☒ Yes ☐ No

If yes, give details. (charge(s), name of police force, city, province/state, country and date of conviction) ▼

Charge(s)	Name of police force	City
DRIVING UNDER THE INFLUENCE OF ALCOHOL	EDMONTON POLICE SERVICE	EDMONTON

Province/State	Country	Date of conviction ▶ (Y M D)
ALBERTA	CANADA	2001 02 01

Surname: SMITH, John (no middle name) | Date of birth: 1960-01-27 | PROTECTED A (When completed)

RESIDENCE (Additional Information)

	Apartment number	Street Number	Street Name	Civic Numb er (if applicable)	From Y M	To Y M
3			1-87-18-W4		2007 01	2009 03
	City	Province or state	Postal code	Country	Telephone number	
	SASKATOON	SASKATCHEWAN	S0G3C0	CANADA	(306) 231-7192	
4		20	HILL AVENUE		2004 01	2007 01
	CALGARY	ALBERTA	T0G3C0	CANADA	(403) 239-7186	
5						
6						
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PERSONNEL SCREENING, CONSENT AND AUTHORIZATION FORM

PROTECTED (when completed)

Surname and full given names	Date of birth (Y M D)
SMITH, John (no middle name)	1960 01 27

C CONSENT AND VERIFICATION (To be completed by the applicant and authorized Departmental/Agency/Organizational Official)

Checks Required (See Instructions)	Applicant's initials	Name of official (print)	Official's initials	Official's Telephone number
1. ☑ Date of birth, address, education, professional qualifications, employment history, personal character references	JS			( )
2. ☑ Criminal record check	JS			( )
3. ☑ Credit check (financial assessment, including credit records check)	JS			( )
4. ☑ Loyalty (security assessment only)	JS			
5. ☑ Other (Law Enforcement Records Checks)	JS			( )

The Privacy Act Statement
The information on this form is required for the purpose of providing a security screening assessment. It is collected under the authority of subsection 7(1) of the *Financial Administration Act* and the Government Security Policy (GSP) of the Government of Canada, and is protected by the provisions of the *Privacy Act* in institutions that are covered by the *Privacy Act*. Its collection is mandatory. A refusal to provide information will lead to a review of whether the person is eligible to hold the position or perform the contract that is associated with this Personnel Screening Request. Depending on the level of security screening required, the information collected by the government institution may be disclosed to the Royal Canadian Mounted Police (RCMP) and the Canadian Security Intelligence Service (CSIS), which conduct the requisite checks and/or investigation in accordance with the GSP and to entities outside the federal government (e.g. credit bureaus). It is used to support decisions on individuals working or applying to work through appointment, assignment or contract, transfers or promotions. It may also be used in the context of updating, or reviewing for cause, the reliability status, security clearance or site access, all of which may lead to a re-assessment of the applicable type of security screening. Information collected by the government institution, and information gathered from the requisite checks and/or investigation, may be used to support decisions, which may lead to discipline and/or termination of employment or contractual agreements. The personal information collected is described in Standard PIB PSU 917 (Personnel Security Screening) which is used by all government agencies, except the Department of National Defence PIB DND/PPE 834 (Personnel Security Investigation File), RCMP PIB CMP PPU 065 (Security/Reliability Screening Records), CSIS PIB SIS PPE 815 (Employee Security), and PWGSC PIB PWGSC PPU 015 (Personnel Clearance and Reliability Records) used for Canadian Industry Personnel. Personal information related to security assessments is also described in the CSIS PIB SIS PPU 005 (Security Assessments/Advice).

I, the undersigned, do consent to the disclosure of the preceding information including my photograph for its subsequent verification and/or use in an investigation for the purpose of providing a security screening assessment. By consenting to the above, I acknowledge that the verification and/or use in an investigation of the preceding information may also occur when the reliability status, security clearance or site access are updated or otherwise reviewed for cause under the Government Security Policy. My consent will remain valid until I no longer require a reliability status, a security clearance or a site access clearance, my employment or contract is terminated, or until I otherwise revoke my consent, in writing, to the authorized security official.

John Smith — Signature
2011-12-01 — Date (Y/M/D)

D REVIEW (To be completed by the authorized Departmental/Agency/Organizational Official responsible for ensuring the completion of sections A, B and C)

Name and title	Telephone number
Address	Facsimile number

E APPROVAL (To be completed by authorized Departmental/Agency/Organizational Security Official only)

I, the undersigned, as the authorized security official, do hereby approve the following level of screening.

Reliability Status

☐ Approved Reliability Status ☐ Not approved

Name and title

Signature — Date (Y/M/D)

Security Clearance (if applicable)

☐ Level I ☐ Level II ☐ Level III ☐ Not recommended

Name and title

Signature — Date (Y/M/D)

Comments

PHOTO
(for Level III T.S., and/or upon request - see instructions)

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INSTRUCTIONS FOR PERSONNEL SCREENING CONSENT AND AUTHORIZATION FORM TBS/SCT 330-23E (Rev. 2002/02)
Once completed, this form shall be safeguarded and handled at the level of Protected A.

General:
If space allotted in any portion is insufficient please use separate sheet using same format.

1. Section A (Administrative Information) Authorized Departmental/Agency/Organizational Official
The Official, based on instructions issued by the Departmental Security Officer, may be responsible for determining, based on five year background history, what constitutes sufficient verification of personal data, educational and professional qualifications, and employment history. References are to be limited to those provided on the application for employment or equivalent forms.

SUPPLEMENTAL INFORMATION REQUIREMENTS
Persons who presently hold a SECURITY CLEARANCE and subsequently marry, remarry or commence a common-law partnership, in addition to having to update sections of the *Security Clearance Form (TBS/SCT 330-60)*, are required to submit an original *Personnel Screening, Consent and Authorization Form*, with the following parts completed:

Part A - As set forth in each question
Part B - As set forth in each question, excluding CRIMINAL CONVICTIONS IN AND OUTSIDE OF CANADA.
Part C - Applicant's signature and date only are required

"Other". This should be used to identify if the security screening is for Site Access, NATO, SIGINT etc.

2. Section B (Biographical Information)
To be completed by the ***applicant***. If more space is required use a separate sheet of paper. → attached "Residence (Additional Information) Form.

Country of Birth - For "NEW" requests, if born abroad of Canadian parents, please provide a copy of your Certificate of Registration of Birth Abroad. If you arrived in Canada less than five years ago, provide a copy of the Immigration Visa, Record of Landing document or a copy of passport.

- List only criminal convictions for which a pardon has NOT been granted. Include on a separate attached sheet of paper, if more than one conviction. Applicant must include those convictions outside Canada. Thereafter sign the separate attached sheet of paper.
- Offences under the *National Defence Act* are to be included as well as convictions by courts-martial are to be recorded.

3. Section C (Consent and Verification)
A copy of Section "C" may be released to institutions to provide acknowledgement of consent.

Criminal record checks (fingerprints may be required) and credit checks are to be arranged through the Departmental Security Office or the delegated Officer.

Consent: may be given only by an applicant who has reached the age of majority, otherwise, the signature of a parent or guardian is mandatory.

The age of majority is:
19 years in NFLD., N.S., N.B., B.C., Yukon, Northwest Territories and Nunavut;
18 years in P.E.I., Que., Ont., Man., Sask. and Alta.

The applicant will provide initials in the " applicant's initials box". – Box 1-5

The official who carried out the verification of the information will print their name, insert their initials and telephone number in the required space (RCMP employee only)
- Reliability Screening (for all types of screening identified within Section A): complete numbers 1 and 2 and 3 if applicable.
- Security Clearance (for all types of screening identified within Section A): complete numbers 1 to 4 and 5 where applicable.
- Other: number 5 is used only where prior Treasury Board of Canada Secretariat approval has been obtained.

4. Section D (Review)
To be completed by authorized Departmental/Agency/Organizational Official who is responsible for ensuring the completion of sections A to C as requested.

5. Section E (Approval)
Authorized Departmental/Agency/Organizational Security Official refers to the individuals as determined by departments, agencies, and organizations that may verify reliability information and/or approve/not approve reliability status and/or security clearances. Approved Reliability Status and Level I, II and III, as well as the signature of the authorized security official or manager are added for Government of Canada use only. Applicants are to be briefed, acknowledge, and be provided with a copy of the "Security Screening Certificate and Briefing Form (TBS/SCT 330-47)".
Note: Private sector organizations do not have the authority to approve any level of security screening.

Photographs: Departments/Agencies/Organizations are responsible for ensuring that three colour photographs of passport size are attached to the form for the investigating agency. Maximum dimensions are 50mm x 70mm and minimum are 43mm x 54mm. The face length from chin to crown of head must be between 25mm x 35mm. The photographs must be signed by the applicant and an authorized security official. The photographs must have been taken within the last six months. It is required for new or upgrade Level III security clearances for identification of the applicant during the security screening investigation by the investigating agency. The investigating agency may in specific incidents request a photograph for a Level I or II clearances when an investigation is required.

* ENSURE ATTACHED "ADDITIONAL INSTRUCTIONS" ARE REVIEWED/FOLLOWED (more detailed information on how to complete TBS 330-23E)

Canada

Part 1 General

1.1 ADMINISTRATIVE

.1 Project meetings will be scheduled throughout the progress of the work and at the call of Departmental Representative.

.2 Provide physical space and make arrangements for meetings.

.3 Departmental Representative will chair the start-up meeting. The Consultant shall chair the construction meetings.

.4 Representative of Contractor, Subcontractor and suppliers attending meetings will be qualified and authorized to act on behalf of party each represents.

1.2 PRECONSTRUCTION MEETING

.1 Within 10 days after award of Contract, request a meeting of parties in contract to discuss and resolve administrative procedures and responsibilities.

.2 Agenda to include:

- .1 Appointment of official representative of participants in the Work.
- .2 Schedule of Work: in accordance with Section 01 32 16 - Construction Progress Schedules - Bar (GANTT) Chart.
- .3 Schedule of submission of shop drawings, samples, colour chips. Submit submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .4 Requirements for temporary facilities, offices, storage sheds, utilities, fences in accordance with Section 01 52 00 - Construction Facilities.
- .5 Delivery schedule of specified equipment.
- .6 Site security in accordance with Section 01 56 00 - Temporary Barriers and Enclosures.
- .7 Proposed changes, change orders, procedures, approvals required, mark-up percentages permitted, time extensions, overtime, administrative requirements.
- .8 Owner provided products and work.
- .9 Record drawings in accordance with Section 01 33 00 - Submittal Procedures.
- .10 Maintenance manuals in accordance with Section 01 78 00 - Closeout Submittals.
- .11 Take-over procedures, acceptance, warranties in accordance with Section 01 78 00 - Closeout Submittals.
- .12 Monthly progress claims, administrative procedures, photographs, hold backs.
- .13 Appointment of inspection and testing agencies or firms.
- .14 Insurances, transcript of policies.

1.3 PROGRESS MEETINGS

.1 During course of Work, progress meetings will be held on a regular basis. Schedule to be determined.

.2 Contractor, major Subcontractors involved in Work, Departmental Representative, Consultant and Owner's representatives are to be in attendance.

.3 Minutes of meetings will be recorded by the Consultant. Minutes will be distributed within 3 working days.

.4 Agenda for project meetings to include the following:

.1 Review, approval of minutes of previous meeting.
.2 Review of Work progress since previous meeting.
.3 Field observations, problems, conflicts.
.4 Problems which impede construction schedule.
.5 Review of off-site fabrication delivery schedules.
.6 Corrective measures and procedures to regain projected schedule.
.7 Revision to construction schedule.
.8 Progress schedule, during succeeding work period.
.9 Review submittal schedules: expedite as required.
.10 Maintenance of quality standards.
.11 Review proposed changes to determine how these will affect the construction schedule and on completion date.
.12 Other business.

END OF SECTION

Part 1 General

1.1 DEFINITIONS

.1 Activity: element of Work performed during course of Project. Activity normally has expected duration and expected cost and expected resource requirements. Activities can be subdivided into tasks.

.2 Bar Chart (GANTT Chart): graphic display of schedule-related information. In typical bar chart, activities or other Project elements are listed down left side of chart, dates are shown across top, and activity durations are shown as date-placed horizontal bars. Generally, Bar Chart should be derived from commercially available computerized project management system.

.3 Baseline: original approved plan (for project, work package, or activity), plus or minus approved scope changes.

.4 Construction Work Week: Monday to Friday, inclusive, will provide five-day work week and define schedule calendar working days as part of Bar (GANTT) Chart submission.

.5 Duration: number of work periods (not including holidays or other nonworking periods) required to complete activity or other project element. Usually expressed as workdays or workweeks.

.6 Master Plan: summary-level schedule that identifies major activities and key milestones.

.7 Milestone: significant event in project, usually completion of major deliverable.

.8 Project Schedule: planned dates for performing activities and the planned dates for meeting milestones. Dynamic, detailed record of tasks or activities that must be accomplished to satisfy Project objectives. Monitoring and control process involves using Project Schedule in executing and controlling activities and is used as basis for decision making throughout project life cycle.

.9 Project Planning, Monitoring and Control System: overall system operated by Departmental Representative to enable monitoring of project work in relation to established milestones.

1.2 REQUIREMENTS

.1 Ensure Project Schedule and Detail Schedules are practical and remain within specified Contract duration.

.2 Include scheduled activities for Commissioning (Cx) in the project schedule. Commissioning schedule will require frequent updating and detailing for planning and availability of stakeholders.

.3 Include scheduled activities for Training in the project schedule.

.4 Plan to complete Work in accordance with prescribed milestones and time frame.

.5 Limit activity durations to maximum of approximately 10 working days, to allow for progress reporting.

.6 Ensure that it is understood that Award of Contract or time of beginning, rate of progress, Interim Certificate and Final Certificate as defined times of completion are of essence of this contract.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Submit to Departmental Representative within 7 working days of Award of Contract Bar (GANTT) Chart as Master Plan for planning, monitoring and reporting of project progress.

.3 Provide schedule in PDF format in sized so that description of work can be clearly read when printed out.

1.4 PROJECT MILESTONES

.1 Project milestones form interim targets for Project Schedule.

.1 Project milestone will be identified through discussion with the Contractor and Departmental Representative at the outset of the project.

1.5 PROJECT SCHEDULE REPORTING

.1 Update Project Schedule on a monthly basis reflecting activity changes and completions, as well as activities in progress.

.2 Include as part of Project Schedule, narrative report identifying Work status to date, comparing current progress to baseline, presenting current forecasts, defining problem areas, anticipated delays and impact with possible mitigation.

1.6 PROJECT MEETINGS

.1 Discuss Project Schedule at regular site meetings, identify activities that are behind schedule and provide measures to regain slippage. Activities considered behind schedule are those with projected start or completion dates later than current approved dates shown on baseline schedule.

.2 Weather related delays with their remedial measures will be discussed and negotiated.

END OF SECTION

Part 1 General

1.1 ADMINISTRATIVE

.1 Submit to Departmental Representative submittals listed for review. Submit promptly and in orderly sequence to not cause delay in Work. Failure to submit in ample time is not considered sufficient reason for extension of Contract Time and no claim for extension by reason of such default will be allowed.

.2 Do not proceed with Work affected by submittal until review is complete.

.3 Present shop drawings, product data, samples and mock-ups in SI Metric units.

.4 Where items or information is not produced in SI Metric units converted values are acceptable.

.5 Review submittals prior to submission to Departmental Representative. This review represents that necessary requirements have been determined and verified, or will be, and that each submittal has been checked and co-ordinated with requirements of Work and Contract Documents. Submittals not stamped, signed, dated and identified as to specific project will be returned without being examined and considered rejected.

.6 Notify Departmental Representative, in writing at time of submission, identifying deviations from requirements of Contract Documents stating reasons for deviations.

.7 Verify field measurements and affected adjacent Work are co-ordinated.

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

.9 Contractor's responsibility for deviations in submission from requirements of Contract Documents is not relieved by Departmental Representative review.

.10 Keep one reviewed copy of each submission on site.

1.2 SHOP DRAWINGS AND PRODUCT DATA

.1 The term "shop drawings" means drawings, diagrams, illustrations, schedules, performance charts, brochures and other data which are to be provided by Contractor to illustrate details of a portion of Work.

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

.3 Indicate materials, methods of construction and attachment or anchorage, erection diagrams, connections, explanatory notes and other information necessary for completion of Work. Where articles or equipment attach or connect to other articles or equipment, indicate that such items have been co-ordinated, regardless of Section under which adjacent items will be supplied and installed. Indicate cross references to design drawings and specifications.

.4 Allow 7 working days for Departmental Representative’s review of each submission.

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

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

.7 Accompany submissions with transmittal letter, containing:

- .1 Date.
- .2 Project title and number.
- .3 Contractor's name and address.
- .4 Identification and quantity of each shop drawing, product data and sample.
- .5 Other pertinent data.

.8 Submissions include:

- .1 Date and revision dates.
- .2 Project title and number.
- .3 Name and address of:
  - .1 Subcontractor.
  - .2 Supplier.
  - .3 Manufacturer.
- .4 Contractor's stamp, signed by Contractor's authorized representative certifying approval of submissions, verification of field measurements and compliance with Contract Documents.
- .5 Details of appropriate portions of Work as applicable:
  - .1 Fabrication.
  - .2 Layout, showing dimensions, including identified field dimensions, and clearances.
  - .3 Setting or erection details.
  - .4 Capacities.
  - .5 Performance characteristics.
  - .6 Standards.
  - .7 Operating weight.
  - .8 Wiring diagrams.
  - .9 Single line and schematic diagrams.
  - .10 Relationship to adjacent work.
  - .11 Legacy code, inventory number, and identification abbreviation noted in appended National Maintenance Management System and Appendix A.

.9 After Departmental Representative's review, distribute copies.

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

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

.12 Submit electronic copy of test reports for requirements requested in specification Sections and as requested by Departmental Representative.

.1 Report signed by authorized official of testing laboratory that material, product or system identical to material, product or system to be provided has been tested in accord with specified requirements.

.2 Testing must have been within 3 years of date of contract award for project.

.13 Submit electronic copy of certificates for requirements requested in specification Sections and as requested by Departmental Representative.

.1 Statements printed on manufacturer's letterhead and signed by responsible officials of manufacturer of product, system or material attesting that product, system or material meets specification requirements.

.2 Certificates must be dated after award of project contract complete with project name.

.14 Submit electronic copy of manufacturer’s instructions for requirements requested in specification Sections and as requested by Departmental Representative.

.1 Pre-printed material describing installation of product, system or material, including special notices and Material Safety Data Sheets concerning impedances, hazards and safety precautions.

.15 Submit electronic copy of Manufacturer's Field Reports for requirements requested in specification Sections and as requested by Departmental Representative.

.16 Documentation of the testing and verification actions taken by manufacturer's representative to confirm compliance with manufacturer's standards or instructions.

.17 Submit electronic copy of Operation and Maintenance Data for requirements requested in specification Sections and as requested by Departmental Representative.

.18 Delete information not applicable to project.

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

.20 If upon review by Departmental Representative, no errors or omissions are discovered or if only minor corrections are made, copy 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.

.21 The review of shop drawings by Departmental Representative is for sole purpose of ascertaining conformance with general concept.

.1 This review shall not mean that 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.

.22 Electronic submission of Shop Drawings

.1 Electronic Shop Drawings (PDF format) shall not exceed 11x17 actual size. Electronic transfer of shop drawings relies on Architect and Engineering Consultants to print a record copy for their files - this can be done providing shop drawings do not exceed 11x17. Larger shop drawings will require hard copies for review.

.2 General Contractor to review shop drawing and place their electronic stamp signifying review.

.3 General Contractor to email all shop drawings to Architect with copy to Engineering Consultant as applicable.

.4 Engineering Consultant to review and place their electronic stamp / marks up, then email to Architect only (Engineering Consultant will not copy anyone else).

.5 Architect to check for coordination and transmit reviewed shop drawings by email to General Contractor.

1.3 SAMPLES

.1 Submit for review samples in duplicate as requested in respective specification Sections. Label samples with origin and intended use.

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

.3 Notify Departmental Representative in writing, at time of submission of deviations in samples from requirements of Contract Documents.

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

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

.6 Make changes in samples which Departmental Representative may require, consistent with Contract Documents.

.7 Reviewed and accepted samples will become standard of workmanship and material against which installed Work will be verified.

1.4 MOCK-UPS

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

1.5 PHOTOGRAPHIC DOCUMENTATION

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

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

.3 Photographs shall be taken at all construction milestones and anytime a problem arises. The minimum requirement is for photographs to be taken on a weekly basis.

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

.5 Digital photographs stored on CD-ROM, DVD, or USB drive, shall be submitted with the Operation and Maintenance Manuals.

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.

END OF SECTION

Part 1 General

1.1 REFERENCES

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

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

.1 Material Safety Data Sheets (MSDS).

.3 Province of Saskatchewan

.1 Occupational Health and Safety Act, 1993, S.S. 2005.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Submit site-specific Health and Safety Plan: Within 7 days after date of Notice to Proceed and prior to commencement of Work. Health and Safety Plan must include:

.1 Results of site specific safety hazard assessment.

.2 Results of safety and health risk or hazard analysis for site tasks and operation found in work plan.

.3 Submit 1 copy of Contractor's authorized representative's work site health and safety inspection reports to Departmental Representative, 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 33 00 - Submittal Requirements and Section 02 81 01 - Hazardous Materials.

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

.8 Departmental Representative's review of Contractor's final Health and Safety plan should not be construed as approval and does not reduce the Contractor's overall responsibility for construction Health and Safety.

.9 Medical Surveillance: where prescribed by legislation, regulation or safety program, submit certification of medical surveillance for site personnel prior to commencement of Work, and submit additional certifications for any new site personnel to Departmental Representative.

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

1.3 FILING OF NOTICE

.1 File Notice of Project with Provincial authorities prior to beginning of Work.

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

1.4 SAFETY ASSESSMENT

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

1.5 MEETINGS

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

1.6 REGULATORY REQUIREMENTS

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

1.7 GENERAL REQUIREMENTS

.1 Develop written site-specific Health and Safety Plan based on hazard assessment prior to beginning site Work and continue to implement, maintain, and enforce plan until final demobilization from site. Health and Safety Plan must address project specifications.

.2 Departmental Representative may respond in writing, where deficiencies or concerns are noted and may request re-submission with correction of deficiencies or concerns.

1.8 RESPONSIBILITY

.1 Be responsible for health and safety of persons on site, safety of property on site and for protection of persons adjacent to site and environment to extent that they may be affected by conduct of Work.

.2 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 Occupational Health and Safety Regulations, 1996.

.2 Comply with Canada Labour Code, Canada Occupational Safety and Health Regulations.

1.10 HAZARDOUS MATERIALS

.1 Where the contractor is in doubt or suspicious material is encountered, stop work and advise the Departmental Representative immediately.

1.11 UNFORSEEN HAZARDS

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

1.12 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 overhead work.

.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.

1.13 POSTING OF DOCUMENTS

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

1.14 CORRECTION OF NON-COMPLIANCE

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

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

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

1.15 BLASTING

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

1.16 POWDER ACTUATED DEVICES

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

1.17 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.

END OF SECTION

Part 1 General

1.1 REFERENCES AND CODES

.1 Perform Work in accordance with National Building Code of Canada (NBC) including amendments up to tender closing date and other codes of provincial or local application provided that in case of conflict or discrepancy, more stringent requirements apply.

.2 Meet or exceed requirements of:

.1 Contract documents.

.2 Specified standards, codes and referenced documents.

1.2 HAZARDOUS MATERIAL DISCOVERY

.1 Asbestos: demolition of spray or trowel-applied asbestos is hazardous to health. Stop work immediately when material resembling spray or trowel-applied asbestos is encountered during demolition work. Notify Departmental Representative.

.2 Notify Departmental Representative if suspicious material is encountered elsewhere within this work.

1.3 BUILDING SMOKING ENVIRONMENT

.1 Comply with smoking restrictions and municipal by-laws.

.2 Smoking on site is restricted to within personal vehicles or designated smoking locations.

END OF SECTION

Part 1 General

1.1 INSPECTION

.1 Allow Departmental Representative and Consultant access to Work. If part of Work is in preparation at locations other than Place of Work, allow access to such Work whenever it is in progress.

.2 Give timely notice requesting inspection if Work is designated for special tests, inspections or approvals by Departmental Representative or Consultant, instructions, or law of Place of Work.

.3 If Contractor covers or permits to be covered Work that has been designated for special tests, inspections or approvals before such is made, uncover such Work, have inspections or tests satisfactorily completed and make good such Work.

.4 Departmental Representative will order part of Work to be examined if Work is suspected to be not in accordance with Contract Documents. If, upon examination such work is found not in accordance with Contract Documents, correct such Work and pay cost of examination and correction. If such Work is found in accordance with Contract Documents, Departmental Representative shall pay cost of examination and replacement.

1.2 ACCESS TO WORK

.1 Allow inspection/testing agencies access to Work, off site manufacturing and fabrication plants.

.2 Co-operate to provide reasonable facilities for such access.

1.3 PROCEDURES

.1 Notify appropriate agency and Departmental Representative in advance of requirement for tests, in order that attendance arrangements can be made.

.2 Submit samples and/or materials required for testing, as specifically requested in specifications. Submit with reasonable promptness and in orderly sequence to not cause delays in Work.

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

1.4 REJECTED WORK

.1 Remove defective Work, whether result of poor workmanship, use of defective products or damage and whether incorporated in Work or not, which has been rejected by Departmental Representative as failing to conform to Contract Documents. Replace or re-execute in accordance with Contract Documents.

.2 Make good other Contractor's work damaged by such removals or replacements promptly.

.3 If in opinion of Departmental Representative, it is not expedient to correct defective Work or Work not performed in accordance with Contract Documents, Departmental Representative will deduct from Contract Price difference in value between Work performed and that called for by Contract Documents, amount of which will be determined by Departmental Representative.

1.5 REPORTS

.1 Submit two (2) copies of inspection and test reports to Departmental Representative.

.2 Provide copies to subcontractor of work being inspected or tested.

1.6 TESTS AND MIX DESIGNS

.1 Furnish test results and mix designs as requested.

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

1.7 MOCK-UPS

.1 Prepare mock-ups for Work specifically requested in specifications. Include for Work of Sections required to provide mock-ups.

.2 Construct in locations acceptable to Departmental Representative and as specified in specific Section.

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

.6 Mock-ups may remain as part of Work.

1.8 EQUIPMENT AND SYSTEMS

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

.2 Submit legacy codes, inventory numbers, and identification abbreviations noted in appended National Maintenance Management System and Appendix A.

END OF SECTION

Part 1 General

1.1 ACTION AND INFORMATIONAL SUBMITTALS

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

1.2 INSTALLATION AND REMOVAL

.1 Provide temporary utilities controls to execute work expeditiously.

.2 Remove from site all such work after use.

1.3 DEWATERING

.1 Provide temporary drainage and pumping facilities to deep excavations and site free from standing water.

1.4 WATER SUPPLY

.1 Departmental Representative will provide continuous supply of potable water for construction use.

.2 Departmental Representative has the right to limit water usage if it is deemed that excessive amounts of water is being used.

1.5 TEMPORARY HEATING AND VENTILATION

.1 Provide temporary heating, for the entire building, required during construction period, including attendance, maintenance, and fuel.

.2 Construction heaters used inside building must be vented to outside or be non-flameless type. Solid fuel salamanders are not permitted.

.3 Provide temporary heat and ventilation in enclosed areas as required to:

.1 Facilitate progress of Work.

.2 Protect Work and products against dampness and cold.

.3 Prevent moisture condensation on surfaces.

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

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

.4 Maintain temperatures of minimum 15° C in areas where construction is in progress.

.5 Ventilating:

.1 Prevent accumulation of dust, fumes, mists, vapours and gases in areas occupied during construction.

.2 Provide local exhaust ventilation to prevent harmful accumulation of hazardous substances into atmosphere of occupied areas.

.3 Dispose of exhaust materials in manner that will not result in harmful exposure to persons.

.4 Ventilate storage spaces containing hazardous or volatile materials.

.5 Ventilate temporary sanitary facilities.

.6 Continue operation of ventilation and exhaust system for time after cessation of work process to assure removal of harmful contaminants.

.6 Permanent heating system of building, may be used when available and with written permission from Departmental Representative. Be responsible for damage to heating system if use is permitted.

.7 On completion of Work for which permanent heating system is used, replace filters, and clean.

.8 Departmental Representative will pay utility charges when temporary heat source is existing building equipment.

.9 Maintain strict supervision of operation of temporary heating and ventilating equipment to:

.1 Conform with applicable codes and standards.

.2 Enforce safe practices.

.3 Prevent abuse of services.

.4 Prevent damage to finishes.

.5 Vent direct-fired combustion units to outside.

.10 Be responsible for damage to Work due to failure in providing adequate heat and protection during construction.

1.6 TEMPORARY POWER AND LIGHT

.1 Provide and maintain temporary lighting throughout project. Existing lighting and power systems may be utilized.

.2 Electrical power and lighting systems installed under this Contract may be used for construction requirements only with prior approval of Departmental Representative, provided guarantees are not affected. Make good damage to electrical system caused by use under this Contract.

.3 Departmental Representative has the right to limit power usage if it is deemed that excessive amounts of power is being used.

1.7 TEMPORARY COMMUNICATION FACILITIES

.1 Provide and pay for temporary telephone, fax, data hook up, and line equipment necessary for own use and use of Departmental Representative.

1.8 FIRE PROTECTION

.1 Provide and maintain temporary fire protection equipment during performance of Work required by Authorities Having Jurisdiction and governing codes, regulations and bylaws.

.2 Burning rubbish and construction waste materials is not permitted on site.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 Canadian Standards Association (CSA International)

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

1.2 ACTION AND INFORMATIONALSUBMITTALS

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

1.3 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.

1.4 SCAFFOLDING

.1 Scaffolding in accordance with CAN/CSA-S269.2.

.2 Provide and maintain scaffolding, ramps, ladders, swing staging, platforms, and temporary stairs.

1.5 HOISTING

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

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

1.6 SITE STORAGE/LOADING

.1 Confine work and operations of employees by Contract Documents. Refer to extent of Contractor laydown area in drawings. 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.

1.7 CONSTRUCTION PARKING

.1 Limited parking may be available near the site. Parking arrangements will be reviewed with the Departmental Representative at project start up.

.2 Provide and maintain adequate access to project site.

1.8 OFFICES

.1 Provide and maintain, during the entire progress of the Work, a suitable office on the site, for own use, with suitable tables or benches for the examination of drawings, specifications, etc., and where all notices and instructions from the Consultant may be received and acknowledged. Provide suitable meeting space for site meetings. Provide adequate heating, ventilating and lighting. Location of these offices to be coordinated with the Departmental Representative.

.2 Provide marked and fully stocked first-aid case in a readily available location.

1.9 EQUIPMENT, TOOL AND MATERIALS STORAGE

.1 Provide and maintain, in clean and orderly condition, lockable weatherproof sheds for storage of tools, equipment and materials.

.2 Locate materials not required to be stored in weatherproof sheds on site in manner to cause least interference with work activities.

1.10 SANITARY FACILITIES

.1 Contractor shall provide temporary sanitary facilities for the use by the workers. Location of facilities outside of building to be designated by the Departmental Representative.

.2 Post notices and take precautions as required by local health authorities. Keep area and premises in sanitary condition.

.3 Contractor shall be responsible for cleaning and maintenance of designated facilities.

1.11 CONSTRUCTION SIGNAGE

.1 Provide and erect construction safety signs.

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

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

.4 Maintain approved signs and notices in good condition for duration of project, and dispose of off site on completion of project or earlier if directed by Departmental Representative.

1.12 PROTECTION AND MAINTENANCE OF TRAFFIC AND PEDESTRIANS

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

.2 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

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

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

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

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

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

.8 Provide snow removal during period of Work.

1.13 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 on an on-going basis.

.3 Store materials resulting from demolition activities that are salvageable.

.4 Stack stored new or salvaged material not in construction facilities.

END OF SECTION

Part 1 General

1.1 INSTALLATION AND REMOVAL

.1 Provide temporary controls to execute Work expeditiously.

.2 Remove from site all such work after use.

1.2 HOARDING

.1 Erect temporary site enclosures using 1.8m high chainlink fence with steel posts spaced at maximum 2.4m on centre. Maintain fence in good repair.

.2 Provide one lockable vehicle 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.

1.3 GUARD RAILS, BARRICADES, AND SIGNAGE

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

.2 Provide Construction Zone warning and access control signage.

1.4 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.

1.5 DUST TIGHT SCREENS AND DUST MITIGATION

.1 Provide dust tight screens or insulated partitions to localize dust generating activities, and for protection of workers, finished areas of Work and public. Dust tight screens must continue from floor slab to underside of structure and be installed tight to substrates and around interferences in order to block transmission of dust.

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

.3 Maintain negative pressure in area of dust generating work. Exhaust directly to the exterior.

.4 Provide walk-off mats inside renovation area and maintain so these to keep them clean.

.5 Provide protection of flooring immediately outside Work area within public corridor area for duration of renovation work.

1.6 HARD WALL SCREENS

.1 Provide floor to underside of structure partitions between renovated areas and occupied spaces in the building to prevent noise transmission.

.2 Partitions shall be minimum 12.7 gypsum board both sides metal studs with batt insulation in all stud cavities.

.3 Maintain in place until noise generating activities are complete in renovated area.

.4 Existing partitions may be left in place to provide hard wall screens.

1.7 ACCESS TO SITE

.1 Provide and maintain access roads, sidewalk crossings, ramps and construction runways as may be required for access to Work.

1.8 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.

1.9 FIRE ROUTES

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

1.10 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.

1.11 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 Departmental Representative locations and installation schedule 3 days prior to installation.

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

1.12 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.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 Within text of each specifications section, reference may be made to reference standards.

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

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

.4 Cost for such testing will be born by Owner 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.

.3 Defective products, whenever identified prior to completion of Work, will be rejected, regardless of previous inspections. Inspection does not relieve responsibility, but is precaution against oversight or error. Remove and replace defective products at own expense and be responsible for delays and expenses caused by rejection.

.4 Should disputes arise as to quality or fitness of products, decision rests strictly with Departmental Representative based upon requirements of Contract Documents.

.5 Unless otherwise indicated in specifications, maintain uniformity of manufacture for any particular or like item throughout building.

.6 Permanent labels, trademarks and nameplates on products are not acceptable in prominent locations, except where required for operating instructions, or when located in mechanical or electrical rooms.

1.3 AVAILABILITY

.1 Immediately upon signing Contract, review product delivery requirements and anticipate foreseeable supply delays for items. If delays in supply of products are foreseeable, notify Departmental Representative of such, in order that substitutions or other remedial action may be authorized in ample time to prevent delay in performance of Work.

.2 In event of failure to notify Departmental Representative at commencement of Work and should it subsequently appear that Work may be delayed for such reason, Departmental

Representative reserves right to substitute more readily available products of similar character, at no increase in Contract Price or Contract Time.

1.4 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, lumber, steel members, doors and frames 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 Departmental Representative.

.9 Touch-up damaged factory finished surfaces to Departmental Representative's satisfaction. Use touch-up materials to match original. Do not paint over name plates.

1.5 TRANSPORTATION

.1 Pay costs of transportation of products required in performance of Work.

1.6 MANUFACTURER'S INSTRUCTIONS

.1 Unless otherwise indicated in specifications, install or erect products in accordance with manufacturer's instructions. Do not rely on labels or enclosures provided with products. Obtain written instructions directly from manufacturers.

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

.3 Improper installation or erection of products, due to failure in complying with these requirements, authorizes Departmental Representative to require removal and re-installation at no increase in Contract Price or Contract Time.

1.7 QUALITY OF WORK

.1 Ensure Quality of Work is of highest standard, executed by workers experienced and skilled in respective duties for which they are employed. Immediately notify Departmental Representative if required Work is such as to make it impractical to produce required results.

.2 Do not employ anyone unskilled in their required duties. Departmental Representative reserves right to require dismissal from site, workers deemed incompetent or careless.

.3 Decisions as to standard or fitness of Quality of Work in cases of dispute rest solely with Departmental Representative, whose decision is final.

1.8 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.

1.9 CONCEALMENT

.1 In finished areas conceal pipes, ducts and wiring in floors, walls and ceilings, except where indicated otherwise.

.2 Before installation inform Departmental Representative if there is interference. Install as directed by Departmental Representative.

1.10 REMEDIAL WORK

.1 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.

.2 Perform remedial work by specialists familiar with materials affected. Perform in a manner to neither damage nor put at risk any portion of Work.

1.11 LOCATION OF FIXTURES

.1 Consider location of fixtures, outlets, and mechanical and electrical items indicated as approximate.

.2 Inform Departmental Representative of conflicting installation. Install as directed.

1.12 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.

1.13 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.

1.14 IDENTIFICATION – EQUIPMENT

.1 Refer to appended National Maintenance Management System and Appendix A for legacy codes, inventory numbers, and identification abbreviations for all mechanical, electrical, and life safety equipemnt.

1.15 PROTECTION OF WORK IN PROGRESS

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

1.16 EXISTING UTILITIES

.1 When breaking into or connecting to existing services or utilities, execute Work at times directed by local governing authorities, with minimum of disturbance to Work, and/or building occupants.

.2 Obtain Departmental Representative approval prior to any disruptions to services.

.3 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.

END OF SECTION

Part 1 General

1.1 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.

.2 Submit written request in advance of cutting or alteration which affects:

- .1 Structural integrity of elements of project.
- .2 Integrity of weather-exposed or moisture-resistant elements.
- .3 Efficiency, maintenance, or safety of operational elements.
- .4 Visual qualities of sight-exposed elements.
- .5 Work of Departmental Representative or separate contractor.

.3 Include in request:

- .1 Identification of project.
- .2 Location and description of affected Work.
- .3 Statement on necessity for cutting or alteration.
- .4 Description of proposed Work, and products to be used.
- .5 Alternatives to cutting and patching.
- .6 Effect on Work of Departmental Representative or separate contractor.
- .7 Written permission of affected separate contractor.
- .8 Date and time work will be executed.

1.2 FORMS

.1 Special forms required during the course of this Work may include, but are not limited to, the following.

- .1 Building permit, other permits, licences, and certificates.
- .2 Dig permit.
- .3 Hot work.
- .4 Confined space entry.
- .5 Site steam protocol.
- .6 Ground disturbance.
- .7 Fire watch plan.

1.3 MATERIALS

.1 Required for original installation.

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

1.4 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.

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

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

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

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

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

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

.11 At penetration of fire rated wall, ceiling, or floor construction, completely seal voids with firestopping or firestopping sealant material using UL or ULC rated assembly in accordance with manufacturer's instructions.

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

.13 Conceal pipes, ducts and wiring in floor, wall and ceiling construction of finished areas except where indicated otherwise.

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.

END OF SECTION

1.1 PROJECT CLEANLINESS

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

.2 Provide “walk-off” mats where required to control dust from tracking out of areas being renovated to public areas or other areas of the building.

.3 Vacuum mats and surrounding area daily and as needed where dust has been tracked from renovated areas.

.4 Remove waste materials from site at daily regularly scheduled times. Do not burn waste materials on site.

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

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

.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.

1.2 FINAL CLEANING

.1 When Work is Substantially Performed remove surplus products, tools, construction machinery, and equipment not required for performance of remaining Work.

.2 Remove waste products and debris other than that caused by others, and leave Work clean and suitable for occupancy.

.3 Prior to final review remove surplus products, tools, construction machinery, and equipment.

.4 Remove waste products and debris other than that caused by Departmental Representative or other Contractors.

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

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

.7 Remove stains, spots, marks and dirt from work, electrical and mechanical fixtures, furniture fitments, walls, and floors.

.8 Clean lighting reflectors, lenses, and other lighting surfaces.

.9 Vacuum clean and dust building interiors, behind grilles, louvres and screens.

.10 Inspect finishes, fitments and equipment and ensure specified workmanship and operation.

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

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

.13 Remove snow and ice from access to building.

1.3 WASTE MANAGEMENT AND DISPOSAL

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

END OF SECTION

Part 1 General

1.1 DEFINITIONS

.1 Materials Source Separation Program (MSSP): consists of series of ongoing activities to separate reusable and recyclable waste material into material categories from other types of waste at point of generation.

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

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

.4 Recycling: process of sorting, cleansing, treating, and reconstituting solid waste and other discarded materials for purpose of using in altered form. Recycling does not include burning, incinerating, or thermally destroying waste.

.5 Reuse: repeated use of product in same form but not necessarily for same purpose. Reuse includes:

.1 Salvaging reusable materials from re-modelling projects, before demolition stage, for resale, reuse on current project or for storage for use on future projects.

.2 Returning reusable items including pallets or unused products to vendors.

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

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

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

.9 Waste Audit (WA): detailed inventory of materials in building. Involves quantifying by volume/weight amounts of materials and wastes generated during construction, demolition, deconstruction, or renovation project. Indicates quantities of reuse, recycling and landfill. Refer to Schedule A.

.10 Waste Management Co-ordinator (WMC) : contractor representative responsible for supervising waste management activities as well as coordinating related, required submittal and reporting requirements.

.11 Waste Reduction Workplan (WRW): written report which addresses opportunities for reduction, reuse, or recycling of materials. Refer to Schedule B. WRW is based on information acquired from WA (Schedule A).

1.2 SUBMITTALS

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

1.3 WASTE REDUCTION WORKPLAN (WRW)

.1 Prepare WRW prior to project start-up.

.2 WRW should include but not limited to:

- .1 Destination of materials listed.
- .2 Deconstruction/disassembly techniques and sequencing.
- .3 Schedule for deconstruction/disassembly.
- .4 Location.
- .5 Security.
- .6 Protection.
- .7 Clear labelling of storage areas.
- .8 Details on materials handling and removal procedures.

.3 Structure WRW to prioritize actions and follow 3R's hierarchy, with Reduction as first priority, followed by Reuse, then Recycle.

.4 Describe management of waste.

.5 Identify opportunities for reduction, reuse, and recycling of materials.

.6 Post WRW or summary where workers at site are able to review content.

.7 Set realistic goals for waste reduction, recognize existing barriers and develop strategies to overcome these barriers.

.8 Monitor and report on waste reduction.

1.4 MATERIALS SOURCE SEPARATION PROGRAM (MSSP)

.1 Prepare MSSP and have ready for use prior to project start-up.

.2 Implement MSSP for waste generated on project in compliance with approved methods and as reviewed by Departmental Representative.

.3 Provide on-site facilities for collection, handling, and storage of anticipated quantities of reusable and recyclable materials.

.4 Provide containers to deposit reusable and recyclable materials.

.5 Locate containers in locations, to facilitate deposit of materials without hindering daily operations.

.6 Locate separated materials in areas which minimize material damage.

.7 Collect, handle, store on-site, and transport off-site, salvaged materials in separate condition.

- .1 Transport to users of material for recycling.

.8 Collect, handle, store on-site, and transport off-site, salvaged materials in combined condition.

.1 Ship materials to site operating under Certificate of Approval.

1.5 STORAGE, HANDLING AND PROTECTION

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

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

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

.4 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.

1.6 DISPOSAL OF WASTES

.1 Do not bury rubbish or waste materials.

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

1.7 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 and where required provide temporary security measures approved by Departmental Representative.

1.8 SCHEDULING

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

Part 2 Execution

2.1 APPLICATION

.1 Do Work in compliance with WRW.

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

2.2 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 Acceptance of Work Procedures:

.1 Contractor's Inspection: Contractor: conduct inspection of Work, identify deficiencies and defects, and repair as required to conform to Contract Documents.

.1 Notify Departmental Representative in writing of satisfactory completion of Contractor's inspection and submit verification that corrections have been made.

.2 Request Departmental Representative review.

.2 Departmental Representative Review:

.1 Departmental Representative and Contractor to review Work and identify defects and deficiencies.

.2 Contractor to correct Work as directed.

.3 Completion Tasks: submit written certificates in English that tasks have been performed as follows:

.1 Work: completed and inspected for compliance with Contract Documents.

.2 Defects: corrected and deficiencies completed.

.3 Equipment and systems: tested, balanced, adjusted, and fully operational.

.4 Certificates required by Fire Commissioner and Utility companies: submitted.

.5 Operation of systems: demonstrated to Departmental Representative’s personnel.

.6 Commissioning of mechanical systems: completed in accordance with Departmental Representative.

.7 Work: complete and ready for final inspection.

.4 Final Inspection:

.1 When completion tasks are done, request final review of Work by Departmental Representative, and Contractor.

.2 When Work is incomplete according to Departmental Representative, complete outstanding items and request re-inspection.

.5 Declaration of Substantial Performance: when Departmental Representative considers deficiencies and defects corrected and requirements of Contract substantially performed, make application for Certificate of Substantial Performance.

.6 Commencement of Lien and Warranty Periods: date of Departmental Representative's acceptance of submitted declaration of Substantial Performance to be date for commencement for warranty period and commencement of lien period unless required otherwise by lien statute of Place of Work.

.7 Final Payment:

.1 When Departmental Representative considers final deficiencies and defects corrected and requirements of Contract met, make application for final payment.

.8 Payment of Holdback: after issuance of Certificate of Substantial Performance of Work, submit application for payment of holdback amount in accordance with contractual agreement.

1.2 FINAL CLEANING

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

.1 Remove surplus materials, excess materials, rubbish, tools and equipment.

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

END OF SECTION

Part 1 General

1.1 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Prepare instructions and data using personnel experienced in maintenance and operation of described products.

.3 Copy will be returned after final review, with Departmental Representative’s comments.

.4 Two weeks prior to Substantial Performance of the Work, submit to Departmental Representative, three final copies (2 hard copies and 1 electronic) of operating and maintenance manuals in English.

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

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

.7 Defective products will be rejected, regardless of previous inspections. Replace products at Contractor’s own expense.

.8 Pay costs of transportation.

1.2 FORMAT

.1 Organize data as instructional manual.

.2 Provide two (2) bound copies and one (1) PDF copy on 1 CD, DVD, or USB drive.

.3 Binders: cloth, hard covered, 3 post expandable, loose leaf paper size 219 x 279 mm. Colour ‘black’ Provide two (2) copies.

.4 CD or DVD: closed session format, write protected and free from errors and viruses.

.5 USB Drive: portable data storage device, which includes flash memory and integrated USB interface.

.6 When multiple binders and discs are used correlate data into related consistent groupings.

.1 Identify contents of each binder on spine.

.7 Cover: identify each binder with type or printed title 'Project Record Documents'; list title of project and identify subject matter of contents. Lettering to be ‘gold’ colour.

.8 Provide printed title on CD or DVD version to coincide with title on bound version.

.9 Provide printed label on USB drive to coincide with title on bound version.

.10 Arrange content by systems, under Section numbers and sequence of Table of Contents.

.11 Provide tabbed fly leaf for each separate product and system, with typed description of product and major component parts of equipment.

.12 Text: manufacturer's printed data, or typewritten data.

.13 Drawings: provide with reinforced punched binder tab.

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

1.3 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 Owner, Consultants, General Contractor, and Sub-Trades, 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.

.2 Colour names, description, and codes.

.3 Shop Drawings: copies of submitted shop drawings, complete with reviewed stamps, comments, and mark-ups.

.4 Product Data: mark each sheet to identify specific products and component parts, and data applicable to installation; delete inapplicable information.

.5 Drawings: supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams.

.6 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.

.7 Training: refer to Section 01 79 00 - Demonstration and Training.

1.4 AS -BUILT DOCUMENTS AND SAMPLES

.1 Maintain, in addition to requirements in General Conditions, at site for Departmental Representative one record copy of:

.1 Contract Drawings.

.2 Specifications.

.3 Addenda.

.4 Change Orders and other modifications to Contract.

.5 Supplemental Instructions.

.6 Request for Information submissions.

.7 Reviewed shop drawings, product data, and samples.

.8 Field test records.

.9 Inspection certificates.

.10 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 Departmental Representative.

1.5 RECORDING INFORMATION ON PROJECT RECORD DOCUMENTS

.1 Record information on set of drawings, and in copy of Project Manual.

.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 Referenced Standards 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, and field test records, required by individual specifications sections.

.7 Provide digital photos for site records.

1.6 EQUIPMENT AND SYSTEMS

.1 For each item of equipment and each system include description of unit or system, and component parts.

.1 Give function, normal operation characteristics and limiting conditions.

.2 Include performance curves, with engineering data and tests, and complete nomenclature and commercial number of replaceable parts.

.3 Provide legacy code, inventory number, and identification abbreviation noted in appended National Maintenance Management System and Appendix A.

.2 Panel board circuit directories: provide electrical service characteristics, controls, and communications.

.3 Include installed colour coded wiring diagrams.

.4 Operating Procedures: include start-up, break-in, and routine normal operating instructions and sequences.

.1 Include regulation, control, stopping, shut-down, and emergency instructions.

.2 Include summer, winter, and any special operating instructions.

.5 Maintenance Requirements: include routine procedures and guide for trouble-shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.

.6 Provide servicing and lubrication schedule, and list of lubricants required.

.7 Include manufacturer's printed operation and maintenance instructions.

.8 Include sequence of operation by controls manufacturer.

.9 Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.

.10 Provide installed control diagrams by controls manufacturer.

.11 Provide Contractor's co-ordination drawings, with installed colour coded piping diagrams.

.12 Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.

.13 Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.

.14 Include test and balancing reports as specified in Section 01 45 00 - Quality Control.

.15 Additional requirements: as specified in individual specification sections.

1.7 MATERIALS AND FINISHES

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

.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.

1.8 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 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 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 Departmental Representative.

.2 Include approved listings in Maintenance Manual.

1.9 PROGRESS PHOTOGRAPHS

.1 Provide two (2) CDs, DVDs, or USB drives.

.2 DVD or CD: closed session format, write protected and free from errors and viruses.

.3 USB drive: portable data storage device, which includes flash memory and integrated USB interface.

.4 Provide printed title on DVD/CD version to coincide with title on Operation and maintenance manuals.

.5 Provide printed label on USB drive to coincide with title on bound version.

.6 Digital photographs shall be in jpg format.

.7 Arrange contents chronologically by date photographs were taken.

.8 Digital photographs stored on CD-ROM, DVD, or USB drive, shall be submitted with the Operation and Maintenance Manuals.

1.10 DELIVERY, STORAGE AND HANDLING

.1 Store spare parts, maintenance materials, and special tools in manner to prevent damage or deterioration.

.2 Store in original and undamaged condition with manufacturer's seal and labels intact.

.3 Store components subject to damage from weather in weatherproof enclosures.

.4 Store paints and freezable materials in a heated and ventilated room.

.5 Remove and replace damaged products at own expense and for review by Departmental Representative.

1.11 WARRANTIES AND BONDS

.1 Submit, warranty information made available during construction phase, to Departmental Representative.

.2 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 Retain warranties and bonds until time specified for submittal.

.3 Except for items put into use with Departmental Representative’s permission, leave date of beginning of time of warranty until Date of Substantial Performance is determined.

.4 Conduct joint 10-month warranty inspection, measured from time of acceptance, by Departmental Representative.

.5 Include information contained in warranty 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.

.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 Procedure and status of tagging of equipment covered by extended warranties.

.5 Post copies of instructions near selected pieces of equipment where operation is critical for warranty and/or safety reasons.

.6 Respond in timely manner to oral or written notification of required construction warranty repair work.

.7 Written verification to follow oral instructions.

.1 Failure to respond will be cause for the Departmental Representative to proceed with action against Contractor.

END OF SECTION

Part 1 General

1.1 ADMINISTRATIVE REQUIREMENTS

.1 Demonstrate operation and maintenance of equipment and systems to Departmental Representative's personnel two weeks prior to date of substantial performance.

.2 Departmental Representative: provide list of personnel to receive instructions, and co-ordinate their attendance at agreed-upon times.

.3 Preparation:

- .1 Verify conditions for demonstration and instructions comply with requirements.
- .2 Verify designated personnel are present.
- .3 Ensure equipment has been inspected and put into operation.
- .4 Ensure testing, adjusting, and balancing has been performed and equipment and systems are fully operational.

.4 Demonstration and Instructions:

- .1 Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, and maintenance of each item of equipment at scheduled times, at the equipment location.
- .2 Instruct personnel in phases of operation and maintenance using operation and maintenance manuals as basis of instruction.
- .3 Review contents of manual in detail to explain aspects of operation and maintenance.
- .4 Prepare and insert additional data in operations and maintenance manuals when needed during instructions.

.5 Time Allocated for Instructions: ensure amount of time required for instruction of each item of equipment or system.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Submit schedule of time and date for demonstration of each item of equipment and each system two weeks prior to designated dates, for Departmental Representative's approval.

.3 Submit reports within one week after completion of demonstration, that demonstration and instructions have been satisfactorily completed.

.4 Give time and date of each demonstration, with list of persons present.

.5 Provide copies of completed operation and maintenance manuals for use in demonstrations and instructions.

1.3 QUALITY ASSURANCE

.1 When specified in individual Sections requiring manufacturer to provide authorized representative to demonstrate operation of equipment and systems:

.1 Instruct Departmental Representative's personnel.

.2 Provide written report that demonstration and instructions have been completed.

.3 Provide sign-in sheet signed by the instructor and all attendees.

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 Refer to all project Specification Sections for detailed description of commissioning requirements.

.3 Acronyms:

.1 Cx - Commissioning.
.2 Cx Authority – Commissioning Authority.
.3 EMCS - Energy Monitoring and Control Systems.
.4 O&M - Operation and Maintenance.
.5 PI - Product Information.
.6 PV - Performance Verification.
.7 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 O&M manual.
.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 Commissioning (Cx) Plan. The Contractor will be responsible for developing the Commissioning (Cx) Plan.

.2 The parties responsible for Cx activities shall be identified in the 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 installed systems are proven to operate satisfactorily under weather, environmental and occupancy conditions to meet functional and operational requirements. Cx activities include transfer of critical knowledge to facility operational personnel.

.6 Departmental Representative will issue Interim Acceptance Certificate when:

.1 Completed Cx documentation has been received, reviewed for suitability and approved by Cx Authority.

.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 Consultant and Cx Authority, to ensure effective performance.

.2 Costs for corrective work, additional tests, inspections, to determine acceptability and proper performance of such items to be borne by Contractor. Above costs to be in form of progress payment reductions or hold-back assessments.

1.5 PRE-CX REVIEW

.1 Before Construction:

.1 Review contract documents, confirm by writing to Departmental Representative:

.1 Adequacy of provisions for Cx.

.2 Aspects of design and installation pertinent to success of Cx.

.2 During Construction:

.1 Co-ordinate provision, location and installation of provisions for Cx.

.3 Before start of Cx:

.1 Have Cx Plan up-to-date.

.2 Ensure installation of related components, equipment, sub-systems, systems are complete.

.3 Fully understand Cx requirements and procedures.

.4 Have Cx documentation shelf-ready.

.5 Understand completely design criteria and intent and special features.

.6 Submit complete start-up documentation to Departmental Representative.

.7 Have Cx schedules up-to-date.

.8 Ensure systems have been cleaned thoroughly.

.9 Complete TAB procedures on systems; submit TAB reports to Departmental Representative for review and approval.

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

.4 Inform 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 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 SUBMITTALS

.1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.

.1 Submit:

.1 Name of Contractor's Cx agent.

.2 Draft Cx documentation.

.3 Preliminary Cx schedule.

.2 Request in writing to Departmental Representative for changes to submittals and obtain written approval at least 8 weeks prior to start of Cx.

.3 Submit proposed Cx procedures to Departmental Representative where not specified and obtain written approval at least 8 weeks prior to start of Cx.

.4 Provide additional documentation relating to Cx process required by Departmental Representative.

1.8 COMMISSIONING DOCUMENTATION

.1 Refer to individual equipment Specification Sections for (Cx) forms: Installation Check Lists, Product Information (PI) and Performance Verification (PV) forms for requirements.

.2 Consultant and Cx Authority to review and approve Cx documentation.

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

1.9 COMMISSIONING SCHEDULE

.1 Provide detailed Cx schedule as part of construction schedule in accordance with Section 01 32 16.07 - Construction Progress Schedules.

.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 Cx meetings will be held following project meetings and as specifically requested.

.2 Purpose: to resolve issues, monitor progress, identify deficiencies, relating to Cx.

.3 Cx meetings will be held on a regular basis until commissioning deliverables have been addressed.

.4 At approximately 50% completion stage a separate Cx scope meeting will be held to review progress, discuss schedule of equipment start-up activities and prepare for Cx. Issues at meeting to include:

.1 Review duties and responsibilities of Contractor and subcontractors, addressing delays and potential problems.

.2 Determine the degree of involvement of trades and manufacturer's representatives in the commissioning process.

.5 Thereafter Cx meetings to be held until project completion and as required during equipment start-up and functional testing period.

.6 Meeting will be chaired by Contractor, who will record and distribute minutes.

.7 Ensure subcontractors and relevant manufacturer representatives are present at 50% and subsequent Cx meetings and as required.

1.11 STARTING AND TESTING

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

1.12 WITNESSING OF STARTING AND TESTING

.1 Provide 14 days notice prior to commencement.

.2 Departmental Representative may witness start-up.

.3 Consultant and Cx Authority will witness testing for PV.

.4 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 Obtain manufacturers installation, start-up and operations instructions prior to start-up of components, equipment and systems and review with Departmental Representative.

.1 Compare completed installation with manufacturer's published data, record discrepancies, and review with manufacturer.

.2 Modify procedures detrimental to equipment performance and review same with manufacturer before start-up.

.2 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.

.3 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.

.3 Verification of legacy codes, inventory numbers, and identification abbreviations noted in appended National Maintenance Management System and Appendix A.

.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 Consultant and Cx Authority after distinct phases have been completed and before commencing next phase.

.4 Documents require tests on approved PV forms.

.5 Failure to follow accepted start-up procedures will result in re-evaluation of equipment by an independent testing agency selected by Departmental Representative. If results reveal that equipment start-up was not in accordance with requirements, and resulted in damage to equipment, implement following:

.1 Minor equipment/systems: implement corrective measures approved by Departmental Representative.

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

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

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

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

1.15 START-UP DOCUMENTATION

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

.2 Start-up documentation to include:

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

.2 Pre-start-up inspection reports.

.3 Signed installation/start-up check lists.

.4 Start-up reports,

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

1.16 OPERATION AND MAINTENANCE OF EQUIPMENT AND SYSTEMS

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

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

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

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

1.17 TEST RESULTS

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

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

1.18 START OF COMMISSIONING

.1 Notify Departmental Representative at least 14 days prior to start of Cx.

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

1.19 INSTRUMENTS / EQUIPMENT

.1 Submit to Departmental Representative for review and approval:

.1 Complete list of instruments proposed to be used.

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

.2 Provide the following equipment as required:

.1 2-way radios.

.2 Ladders.

.3 Equipment as required to complete work.

1.20 COMMISSIONING PERFORMANCE VERIFICATION

.1 Carry out Cx:

.1 Under actual 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 Consultant and Cx Authority to witness activities and verify results following the Contractor’s performance verification.

1.22 AUTHORITIES HAVING JURISDICTION

.1 Where specified start-up, testing or commissioning procedures duplicate verification requirements of authority having jurisdiction, arrange for authority to witness procedures so as to avoid duplication of tests and to facilitate expedient acceptance of facility.

.2 Obtain certificates of approval, acceptance and compliance with rules and regulation of authority having jurisdiction.

.3 Provide copies to Departmental Representative within 10 days of test and with Cx report.

1.23 COMMISSIONING CONSTRAINTS

.1 Commissioning will be undertaken on new equipment and modified equipment provided under this contract. Where these are tied into existing building systems the Cx will need to be coordinated with the building operator.

1.24 EXTRAPOLATION OF RESULTS

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

1.25 EXTENT OF VERIFICATION

.1 Tenant areas:

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

.2 Number and location to be at discretion of Departmental Representative.

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

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

.5 Perform additional commissioning until results are acceptable to Consultant and Cx Authority.

1.26 REPEAT VERIFICATIONS

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

.1 Verification of reported results fail to receive Consultant's or Cx Authority approval.

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

.3 Departmental Representative deems Contractor's request for second verification was premature.

1.27 SUNDRY CHECKS AND ADJUSTMENTS

.1 Make adjustments and changes which become apparent as Cx proceeds.

.2 Perform static and operational checks as applicable and as required.

1.28 DEFICIENCIES, FAULTS, DEFECTS

.1 Correct deficiencies found during start-up and Cx to satisfaction of Departmental Representative.

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

1.29 COMPLETION OF COMMISSIONING

.1 Upon completion of Cx leave systems in normal operating mode.

.2 Except for warranty and seasonal verification activities specified in Cx specifications, complete Cx prior to issuance of Interim Certificate of Completion.

.3 Cx to be considered complete when contract Cx deliverables have been submitted and accepted by Cx Authority.

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 Provide training in accordance with Section 01 91 41 - Commissioning (Cx) - Training and requirements of Contract Specification Sections.

1.32 MAINTENANCE MATERIALS, SPARE PARTS, SPECIAL TOOLS

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

1.33 OCCUPANCY

.1 Cooperate fully with Departmental Representative during stages of acceptance; facility will remain fully occupied.

1.34 INSTALLED INSTRUMENTATION

.1 Use instruments installed under Contract for TAB and PV if:

.1 Accuracy complies with these specifications.

.2 Calibration certificates have been deposited with Departmental Representative.

.2 Calibrated EMCS sensors may be used to obtain performance data provided that sensor calibration has been completed and accepted.

1.35 PERFORMANCE VERIFICATION TOLERANCES

.1 Application tolerances:

.1 Specified range of acceptable deviations of measured values from specified values or specified design criteria. Unless noted otherwise in this contract Specifications, 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 noted otherwise in this contract Specifications actual values to be within +/- 2 % of recorded values.

1.36 OWNER'S PERFORMANCE TESTING

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

Part 2 Products

2.1 NOT USED

.1 Not used

Part 3 Execution

3.1 SCHEDULE OF ARCHITECTURAL SYSTEMS

.1 Not applicable.

3.2 SCHEDULE FOR MECHANICAL SYSTEMS

.1 Produce schedule of Cx activities in bar chart format to a scale that will ensure legibility. Bar chart to indicate:

.2 Sequences of testing equipment and systems, interrelationship between tests, duration of tests and training periods.

.3 Cx resources which will be committed to this project to ensure completion by prescribed dates.

- .1 Training Plan.
- .2 Cx Documentation Plan.
- .3 Water/fire mains and related site fire hydrants:

.4 Commission as soon as installation is complete, using procedures described in NFPA reference standards to provide protection for exterior envelope of new building during construction.

.5 Wet pipe sprinkler systems:

- .1 Test completed systems in accordance with NFPA 13.

.6 Plumbing systems:

- .1 To be filled, then proceed with flushing, cleaning and disinfection processes.
- .2 Test plumbing and piping systems installed under this project

.7 HVAC systems:

- .1 Ductwork, piping and conduit systems that will be concealed to be tested and certified to specified standards before being concealed. This work is specified in relevant technical sections of Division 23.
- .2 HVAC systems to be initially started up, "bumped" in a stand-alone mode and pre-start-up inspections completed.
- .3 Start after dust-producing construction procedures have been completed and areas are dust-free.
- .4 Start HVAC to replace temporary heating systems after Consultant's written approval.
- .5 Operate HVAC to permit TAB and ensure full compliance with contract documents when weatherstripping, caulking and sealing of exterior envelope has been completed, and interior partitions and doors are installed and ceiling return plenums are in place.

.8 HVAC and related hydronic systems:

- .1 Test in conjunction with EMCS, and fire and smoke detection systems.

.9 Items which have a detrimental effect on operation and maintenance. To receive preliminary attention at this point. To be fully commissioned at same time as relevant equipment and systems.

.10 Vibration isolation and seismic control measures:

.1 Test these measures at same time as connected system.

.11 Equipment and systems subject to specified codes and standards or subject to approval of an authority having jurisdiction:

.1 Commission equipment and systems in accordance with those requirements.

.2 Where testing is required as part of a regulatory process, and where Cx procedures are fully developed, are appropriate to project, ensure tests as required by such codes are performed. Departmental Representative to witness tests as part of Quality Assurance role.

.12 Controls:

.1 Testing and Cx to be specified in Section 25 01 11 - EMCS: Start-Up, Verification and Commissioning, which defines conditions for acceptance.

.2 Point-by-point and end-to-end testing to be carried out by installation Contractor, monitored by Departmental Representative and verified as part of system verification.

.3 Demonstration of operation of systems under operating conditions and over full operating range to take place prior to 30-day test period and to be witnessed by Departmental Representative. Includes simulated opposite-season tests. Controls programming and operation to be verified after HVAC systems have been TAB'd.

.13 To reduce VOC concentrations to acceptable levels:

.1 Flow rates of outside air into HVAC systems to be adjusted as required during Cx, and as necessary after occupancy.

.14 Commission Mechanical systems and associated equipment as follows:

.1 Plumbing systems:

.1 Installation and Operation of all plumbing fixtures installed under this project.

.2 All piping installed to serve fixtures.

.2 Hydronic systems:

.1 To be filled, pumps "bumped" in stand-alone mode and pre-start-up inspections completed. Then undertake cleaning and flushing processes.

.2 Commission only after relevant water treatment systems have been commissioned.

.3 Commission at same time as HVAC systems are being TAB'd.

.3 HVAC and exhaust systems:

.1 HVAC systems (AHU-1 and zone cooling coils)

.2 Exhaust systems (All exhaust fan systems and controls)

.3 Terminal Heating Units (All duct heating coils with associated controls for each device)

.4 Fire and life safety systems:

.1 Wet pipe sprinkler systems.

.15 Product Information forms shall be completed and submitted with Shop Drawings. A sample of each form is provided with the specifications.

.16 Performance Verification forms (samples provided as noted) shall be finalized with contractor and completed by the contractor prior to performance review with Departmental Representative for the following mechanical systems:

.1 Air handling Unit (AHU-1, PV sample provided)

.2 Exhaust fans EF-2 to EF-6 (PV sample provided) – 100% to be reviewed with Cx Agent after commissioning is complete.

.3 Heat Exchangers HX-1 and HX-2 – 100% to be reviewed with Cx Agent after commissioning is complete.

.4 Pumps P-1, P-2, and P-3 and chilled water pump (PV sample provided) – 100% to be reviewed with Cx Agent after commissioning is complete.

.5 All Duct Heating Coils: 100% to be reviewed with Cx Agent after commissioning is complete.

.6 All Duct Cooling Coils: 100% to be reviewed with Cx Agent after commissioning is complete.

.7 All Circulating Fans: 100% to be reviewed with Cx Agent after commissioning is complete.

.8 Testing and Air Balancing Report: 30% to be reviewed with Cx Agent after commissioning is complete.

3.3 SCHEDULE OF ELECTRICAL SYSTEMS

.1 The following is a listing of the building electrical systems to be commissioned:

.1 Panelboards Breaker Type

.2 Motor Starters To 600 V

.3 Lighting

.4 Emergency Lighting

.5 Exit Signs

.6 Fire Alarm Systems

3.4 INTEGRATED LIFE SAFETY SYSTEMS

.1 Upon completion of individual system tests, test for integration of life safety systems upon:

.1 Loss of power

.2 Fire alarm signal

.2 Fire Protection Systems: test integrated systems to verify that components work together as designed.

.3 Performance of HVAC, fire protection, EMCS and systems forming part of integrated systems to be verified after systems has been TAB'd to ensure compliance with prescribed requirements.

.4 Fire alarm call out, horn strobes.

.5 Emergency lighting, exit signage.

END OF SECTION

Part 1 General

1.1 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.

.4 Legacy codes, inventory numbers, and identification abbreviations as per appended National Maintenance Management System and Appendix A.

.2 Equipment manufacturer's installation/start-up check lists are acceptable for use. As deemed necessary by Departmental Representative supplemental additional data lists may be required for specific project conditions.

.3 Use check lists for equipment installation. Document check list verifying checks have been made, indicate deficiencies and corrective action taken.

.4 Installer to sign check lists upon completion, certifying stated checks and inspections have been performed. Return completed check lists to Departmental Representative. Check lists will be required during Commissioning and will be included in O&M Manual 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.

1.2 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 Cx Manual at completion of work.

.2 Prior to Performance Verification (PV) of systems complete items on PI forms related to systems and obtain Consultant and Cx Authority approvals.

1.3 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, and records the measured data and readings taken during functional testing and Performance Verification procedures.

.3 Prior to PV of integrated system, complete the PV forms of related systems and obtain Consultant's and Cx Authority approval.

1.4 COMMISSIONING FORMS

.1 Example forms are included appended to this Section.

.2 The Consultant will develop and provide the Contractor with final project-specific Commissioning forms in hard-copy format complete with specification data.

.3 Revise items on Commissioning forms to suit project requirements.

1.5 COMMISSIONING VERIFICATION PROCESS

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

.2 Strategy for Use:

.1 Consultant provides Contractor project-specific Commissioning forms with Specification data included.

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

.3 Confirm operation as per design criteria and intent.

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

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

.6 Record analytical and substantiating data.

.7 Reported results will be verified by the Consultant and Cx Authority.

.8 Form to bear signatures of recording technician and reviewed and signed off by Consultant and Cx Authority.

.9 Submit immediately after tests are performed.

.10 Reported results in true measured SI unit values.

.11 Originals of completed forms are to be retained on site during start-up, testing and commissioning period. Maintain in Commissioning Manual binder.

.12 Forms to be hard copy with type written results in Commissioning Manual Binder.

END OF SECTION

Mechanical Component Form Index		
Section 1: Air Moving Equipment		
Form	Equipment	Reference
CFM1.1	Air Handling Unit AHU-1	Provided in Specifications
CFM1.2	Retunr Fan RF-1	Provided in Specifications
CFM1.3	Exhaust Fan EF-3	Provided in Specifications
CFM1.4	Exhaust Fan EF-4	Provided in Specifications
CFM1.5	Exhaust Fan EF-6	Provided in Specifications
CFM1.6	Circulating Fan CF-1	Provided in Specifications
CFM1.7	Circulating Fan CF-2	Similar to CFM1.6
CFM1.8	Circulating Fan CF-3	Similar to CFM1.6
CFM1.9	Circulating Fan CF-4	Similar to CFM1.6
CFM1.10	Circulating Fan CF-5	Similar to CFM1.6
CFM1.11	Circulating Fan CF-6	Similar to CFM1.6
Section 2: Hydronic Equipment		
Form	Equipment	Reference
CFM2.1	Pump P-1	Provided in Specifications
CFM2.2	Pump P-2	Similar to CFM2.2
CFM2.3	Pump P-3	Provided in Specifications
CFM2.4	Heat Exchanger HX-1	Provided in Specifications
CFM2.5	Heat Exchanger HX-2	Similar to CFM2.4
Section 3: Air Conditioning Equipment		
Form	Equipment	Reference
CFM3.1	Cooling Coil CC-2	Provided in Specifications

Project Name:	**Project #:**	**57/2017**
TBU50 HVAC Replacement - Regina, Saskatchewan	**Component Form #:**	**CFM1.1**

Component Verification Form		*Section:*
System: **Air Moving Equipment**	*Equipment:* **Air Handling Unit**	*Tag:* **AHU-1**

INSTALLED EQUIPMENT DATA:

Manufacturer	
Type	
Model Number	
Serial Number	

LOCATION DATA:

Building	TBU50
Area Served	Main Floor & Second Floor
Floor Located	Basement
Room	001

PERFORMANCE DATA:

	Specified	Shop Drawings	Required Modification	Installed	
Supply Fan:					
Fan Size & Type	838 (33") CP Airfoil Class II		-	Eng: ☐	Con: ☐
Air Flow	8,962 L/s (19,000 CFM)		-	Eng: ☐	Con: ☐
T.S.P.	834 Pa (3.35 in.w.c.)		-	Eng: ☐	Con: ☐
E.S.P.	311 Pa (1.25 in.w.c.)		-	Eng: ☐	Con: ☐
Fan RPM	1194 (1620 max)		-	Eng: ☐	Con: ☐
Motor Size	14.92 kW (20.0 hp)		-	Eng: ☐	Con: ☐
Motor RPM	1750		-	Eng: ☐	Con: ☐
Motor Efficiency	Premium		-	Eng: ☐	Con: ☐
Voltage / Hz / Phase	208/60/3		-	Eng: ☐	Con: ☐
Heating Coil:					
Air Flow	8,962 L/s (19,000 CFM)		-	Eng: ☐	Con: ☐
E.A.T.	-7.80 C (18.0 F)		-	Eng: ☐	Con: ☐
L.A.T	27.80 C (82.0 F)		-	Eng: ☐	Con: ☐
A.P.D.	37 Pa (0.15 in.w.c.)		-	Eng: ☐	Con: ☐
Water Flow	5.32 L/s (84.3 GPM)		-	Eng: ☐	Con: ☐
Medium	30% Propylene Glycol		-	Eng: ☐	Con: ☐
E.W.T.	87.8 C (190.0 F)		-	Eng: ☐	Con: ☐
L.W.T.	70.6 C (159.0 F)		-	Eng: ☐	Con: ☐
W.P.D.	26.59 kPa (8.9 ft.w.c.)		-	Eng: ☐	Con: ☐
Energy Exchanged	364.20 kW (1242.7 MBH)		-	Eng: ☐	Con: ☐

Comments

SIGN-OFFS:

Contractor: _____ Date: _____

Engineer: _____ Date: _____

CxA: _____ Date: _____

Project Name:	**Project #:**	**57/2017**
TBU50 HVAC Replacement - Regina, Saskatchewan	**Component Form #:**	**CFM1.2**

Component Verification Form | *Section:*

System:	*Equipment:*	*Tag:*
Air Moving Equipment	**Return Fan**	**RF-1**

INSTALLED EQUIPMENT DATA:

Manufacturer	
Type	
Model Number	
Serial Number	

LOCATION DATA:

Building	TBU50
Area Served	Main Floor & Second Floor
Floor Located	Basement
Room	001

PERFORMANCE DATA:

	Specified	Shop Drawings	Required Modification	Installed	
Return Fan:					
Fan Type	Mixed Flow Inline		-	Eng: ☐	Con: ☐
Arrangement	Arrangement 9		-	Eng: ☐	Con: ☐
Air Flow	5,189 L/s (11,000 CFM)		-	Eng: ☐	Con: ☐
S.P.	374 Pa (1.50 in.w.c.)		-	Eng: ☐	Con: ☐
Fan RPM	977		-	Eng: ☐	Con: ☐
Motor Size	3.73 kW (5.0 hp)		-	Eng: ☐	Con: ☐
Motor RPM	1750		-	Eng: ☐	Con: ☐
Motor Efficiency	Premium		-	Eng: ☐	Con: ☐
Voltage / Hz / Phase	208/60/3		-	Eng: ☐	Con: ☐

Comments

SIGN-OFFS:

Contractor: _____ Date: _____

Engineer: _____ Date: _____

CxA: _____ Date: _____

Project Name:	**Project #:**	**57/2017**
TBU50 HVAC Replacement - Regina, Saskatchewan	**Component Form #:**	**CFM1.3**

Component Verification Form		*Section:*
System: **Air Moving Equipment**	*Equipment:* **EXHAUST FAN**	*Tag:* **EF-3**

INSTALLED EQUIPMENT DATA:

Manufacturer	
Type	
Model Number	
Serial Number	

LOCATION DATA:

Building	TBU50
Area Served	Room 113 / 115
Floor Located	Roof
Room	-

PERFORMANCE DATA:

	Specified	Shop Drawings	Required Modification	Installed
Fan:				
Fan Type	Downblast Centrifugal		-	Eng: ☐ Con: ☐
Air Flow	855 L/s (1,812 CFM)		-	Eng: ☐ Con: ☐
S.P.	125 Pa (0.5 in.w.c.)		-	Eng: ☐ Con: ☐
Sound	10.2 Sones		-	Eng: ☐ Con: ☐
Motor Size	0.25 kW (0.33 hp)		-	Eng: ☐ Con: ☐
Motor RPM	1725		-	Eng: ☐ Con: ☐
Voltage / Hz / Phase	208/60/1		-	Eng: ☐ Con: ☐
Motor Type	EC Motor		-	Eng: ☐ Con: ☐
Options:				
Control	Fan Mounted Speed Control		-	Eng: ☐ Con: ☐
Disconnect	NEMA 3 Pre-Wired		-	Eng: ☐ Con: ☐
Back Draft Damper	Yes		-	Eng: ☐ Con: ☐
Roof Curb	Yes		-	Eng: ☐ Con: ☐

Comments

SIGN-OFFS:

Contractor: _____ Date: _____

Engineer: _____ Date: _____

CxA: _____ Date: _____

Prepared By: HDA Engineering Ltd. Regina, Sk, (306) 525-9815

Project Name:	**Project #:**	**57/2017**
TBU50 HVAC Replacement - Regina, Saskatchewan	**Component Form #:**	**CFM1.4**

Component Verification Form	*Section:*

System:	*Equipment:*	*Tag:*
Air Moving Equipment	**EXHAUST FAN**	**EF-4**

INSTALLED EQUIPMENT DATA:

Manufacturer	
Type	
Model Number	
Serial Number	

LOCATION DATA:

Building	TBU50
Area Served	Room 109 / 112
Floor Located	Roof
Room	-

PERFORMANCE DATA:

	Specified	Shop Drawings	Required Modification	Installed	
Fan:					
Fan Type	Downblast Centrifugal		-	Eng: ☐	Con: ☐
Air Flow	682 L/s (1,812 CFM)		-	Eng: ☐	Con: ☐
S.P.	125 Pa (0.5 in.w.c.)		-	Eng: ☐	Con: ☐
Sound	11.1 Sones		-	Eng: ☐	Con: ☐
Motor Size	0.25 kW (0.33 hp)		-	Eng: ☐	Con: ☐
Motor RPM	1725		-	Eng: ☐	Con: ☐
Voltage / Hz / Phase	208/60/1		-	Eng: ☐	Con: ☐
Motor Type	EC Motor		-	Eng: ☐	Con: ☐
Options:					
Control	Fan Mounted Speed Control		-	Eng: ☐	Con: ☐
Disconnect	NEMA 3 Pre-Wired		-	Eng: ☐	Con: ☐
Back Draft Damper	Yes		-	Eng: ☐	Con: ☐
Roof Curb	Yes		-	Eng: ☐	Con: ☐

Comments

SIGN-OFFS:

Contractor: _____ Date: _____

Engineer: _____ Date: _____

CxA: _____ Date: _____

Prepared By: HDA Engineering Ltd. Regina, Sk, (306) 525-9815

Project Name: TBU50 HVAC Replacement - Regina, Saskatchewan	**Project #:** 57/2017
	Component Form #: CFM1.5

Component Verification Form — *Section:*

System:	*Equipment:*	*Tag:*
Air Moving Equipment	**EXHAUST FAN**	**EF-6**

INSTALLED EQUIPMENT DATA:

Manufacturer	
Type	
Model Number	
Serial Number	

LOCATION DATA:

Building	TBU50
Area Served	Room 102
Floor Located	Main Floor
Room	102

PERFORMANCE DATA:

	Specified	Shop Drawings	Required Modification	Installed
Fan:				
Fan Type	Centrifugal Square Inline		-	Eng: ☐ Con: ☐
Air Flow	880 L/s (1,866 CFM)		-	Eng: ☐ Con: ☐
S.P.	125 Pa (0.5 in.w.c.)		-	Eng: ☐ Con: ☐
Sound	12.2 Sones		-	Eng: ☐ Con: ☐
Motor Size	0.373 kW (0.50 hp)		-	Eng: ☐ Con: ☐
Motor RPM	1725 RPM		-	Eng: ☐ Con: ☐
Voltage / Hz / Phase	208/60/1		-	Eng: ☐ Con: ☐
Motor Type	EC Motor		-	Eng: ☐ Con: ☐
Options:				
Control	Fan Mounted Speed Control		-	Eng: ☐ Con: ☐
Insulated Housing	12mm		-	Eng: ☐ Con: ☐
Isolators	Spring		-	Eng: ☐ Con: ☐

Comments

SIGN-OFFS:

Contractor: _____ Date: _____

Engineer: _____ Date: _____

CxA: _____ Date: _____

Prepared By: HDA Engineering Ltd. Regina, Sk, (306) 525-9815

Project Name:	**Project #:**	**57/2017**
TBU50 HVAC Replacement - Regina, Saskatchewan	**Component Form #:**	**CFM1.6**

Component Verification Form

System:	*Equipment:*	*Section:* / *Tag:*
Air Moving Equipment	**EXHAUST FAN**	**CF-1**

INSTALLED EQUIPMENT DATA:

Manufacturer	
Type	
Model Number	
Serial Number	

LOCATION DATA:

Building	TBU50
Area Served	Gymnasium
Floor Located	Main Floor
Room	101

PERFORMANCE DATA:

	Specified	Shop Drawings	Required Modification	Installed
Fan:				
Fan Diameter	1422mm (56")		-	Eng: ☐ Con: ☐
Downrod Length	254mm (10")		-	Eng: ☐ Con: ☐
Air Flow	10,377 L/s (22,000 CFM)		-	Eng: ☐ Con: ☐
Motor Amps	0.70		-	Eng: ☐ Con: ☐
Motor Watts	55		-	Eng: ☐ Con: ☐
Voltage / Hz / Phase	120/60/1		-	Eng: ☐ Con: ☐
Options:				
Control	Variable Speed w/ Reverse		-	Eng: ☐ Con: ☐
Ceiling Mounted Cage	Yes		-	Eng: ☐ Con: ☐

Comments

SIGN-OFFS:

Contractor: _____ Date: _____

Engineer: _____ Date: _____

CxA: _____ Date: _____

Prepared By: HDA Engineering Ltd. Regina, Sk, (306) 525-9815

Project Name:	**Project #:**	**57/2017**
TBU50 HVAC Replacement - Regina, Saskatchewan	**Component Form #:**	**CFM2.1**

Component Verification Form		*Section:*
System: **Hydronic Equipment**	*Equipment:* **MAIN HEATING PUMP**	*Tag:* **P-1**

INSTALLED EQUIPMENT DATA:

Manufacturer	
Type	
Model Number	
Serial Number	

LOCATION DATA:

Building	TBU50
Area Served	Heating System
Floor Located	Basement
Room	001

PERFORMANCE DATA:

	Specified	Shop Drawings	Required Modification	Installed	
Fan:					
Pump Size	76 x 76 (3 x 3)		-	Eng: ☐	Con: ☐
Flow	7.89 L/s (125 US gpm)		-	Eng: ☐	Con: ☐
Fluid	Prop Glycol 30%		-	Eng: ☐	Con: ☐
Head	89.60 kPa (30.0 ft.w.c.)		-	Eng: ☐	Con: ☐
Pump Efficiency			-	Eng: ☐	Con: ☐
Motor Size	2.24 kW (3.00 hp)		-	Eng: ☐	Con: ☐
Motor Efficiency	Premium		-	Eng: ☐	Con: ☐
Voltage / HZ / Phase	208/60/3		-	Eng: ☐	Con: ☐
Options:					
Motor	Inverter Duty		-	Eng: ☐	Con: ☐
Control	VFD		-	Eng: ☐	Con: ☐

Comments

SIGN-OFFS:

Contractor: _____ Date: _____

Engineer: _____ Date: _____

CxA: _____ Date: _____

Prepared By: **HDA Engineering Ltd.** Regina, Sk, (306) 525-9815

Project Name: TBU50 HVAC Replacement - Regina, Saskatchewan	**Project #:** 57/2017
	Component Form #: CFM2.3

Component Verification Form

Section:

System:	*Equipment:*	*Tag:*
Hydronic Equipment	**COIL CIRC PUMP**	**P-3**

INSTALLED EQUIPMENT DATA:

Manufacturer	
Type	
Model Number	
Serial Number	

LOCATION DATA:

Building	TBU50
Area Served	Heating System
Floor Located	Basement
Room	001

PERFORMANCE DATA:

	Specified	Shop Drawings	Required Modification	Installed	
Fan:					
Pump Size	51 x 51 (2 x 2)		-	Eng: ☐	Con: ☐
Flow	5.36 L/s (85 US gpm)		-	Eng: ☐	Con: ☐
Fluid	Prop Glycol 30%		-	Eng: ☐	Con: ☐
Head	74.70 kPa (25.0 ft.w.c.)		-	Eng: ☐	Con: ☐
Pump Efficiency			-	Eng: ☐	Con: ☐
Motor Size	2.24 kW (3.00 hp)		-	Eng: ☐	Con: ☐
Motor Efficiency	Premium		-	Eng: ☐	Con: ☐
Voltage / Phase	208/60/3		-	Eng: ☐	Con: ☐
Options:					
Motor Control	Inverter Duty		-	Eng: ☐	Con: ☐
	VFD		-	Eng: ☐	Con: ☐

Comments

SIGN-OFFS:

Contractor: _____ Date: _____

Engineer: _____ Date: _____

CxA: _____ Date: _____

Prepared By: HDA Engineering Ltd. Regina, Sk, (306) 525-9815

Project Name:	**Project #:**	**57/2017**
TBU50 HVAC Replacement - Regina, Saskatchewan	**Component Form #:**	**CFM2.4**

Component Verification Form		*Section:*
System: **Hydronic Equipment**	*Equipment:* **HEAT EXCHANGER**	*Tag:* **HX-1**

INSTALLED EQUIPMENT DATA:

Manufacturer	
Type	
Model Number	
Serial Number	

LOCATION DATA:

Building	TBU50
Area Served	Heating System
Floor Located	Basement
Room	001

PERFORMANCE DATA:

	Specified	Shop Drawings	Required Modification	Installed	
Fan:					
Fluids	LP Steam to Water		-	Eng: ☐	Con: ☐
Plate Material	AISI 316L Stainless Steel		-	Eng: ☐	Con: ☐
Frame Material	Epoxy Painted Carbon Steel		-	Eng: ☐	Con: ☐
Design Pressure	1030 kPa (150 psig)		-	Eng: ☐	Con: ☐
Maximum Temp.	149 Deg.C. (300 Deg.F.)		-	Eng: ☐	Con: ☐
Steam Side					
Mass Flow	892 kg/hr (1965.93 lb/hr)		-	Eng: ☐	Con: ☐
Volume Flow Rate	3,378.364 GPM			Eng: ☐	Con: ☐
Inlet Temp	121.0 Deg.C (249.76 Deg.F.)			Eng: ☐	Con: ☐
Outlet Temp	72.0 Deg.C (161.56 Deg.F.)			Eng: ☐	Con: ☐
Operating Pressure	36.94 ft(water)g		-	Eng: ☐	Con: ☐
Water Side					
Mass Flow	32220 kg/hr (71034.17 lb/hr)		-	Eng: ☐	Con: ☐
Volume Flow Rate	143.0 GPM			Eng: ☐	Con: ☐
Inlet Temp	71.1 Deg.C (160.0 Deg.F.)			Eng: ☐	Con: ☐
Outlet Temp	87.8 Deg.C (190.0 Deg.F.)			Eng: ☐	Con: ☐
Operating Pressure	11.0 ft(water)g		-	Eng: ☐	Con: ☐

Comments

SIGN-OFFS:

Contractor: _____ Date: _____

Engineer: _____ Date: _____

CxA: _____ Date: _____

Prepared By: HDA Engineering Ltd. Regina, Sk, (306) 525-9815

Project Name:	Project #:	24/2014
New Police Building - Onion Lake, Saskatchewan	Component Form #:	CFM3.1

Component Verification Form		*Section:*
System: **Air Conditioning Equipment**	*Equipment:* **COOLING COIL**	*Tag:* **CC-2**

INSTALLED EQUIPMENT DATA:

Manufacturer	
Type	
Model Number	
Serial Number	

LOCATION DATA:

Building	TBU50
Area Served	Main Floor & Second Floor
Floor Located	Basement
Room	Room 001

PERFORMANCE DATA:

	Specified	Shop Drawings	Required Modification	Installed	
Cooling Coil:					
Air Flow	425 L/s (900 CFM)		-	Eng: ☐	Con: ☐
E.A.T.	26.70 C (80.0 F)		-	Eng: ☐	Con: ☐
L.A.T.	26.70 C (80.0 F)		-	Eng: ☐	Con: ☐
A.P.D.	67 Pa (0.27 in.w.c.)			Eng: ☐	Con: ☐
Water Flow	0.40 L/s (6.3 GPM)		-	Eng: ☐	Con: ☐
Medium	40% Prop. Glycol		-	Eng: ☐	Con: ☐
E.W.T.	7.20 C (45.0 F)		-	Eng: ☐	Con: ☐
L.W.T.	13.90 C (57.0 F)		-	Eng: ☐	Con: ☐
W.P.D.	9.56 kPa (3.20 ft.w.c.)		-	Eng: ☐	Con: ☐
Total Energy	10.30 kW (35.246 MBH)		-	Eng: ☐	Con: ☐
Sensible Energy	6.90 kW (23.693 MBH)		-	Eng: ☐	Con: ☐

Comments

SIGN-OFFS:

Contractor: _____ Date: _____

Engineer: _____ Date: _____

CxA: _____ Date: _____

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 This Section specifies roles and responsibilities of Training.

1.2 TRAINEES

.1 Trainees: personnel selected for operating and maintaining this facility. Includes Facility Manager, building operators, maintenance staff, security staff, and technical specialists as required.

.2 Trainees will be available for training for purposes of familiarization with systems.

1.3 INSTRUCTORS

.1 Consultant will provide:

.1 Descriptions of systems.

.2 Instruction on design philosophy, design criteria, and design intent.

.2 Contractor and certified factory-trained manufacturers' personnel: to provide instruction on the following:

.1 Start-Up, operation, shut-down of equipment, components and systems.

.2 Control features, reasons for, results of, implications on associated systems of, adjustment of set points of control and safety devices.

.3 Instructions on servicing, maintenance and adjustment of systems, equipment and components.

.3 Contractor and equipment manufacturer to provide instruction on:

.1 Start-up, operation, maintenance and shut-down of equipment they have certified installation, started up and carried out PV tests.

1.4 TRAINING OBJECTIVES

.1 Training to be detailed and duration to ensure:

.1 Safe, reliable, cost-effective, energy-efficient operation of systems in normal and emergency modes under all conditions.

.2 Effective on-going inspection, measurements of system performance.

.3 Proper preventive maintenance, diagnosis and trouble-shooting.

.4 Ability to update documentation.

.5 Ability to operate equipment and systems under emergency conditions until appropriate qualified assistance arrives.

1.5 TRAINING MATERIALS

.1 Instructors to be responsible for content and quality.

.2 Training materials to include:

.1 "As-Built" Contract Documents.

.2 Operating & Maintenance Manual.

.3 TAB and PV Reports.

.3 Departmental Representative 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 for duration specified in relevant Specification Sections.

.3 Training to be completed prior to acceptance of facility.

1.7 RESPONSIBILITIES

.1 Be responsible for:

.1 Implementation of training activities,

.2 Coordination among instructors,

.3 Quality of training, training materials,

.2 Departmental Representative will evaluate training and materials.

.3 Upon completion of training, provide written report, signed by Instructors, with complete list of attendees, and witnessed by Consultant and Cx Authority.

.4 Coordination with Departmental Representative.

1.8 TRAINING CONTENT

.1 Training to include demonstrations by Instructors using the installed equipment and systems.

.2 Provide specialized training as specified in relevant Sections of the Specifications.

.3 Content to include the following plus any items required by the relevant Sections of the Specifications:

.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 Interaction among systems during integrated operation.

.10 Review of O&M documentation.

END OF SECTION

National Maintenance Management System (NMMS)

Created December 13th, 2013

Scope of Work

Maintenance Information gathering

The RCMP is looking to obtain a complete list of all building information required for maintenance within buildings, as well as the property owned by the RCMP. Each piece of equipment will need to be inventoried according to the legacy code indicated in Appendix A, followed by an inventory number and identification abbreviation listed in Appendix D. (Note: All of the highlighted items in the Legacy Code Manual are required to be inventoried; all other items in the manual are not required). In the event there is no abbreviation currently listed for a piece of equipment, the project authority will be notified and an abbreviation will be provided in writing.

All Mechanical equipment, Electrical equipment, and Life Safety equipment require labels to be installed. The labels will show the legacy code and inventory number. Each label will be placed in a location that is consistent for all similar types of equipment. (Note: There should never be 2 pieces of equipment with identical identification numbers). The labels will be installed level and square to the surrounding area and will be expected to last the life of the equipment being labeled. General valves located in the buildings will be listed and a master Valve Tag list hung in the mechanical rooms. Valve tag lists will be laminated. All electrical panels will be labeled, including all circuits within the panels. Each receptacle/switch in the building will be labeled with the panel number and circuit number.

All O&M manuals as well as Standard Operating Procedure manuals will be updated following the same numbering sequence as the legacy codes in Appendix A. Pieces of equipment that are combined to form one system within a building will have similar numbers in order to avoid confusion in regular maintenance activities (example provided in Appendix B).

An Inventory sheet Appendix C will be filled out for each piece of equipment inventoried. In the event there are multiple identical items ie: radiator control valves, one profile Inventory sheet can be filled out to cover all the valves, provided that the legacy code and inventory numbers for each valve are listed. These items will need to be reviewed and permission granted by the Project Authority prior to the submission of the Inventory sheet.

APPENDIX A: LEGACY CODES

See attached document:

Appendix A: Legacy Code Manual

APPENDIX B: INVENTORY NAMING REFERENCE

Every asset needs to be converted into a numeric value using the Legacy Code Manual (LCM). A typical Legacy code will unfold as such:

Legacy code-legacy class-legacy type code-Type abbreviation-amount of items in the building, or, as represented in its true form 00-000-AAA-0. For greater understanding let us assign a legacy number to a detachments forced air natural gas furnace.

According to the LCM we must first identify the legacy code. The LCM has a code for heating and the number associated is 20. Heating would be the best description for what a furnace would fall under so the start of our id would be **20-legacy class-legacy type code-Type abbreviation-amount of items in the building.** In the LCM we will now find the class. Class 339 is identified in our LCM as Furnace warm air.

Our number now looks as follows: **20-339-legacy type code-Type abbreviation-amount of items in the building.** We now look for the Legacy type. We see in the LCM in the Furnace warm air category we have three options. They are 1-Electric, 2-Natural & Propane, 3- Oil. We know that this furnace is a natural gas unit as stated above, so the number that must be associated is 2.

Our Legacy now reads: **20-339-2-Type abbreviation-amount of items in the building.** We now must identify a brief alphabetical description to the item. Here we refer to the provided item Abbreviation list. We see that furnace is labelled as FU.

Our Legacy now reads: **20-339-2-FU-amount of items in the building.** The last number is as simple as assigning a number to the furnace in relation to how many there is in the building. For this example we will assume that there is only one furnace in this building, so we will call it furnace 1.

Our finished completed Legacy now reads: **20-339-2-FU-1**

We will note that if the building had 2 or more furnaces the legacy would be

Furnace 1 (Furnace would have the physical label as such) 20-339-2-FU-1

Furnace 2 (This furnace would be physical labeled as) 20-339-2-FU-2 etc.

Air handling unit #1 (AHU1) will consist of Supply Fan #1 (SF1), Return Fan #1 (RF1) etc.

APPENDIX C: INVENTORY SHEET -EXAMPLES

NMMS INVENTORY SHEET	
Building Name	**Region/CSU**
Building Address	
Building Code (NMMS)	
Floor	**Room**

Reference # (NMMS #)	**Life Safety**	Yes	No
Equipment Description & Type			
Manufacturer			
Model Type	**Size**		
Model #	**Serial #**		

Condition	0 Unknown	1 Warranty	2 Excellent
	3 Fair	4 Unreliable	5 Obsolete
Service Level	1 Mandated	2 Life Cycle	3 Enhanced

Amperage	**Voltage**	**Phase**
KVA	**Primary**	**Secondary**
RPM	**Frame**	**HP**
REMARKS		
NOTES		

Inventory sheet for an Air Handler Unit

NMMS INVENTORY SHEET	
Building Name	**TBU#**
Floor	**Room**

Reference # (NMMS #)			
Equipment Description & Type			
Manufacturer			
Model #/Type		**Serial #**	
Condition	0 Unknown	1 Warranty	2 Excellent
	3 Fair	4 Unreliable	5 Obsolete
Service Level	1 Mandated	2 Life Cycle	3 Enhanced

FAN	
Manufacturer:	
Model #/Type:	**Serial #:**
Capacity (CFM):	

MOTOR			
Manufacturer:			
Model #/Type:		**Serial #:**	
Amperage:	**Voltage:**	**Phase:**	**Hz:**
RPM:	**Frame:**	**HP:**	**Belt(size):**
NOTES			
Name:	**Date:**		

NMMS INVENTORY SHEET

Building Name SASKATOON DETACH	**TBU#** FBU53
Floor SASKATOON	**Room** MECHANICAL Room. #217

Reference # (NMMS #)	30-50-4 – AHU-1 (F-1 Cold Deck)
Equipment Description & Type	Air Handler Unit
Manufacturer	Scott Springfield MFG INC.
Model #/Type	HQ-400-AHU35300-H-C
Serial #	D03-01416-M1

Condition	0 Unknown	1 Warranty	2 (Excellent)
	3 Fair	4 Unreliable	5 Obsolete
Service Level	(1 Mandated)	2 Life Cycle	3 Enhanced

FAN

Manufacturer:	GREENHECK	NMMS# 30-260-1-F-1	
Model #/Type:	44-PLN-HORV-11	**Serial #:**	03C13658
Capacity (CFM):	35345	RPM 1130	TSP 6.0

MOTOR

Manufacturer:	BALDOR	NMMS# 30-239-300-F-1			
Model #/Type:	42F099W589G-1	**Serial #:**	Z0210280270		
Amperage:	7	**Voltage:**	575	**Phase:** 3	**Hz:** 60
RPM:		**Frame:**	364T	**HP:**	**Belt(size):** 5VX1250(4)

NOTES PRE FILTERS (20) 24X24X2
FINAL FILTERS (20) 24X24X12

Name: Ed Bugg **Date:** Nov 18/2013

NMMS INVENTORY SHEET

Building Name: Saskatoon	Region/CSU: FBU52
Building Address:	
Floor: 2nd.	Room: ~~555~~. 217

Reference #: (NMMS #) 05-386-0-mcc-1E		Life Safety:	Yes/No
Equipment Description & Type: Motor Control Center (Emergency Power)			
Manufacturer: Cutler hammer			
Model Type: Freedom Series		Serial #:	
Model # 2100		Size:	
Condition:	0 Unknown	1 Warranty	2 Excellent
	3 Fair	4 Unreliable	5 Obsolete
Service Level	0 Mandated	2 Life Cycle	3 Enhanced

Amperage: 600	Voltage: 600	Phase: 3ϕ 4wire
KVA:	Primary:	Secondary:
RPM:	Frame:	HP:
Remarks:		
Notes:		
Name:	Date:	Signature:

NMMS INVENTORY SHEET

Building Name: SASKATOON DETACH	Region/CSU: FBU 53
Building Address: SASKATOON	
Floor:	Room:

Reference #: (NMMS #): 60-300-1- FD#		Life Safety:	
Equipment Description & Type: FIRE DAMPERS AS PER ATTACHED SHEET.			
Manufacturer:			
Model Type:		Size:	
Model #:		Serial #:	
Condition:	0 Unknown	1 Warranty	2 Excellent
	3 Fair	4 Unreliable	5 Obsolete
Service Level:	1 Mandated	2 Life Cycle	3 Enhanced

Amperage	Voltage	Phase
KVA	Primary	Secondary
RPM	Frame	HP
Remarks		
Notes		
Name:	Date:	Signature:

SASKATOON - DETACHMENT FBU53

FIRE DAMPERS Main Floor

FD#	Room #	(5)	156 - Monitoring Room
2 →	157		CER Room
3 →	"		"
4 →	"		"
5 →	"		"
6 →	"		"
7 -	151		EXISTOR Room
8 -	153.1	(2)	Operational Work Shop
9 -	"		"
10 -	141.4	(2)	Vehicle Work Area
11 -	141.4		" " "
12 -	141.4.1	(5)	Work Bay Storage
13 -	"		" " "
14 -	"		" " "
15 -	"		" " "
16 -	"		" " "
17 -	141.1	(4)	Server Room
18 -	"		"
19 -	"		"
20 -	"		"
21 -	139.1	(4)	Alarm Room
22 -	"		
23 -	"		
24 -	"		

APPENDIX D: GLOSSARY OF TERMS/ABBREVIATIONS

Abbreviations (Plumbing)

WF-Water filter

ST- Steam Trap

B-Boiler

CV-Control valve

WM-Water meter

EX-Heat exchanger

FH-Fire hydrant

EW-eye wash station

FT-flash tank

FU-furnace

H-humidifier

GI-grease interceptor

OI-oil interceptor

PRV-Pressure regulator

P-pump

CT-condensate tank

ET-expansion tank

UH-unit heater

MV-mixing valve

DF-drinking fountain

WS-water softener

WH-water heater

BFP-Back flow preventer

PF-pot/chemical feeder

SSF-side stream filter

AS-Air scoop

LWC-low water cutoff

RF-Relief valve

FV-Flow valve

TS-Tamper switch/valve

TV-Trunk valve

GF-glycol feeder

Abbreviations (Mechanical)

DCS-dust collector system

SF-supply fan

FD-Fire damper

AAC-Air compressor

CS-chimney stack

CUH-cabinet unit heater

COND-air conditioner condenser

HW-Thermal heat wheel

CT-Cooling Tower

AHU-air handler unit

RF-return fan

FU-Furnace

UH-unit heater

VAV-variable air volume box

AC-air condition evaporator

BEAR-bearing

CH-chiller

DAMP-Dampers

DL-dock load leveler

AD-air dryer

H-Hoisting equipment

SE-special equipment (example pool)

FRE-firing range equipment

EL-Elevator (lift/physical disability/freight)

EX Fan-exhaust fan

MS-Mechanical

RTU-roof top unit

WALK IN- walk in freezer

Abbreviations (Electrical)

MAIN-Main breaker

MCC-Motor control center

SPL-Splitter

EL-emergency light

FP-fire alarm panel

P-Pump

CWP-chilled water pump

CP-condensate pump

EF-exhaust fan

CHILL-Chiller

TS-transfer switch

COP-distribution panel

TX-Transformers

PNL-Panel

EX-exit sign

VSD-Variable speed drive

SP-sump pump

HP-heat pump

AHU-Air handler

FF-force flow fan

GEN-Generator

Abbreviations (Carpentry)

Emergency Exits = EE-(Room Number)

Fire Doors = FD-(Room Number)

Fixed Ladders =FBUXXX-(Room Number)

Fire Extinguishers =FBUXXX-(Room Number)

Overhead Doors =FBUXXX-(Room Number)

First Aid Kits =FBUXXX-(Room Number)

Exterior Stairs and railings = FBUXXX-(Sequential Number)

Suspended Platforms = FBUXXX-(Room Number)

Roof Anchoring System= FBUXXX-(Sequential Number)

MASTER COPY

NMMS System Codes (first number in Equipment Numbering)

Legacy Code	Name
	Safety Code Inspection Program
5	Electrical Service and Distribution - Low Voltage
6	Electrical Service and Distribution - High Voltage
10	Electrical Auxiliary and Stand-by Power
15	Control and Monitoring Systems
20	Heating
25	Refrigeration
30	Ventilation and Air Distribution
40	Compressed Air - Auxiliary and Process
50	Water Supply
51	Water Treatment
55	Plumbing and Drainage
60	Fire Protection and Alarm
65	Vertical and Horizontal Transporting Devices
70	Security
71	Regulated Pressure Vesssels
72	Environmental
74	Safety Equipment
75	Special Purpose
77	Laboratories
79	Energy
80	Architectural and Structural
85	Grounds
90	Cafeteria

Example: 40-10-4-AC1
Where
40 = System Code (Compressed Air - Auxiliary and Process)
10 = Class (Air Compressor)
4 = Type (Reciprocating Air Cooled)
AC1 = any existing equipment numbering, if none could be a simple counter (i.e. 01)

MECHANICAL
- Carpentry
- Plumbing
- Electrical

Master Inventory List For RMS PM System

Class Legacy Code	Class Description	Type Legacy Code		Type Description
	Mandated Items Highlighted			
5	**Filter, Air**			
		7	☐	HEPA
		6	☐	Disposable Pleated
		9	☐	Electro Static
		10	☐	Compressor
		1	☐	Disposable Glass
		3	☐	Disposable Bag
		4	☐	Disposable Charcoal
		8	☐	Washable
		5	☐	Disposable Roll
		2	☐	Disposable Poly Pad
7	**Filter Water**			
		5	☐	Charcoal
		2	☐	Cartridge
		1	☐	Resin
		0	☐	General
8	**Filter Oil**			
		0	☐	General
		1	☐	Elimination
9	**Aerator / Blower**			
		1	☐	Surface Aerator
		2	☐	Immersion Diffuser Aerator
10	**Air Compressor**			
		7	☐	Portable
		6	☐	Special Purpose
		1	☐	Screw (Water Cooled)
		2	☐	Screw (Air Cooled)
		3	☐	Reciprocating (Water Cooled)
		4	☐	Reciprocating (Air Cooled)

Master Inventory List For RMS PM System

Class Legacy Code	Class Description	Type Legacy Code		Type Description
	Mandated Items Highlighted			
		5	☐	Reciprocating (Oilless)
11	**After Cooler/Inter Cooler**			
		1	☐	Air Cooled
		2	☐	Water Cooler
15	**Vacuum Pump**			
		0	☐	General
16	**Vacuum Cleaner**			
		1	☐	Central Vac
25	**Air Conditioner Unit (DX)**			Air Conditioner Packaged
		1	☐	Roof Top
		2	☐	Water Cooled
		3	☐	Duct condenser
		4	☐	Through the Wall
		5	☐	Window
		6	☐	Split System
50	**Air Handling Unit**			
		1	☐	Heating Coil - Hot Water
		2	☐	Heating Coil - Steam
		3	☐	Heating Coil - Electric
		4	☐	Cooling Coil - Chilled Water
		5	☐	Heating & Cooling Coil
		6	☐	Electric Heating & Cooling Coil
		7	☐	Gas Heating
51	**Air Distribution System**			Does not include the Air Handling Unit
		6	☐	Silencer, Rectangular
		7	☐	Silencer, Rectangular L Shape
		8	☐	Silencer, Round
		2	☐	Duct Work
		3	☐	Difusers & Grilles

Master Inventory List For RMS PM System

Class Legacy Code	Class Description	Type Legacy Code	Type Description
	Mandated Items Highlighted		
		5	☐ Air Valve
		0	☐ General
		1	☐ Louvers & Screens
52	Agitator		
		1	☐ Bio Waste
		0	☐ General
53	Terminal units on air distribution systems		
		4	☐ Mixing Box
		5	☐ Dumping Box
		1	☐ Variable air volume (VAV)
		2	☐ Constant Volume
		3	☐ Induction
55	Trap/Vent		
		6	☐ Automatic Water Trap
		3	☐ Steam Trap
		4	☐ Condensate Trap (Compressed Air)
		5	☐ Automatic Oil Trap (Air)
		1	☐ Automatic Air Vent
		2	☐ Manual Air Vent
57	Autoclave		
		0	☐ General
58	Ash Removal		
		0	☐ General
60	Battery and Charger		
		1	☐ Batteries & Charger
65	Backflow Preventer		
		0	☐ General

Master Inventory List For RMS PM System

Class Legacy Code	Class Description	Type Legacy Code	Type Description
	Mandated Items Highlighted		
70	**Boiler Hot Water**		
		3	☐ Oil Fired
		4	☐ Gas Fired
		1	☐ Combination Gas, Oil, Electric
		2	☐ Electric
75	**Boiler Steam**		
		1	☐ Oil Fired
		2	☐ Gas Fired
		3	☐ Electric
		4	☐ Combination Gas, Oil, Electric
90	**Burner**		
		1	☐ Oil
		2	☐ Gas/Propane
		3	☐ Combination
93	**Bus Way**		
		0	☐ General
95	**Bus Work Structure Insulators**		
		0	☐ General
96	**Load Break Switch**		
		2	☐ Automatic
		1	☐ Manual
97	**Cables Primary Secondary Feeders**		
		0	☐ General
100	**Chiller**		
		7	☐ Hermatic, Air Cooled
		1	☐ Absorption
		2	☐ Centrifugal Low Pressure
		3	☐ Centrifugal High Pressure

Master Inventory List For RMS PM System

Class Legacy Code	Class Description	Type Legacy Code	Type Description
	Mandated Items Highlighted		
		4	☐ Reciprocating
		5	☐ Screw
		6	☐ Cascading
120	**Circuit Breaker**		
		3	☐ Vacuum
		4	☐ Molded Case
		1	☐ Air
		2	☐ Oil
		5	☐ Gas
123	**Excitor**		
		0	☐ General
124	**DC Generator**		
		0	☐ General
125	**Surge Protection/Transient Voltage Unit**		
		0	☐ General
128	**Capacitor**		
		2	☐ Capacitor Bank
		1	☐ Unit
130	**Coil**		Any coils except those included with the Air Handling Un
		3	☐ Hot Water
		5	☐ Steam
		6	☐ Heat Recovery Glycol
		7	☐ Heat Recovery Refrigerant
		4	☐ Direct Expansion
		2	☐ Evaporative Cooler
		1	☐ Chilled Water
137	**Cold Room / Walk-In Refrigerator/Freezer**		
		3	☐ Garbage Refrigerator

Master Inventory List For RMS PM System

Class Legacy Code	Class Description	Type Legacy Code		Type Description
	Mandated Items Highlighted			
		2	☐	Walk-In Refrigerator/Freezer
		1	☐	Cold Room
140	**Air Purifier**			
		0	☐	General
142	**Condenser Evaporative**			
		0	☐	General
144	**Building Communication Systems**			Communication Systems. Exclude Fire alarm voice communication system integrated
		1	☐	Intercom System
		0	☐	General
147	**Compressed Air Dryer**			
		2	☐	Chemical Air Dryer
		1	☐	Refrigerated Air Dryer
148	**Compressor Refrigeration**			
		1	☐	Reciprocating
		2	☐	Rotary
150	**Condenser**			
		2	☐	Water or Glycol Cooled
		1	☐	Air Cooled
152	**Controls, Boilers**			Controls, Boilers
		4	☐	Boiler Furnace
		1	☐	Various Boiler Controls
		3	☐	Combustion Management
		2	☐	Analyser
153	**Controls Electric Electronic**	**(30 volts and less)**		
		25	☐	Carbon monoxide detector (fixed)
		29	☐	Numeric Input/Output
		23	☐	Gas Detector Monitor CO2

Master Inventory List For RMS PM System

Class Legacy Code	Class Description	Type Legacy Code		Type Description
Mandated Items Highlighted				
		26	☐	Transformer
		30	☐	Differential Pressure Transmitter
		31	☐	Refrigerant Leak Detector
		28	☐	Analog Input/Output
		24	☐	Gas Monitor (portable for confined spaces)
		21	☐	LED
		10	☐	Portable Command Unit
		2	☐	Link Panel
		3	☐	Communication Panel (DDC)
		4	☐	Controller
		5	☐	Input/Output Card
		6	☐	Extension Card
		7	☐	Computer / Monitor
		8	☐	Printer
		9	☐	Thermostat
		11	☐	Control Valve Assembly With or Without Positioner
		12	☐	Temperature Transmitter
		13	☐	Humidity Transmitter
		14	☐	Level Transmitter
		15	☐	Pressure Transmitter
		16	☐	Flow Transmitter
		18	☐	Contact
		20	☐	Current or Voltage Detecting Relay
		22	☐	Transducer
		1	☐	Panel
		27	☐	Actuator with or without positioner
		17	☐	Relay
		19	☐	Timers
154	**Controls, Pneumatic**			
		15	☐	Differential pressure indicator (Magnehelic)
		2	☐	Thermostat
		3	☐	Controller
		4	☐	Actuator With or Without Positioner
		5	☐	Control Valve Assembly With or Without Positioner

Master Inventory List For RMS PM System

Class Legacy Code	Class Description	Type Legacy Code		Type Description
	Mandated Items Highlighted			
		6	☐	Temperature Transmitter
		7	☐	Humidity Transmitter
		8	☐	Level Transmitter
		9	☐	Pressure Transmitter
		10	☐	Flow Transmitter
		11	☐	Relay (inverting or not)
		12	☐	E/P or P/E
		13	☐	I to P or I/P
		14	☐	Transducer
		1	☐	Panel
155	**Controls, Electric (31 Volts and more)**			
		9	☐	Remote Control Station
		1	☐	Thermostat
		2	☐	Electric Actuator
		3	☐	Relay
		4	☐	Contact
		5	☐	Current or Voltage Detecting Relay
		6	☐	SCR
		7	☐	Timer
		8	☐	Limits (start/stop, end of line, proximity, etc)
156	**Metering and Recording**			
		12	☐	Thermometer
		13	☐	Water level indicator
		75	☐	Special Equipment
		1	☐	Water Meter
		2	☐	HTHW Meter
		3	☐	Chilled Water Meter
		4	☐	Steam Meter
		5	☐	Gas Meter
		6	☐	Combined Meter
		7	☐	Electric Meter
		8	☐	Ph Meter
		9	☐	Conductivity Meter

Master Inventory List For RMS PM System

Class Legacy Code	Class Description	Type Legacy Code	Type Description
	Mandated Items Highlighted		
		10 ☐	Chart Recorder
		11 ☐	Electronic Recorder or Counter
160	Convector		
		4 ☐	Glycol
		3 ☐	Freon
		2 ☐	Steam
		1 ☐	Hot Water
170	Converter		
		75 ☐	Special Purpose
		0 ☐	General
172	Conveyor		
		0 ☐	General
180	Cooling Tower		
		2 ☐	Induced Draft (Cross Flow)
		3 ☐	Natural Draft
		1 ☐	Forced Flow
		4 ☐	Fan - Cooling Tower
185	Dust Collector System		The checklist include all components.
		0 ☐	General
186	Dampers		
		3 ☐	Opposed, Pneumatic Operated
		4 ☐	Opposed, Electric Operated
		2 ☐	Parallel, Electric Operate
		1 ☐	Parallel, Pneumatic Operated
190	Deaerator		
		0 ☐	General
195	Dehumidifier		

Master Inventory List For RMS PM System

Class Legacy Code	Class Description	Type Legacy Code	Type Description
	Mandated Items Highlighted		
		2	☐ Chemical
		3	☐ Mechanical, Chilled Water
		1	☐ Mechanical (DX)
199	**Desuperheater**		
		1	☐ Spray
		2	☐ Indirect Contact
200	**Disconnects**		
		5	☐ Main Disconnect
		1	☐ Fusible Disconnect
		2	☐ Non Fusible Disconnect
		3	☐ Bus Duct
		4	☐ Isolating
201	**Electrical Devices Miscellaneous**		
		2	☐ Electromagnetic
		5	☐ Voltage Regulator
		7	☐ Photocell
		11	☐ Voltmeter Ammeter
		4	☐ Irradiator
		8	☐ Power Conditioner
		12	☐ Dimmer
		9	☐ Emergency Stop Button
		1	☐ Modular Wiring
		0	☐ Non-Categorized
		3	☐ Hand Dryer
		6	☐ Magnetic Synthesizer
		10	☐ Surge Pack
212	**Panelboard**		
		0	☐ General
215	**Distribution Splitter Trough**		
		0	☐ General

Master Inventory List For RMS PM System

Class Legacy Code	Class Description	Type Legacy Code		Type Description
	Mandated Items Highlighted			
220	**Distribution Switchboard**			
		0	☐	General
223	**Sump Pit (Interior)**			If the sump pit is exterior, checklist is included with the class-type Storm Drainage System - General
		0	☐	General
230	**Dock Load Leveler**			
		1	☐	All
235	**Drains**			
		3	☐	Trap Seal Primer
		1	☐	Floor
		2	☐	Roof
239	**Motor**			
		1	☐	Gasoline
		2	☐	Diesel
		650	☐	Vertical Horizontal Transportation
		250	☐	Cooling
		400	☐	Compressed Air
		800	☐	Architectural
		750	☐	Special Systems
		900	☐	Kitchen
		0	☐	General
		200	☐	Heating
		500	☐	Water Supply Domestic
		550	☐	Plumbing Drain Sewage
		720	☐	Environment
		850	☐	Grounds
		300	☐	Ventilation
		600	☐	Fire
240	**Vertical & Horizontal Transportation (SCIP)**			
		13	☐	Elevator, High rise building

Master Inventory List For RMS PM System

Class Legacy Code	Class Description	Type Legacy Code		Type Description
	Mandated Items Highlighted			
		7	☐	Dumbwaiter
		3	☐	Freight Elevator Electric
		4	☐	Freight Elevator Hydraulic
		8	☐	Vehicle Lift
		10	☐	Escalator
		11	☐	Moving Walkways
		12	☐	Elevator Shaft
		5	☐	Lift, Physical Disability
		1	☐	Passenger Elevator Electric
		2	☐	Passenger Elevator Hydraulic
		9	☐	Freight Platform Lift
245	Economizer			
		1	☐	Boiler Type
250	Emergency Generator System			
		7	☐	Float Switch Level Controls
		6	☐	Remote Radiator
		1	☐	Diesel Generator Set
		2	☐	Gasoline or Gas Generator Set
		3	☐	Turbine Generator Set
		4	☐	Steam Generator Set
		5	☐	Alternator
257	Heat Exchanger			
		208	☐	Heating steam to liquid
		257	☐	Glycol to Air Cooling
		252	☐	Fluid to Fluid Cooling
		201	☐	Fluid to Air Heating
		202	☐	Fluid to Fluid Heating
		203	☐	Air to Air Heating
		206	☐	Solar Heating
		207	☐	Glycol Heating
		253	☐	Air to Air Cooling
		254	☐	Plate Cooling

Master Inventory List For RMS PM System

Class Legacy Code	Class Description	Type Legacy Code	Type Description
	Mandated Items Highlighted		
		255	☐ Thermal Wheel Cooling
		256	☐ Solar Cooling
		204	☐ Plate Heating
		205	☐ Thermal Wheel Heating
		5	☐ Liquid to Air
		7	☐ Steam to Liquid
		8	☐ Steam to Steam
		9	☐ Liquid to Steam
		1	☐ Fluid to Fluid
		2	☐ Air to Air
		3	☐ Plate
		4	☐ Thermal Wheel
		6	☐ Solar Panel
259	**Expansion Joint Piping**		
		1	☐ Bellows Type
		2	☐ Slip Type
		3	☐ Flexible Type (Braded)
260	**Fan**		
		14	☐ Pressurization, Base Mounted
		15	☐ Pressurization, In-Line
		16	☐ Pressurization, Roof Mounted
		12	☐ Transfer, Base Mounted
		13	☐ Transfer, In-Line (caisson)
		5	☐ Return, Based Mounted
		2	☐ Supply, In-Line
		3	☐ Supply, Roof Mounted
		4	☐ Supply, Wall Mounted
		6	☐ Return In-Line
		7	☐ Return, Roof mounted
		8	☐ Exhaust, Base Mounted
		9	☐ Exhaust, In-Line
		10	☐ Exhaust, Roof Mounted
		11	☐ Exhaust, Wall Mounted

Master Inventory List For RMS PM System

Class Legacy Code	Class Description	Type Legacy Code	Type Description
	Mandated Items Highlighted		
		1 ☐	Supply, Based Mounted
261	Fan Ceiling Circulation		
		1 ☐	Ceiling Fan, Propeller
265	Fan Combustion		
		1 ☐	Forced Draft
		2 ☐	Induced Draft
270	Fan Exhaust		
	DISPOSABLE	3 ☐	Washroom
		1 ☐	Vault Exhaust
		0 ☐	General
271	Fan Exhaust Ash		
		0 ☐	General
273	Contaminants Extraction System		
		2 ☐	Chemical Extraction System
		3 ☐	Paint Booth Extraction System
		4 ☐	Automobile Exhaust Extraction System
		5 ☐	Welding Fume Extraction System
		1 ☐	Laboratory Fume Hood assembly
274	Canopy Hood Assembly		
		0 ☐	General
275	Scrubber		
		1 ☐	Wet Collector
280	Fan Coil Unit		
		0 ☐	General
290	Fire Alarm System		
		3 ☐	Heat Detector

Master Inventory List For RMS PM System

Class Legacy Code	Class Description	Type Legacy Code		Type Description
	Mandated Items Highlighted			
		4	☐	Smoke Detector
		1	☐	Fire Alarm Voice Communication System Integrated
		2	☐	Domestic Smoke Detector
		0	☐	General
		5	☐	Pull Station
300	Fire Dampers Fire Stop Flaps			
		1	☐	Fire Dampers, Gravity
		2	☐	Fire Dampers, Spring Loaded
		3	☐	Fire Dampers, Motorized
		4	☐	Fire Dampers, Opposed Blade
		5	☐	Fire Flaps
310	Fire Extinguishers Portable			
		0	☐	General
		1	☐	Sodium Chloride
		2	☐	Water (Pump & Pressurized)
		3	☐	Dry Chemical
		4	☐	CO2
		5	☐	Halon
311	Fire Suppression Systems			
		6	☐	Wet Chemical
		7	☐	Commercial Cooking Equipment
		8	☐	Clean Agent
		5	☐	Water
		1	☐	CO2
		2	☐	Dry Chemical
		3	☐	Halon
		4	☐	Foam
315	Fire Hydrants			
		3	☐	Post indicator valve for hydrants
		1	☐	Fire Hydrant
		2	☐	Siamese Connections

Master Inventory List For RMS PM System

Class Legacy Code	Class Description	Type Legacy Code		Type Description
	Mandated Items Highlighted			
325	**Fire Pump Supply Booster**			Fire Pump Supply Booster
		1	☐	**Electric**
		3	☐	**Diesel**
330	**First Aid Kit**			First Aid Kit
		0	☐	General
331	**Eye wash & Emergency Shower**			
		3	☐	Eye Wash
		4	☐	**Emergency Shower**
		1	☐	**Combination Eye Wash & Shower**
		2	☐	Portable Station Eye Wash
332	**Emergency Alarms Washrooms**			
		0	☐	General
335	**Flash Tank**			
		1	☐	Condensate (High Pressure)
		2	☐	Blow Down
339	**Furnace Warm Air**			
		1	☐	Electric
		2	☐	Gas (Natural & Propane)
		3	☐	Oil
341	**Heater**			
		4	☐	Baseboard Electric
		1	☐	Glycol Ramp
		3	☐	Ramp electric
		5	☐	Electric
		6	☐	Cables Electric
		2	☐	Duct Electric
342	**Radiant Infrared Heater**			

Master Inventory List For RMS PM System

Class Legacy Code	Class Description	Type Legacy Code		Type Description
	Mandated Items Highlighted			
		1	☐	Electric
		2	☐	Gas Fired Straight Tube Heater
		3	☐	Gas Fired U Shape Tube Heater
		4	☐	Gas Fired Panel Heater
345	**Hoisting Equipment**			
		6	☐	Pneumatic/Hydraulic
		4	☐	Overhead Chainfall Manual
		1	☐	Travelling Bridge Crane Powered
		2	☐	Travelling Bridge Crane Manual
		3	☐	Overhead Chainfall Electric
		5	☐	Wharf & Jetty Crane
350	**Humidifier**			
		7	☐	Direct Steam Injection
		4	☐	Electrolysis (electronic)
		5	☐	Infra-red
		6	☐	Gas
		3	☐	Direct Steam Injection (Local)
		1	☐	Atomizing
		2	☐	Drum Type
355	**Incinerator**			
		1	☐	**Oil Fired**
		2	☐	**Gas Fired**
360	**Induction Unit**			
		1	☐	General
361	**Sand Trap**			
		0	☐	Sand/Sediment
			☐	
362	**Interceptor Grease or Oil**			
		3	☐	Grease Trap
		1	☐	**Oil Water Trap**

Master Inventory List For RMS PM System

Class Legacy Code	Class Description	Type Legacy Code		Type Description
	Mandated Items Highlighted			
		2	☐	Oil Trap
			☐	
363	**Sediment Trap**			
		0	☐	General
			☐	
365	**Irrigation System**			
		0	☐	General
			☐	
370	**Lighting**			
		4	☐	Emergency - On Emergency Power
		14	☐	Exterior - Pot
		15	☐	Interior - Halogen
		16	☐	Exterior - Weatherproof
		3	☐	**Emergency - Exit sign**
		6	☐	Interior - Incandescent
		5	☐	Interior - Fluorescent
		7	☐	Interior - Programmable Control
		8	☐	Interior - Safety Light
		9	☐	Exterior - Lamp Posts
		10	☐	Exterior - Catenary
		11	☐	Exterior - Wall Mounted
		12	☐	Exterior - Position lights
		13	☐	Exterior - Landing-Direction Lights
		1	☐	**Emergency - Battery Wet Type**
		2	☐	**Emergency - Battery Dry Type**
			☐	
381	**Lightning Rod**			
		0	☐	General
			☐	
383	**Master Clock**			
		0	☐	General
			☐	
386	**Motor Control Center (MCC)**			
		0	☐	General
			☐	

Master Inventory List For RMS PM System

Class Legacy Code	Class Description	Type Legacy Code	Type Description
	Mandated Items Highlighted		
387	**Piping Systems**		
		15	☐ Glass
		16	☐ Stainless steel
		10	☐ Compressed Gases
		12	☐ Gas/Fuel Oil/Oil
		3	☐ Sewage, Outdoor
		7	☐ Chilled Water
		9	☐ Steam
		6	☐ Domestic Water
		5	☐ High Temperature Hot Water
		2	☐ Condensate
		8	☐ Glycol
		4	☐ Sewage & Drainage, Indoor
		11	☐ Natural Gas/Propane
		1	☐ Compressed Air
		13	☐ Fuel Transfer
		14	☐ Chemical Products
		17	☐ Valves - Non-Categorized
			☐
388	**Plumbing Fixtures**		
		7	☐ Outdoor taps (freeze protection)
		0	☐ All Elements
		2	☐ Water Closets (Toilets)
		3	☐ Urinals
		4	☐ Slop Sink
		5	☐ Shower
		6	☐ Bath
		1	☐ Sinks
			☐
391	**PCB Storage Site**		
		0	☐ General
395	**Preheater Oil**		
		0	☐ General

Master Inventory List For RMS PM System

Class Legacy Code	Class Description	Type Legacy Code	Type Description
	Mandated Items Highlighted		
396	**Pressure Regulating Valves**		
		4	☐ Pressure Reducing Valve Water
		1	☐ Pressure Reducing Valves Steam
		2	☐ Pressure relief valve
		3	☐ Pressure & Temperature Relief Valve
		5	☐ Propane Gas
		0	☐ General
397	**Projector Slide**		
		0	☐ General
399	**Regulated Pressure Vessels (SCIP)**		
		1	☐ External 12 Internal 24
		2	☐ External 12 Internal 12 (Boilers)
400	**Pump**		
		0	☐ non categorized
		508	☐ Well pump turbine
		100	☐ Chiller oil pump
		507	☐ Pump House or Room
		301	☐ HVAC Chilled Base Mount
		302	☐ HVAC Heating In-Line
		303	☐ HVAC Heating Base Mount
		304	☐ HVAC Heating Recovery In-Line
		306	☐ HVAC Air Washer or Scrubber
		307	☐ HVAC Spray (Humidifier)
		500	☐ Potable Water In-Line Booster
		503	☐ Well Pump Base Mount
		504	☐ Potable Hot Water Circulator In-Line
		505	☐ Potable Hot Water Circulator Base Mount
		550	☐ Sump Pump Submersible
		551	☐ Sump Pump Float Type
		552	☐ Duplex Sump Pump & Tank, Submersible
		553	☐ Duplex Sump Pump & Tank, Float Type
		600	☐ Diesel Engine Driven (Fire)

Master Inventory List For RMS PM System

Class Legacy Code	Class Description	Type Legacy Code	Type Description
Mandated Items Highlighted			
		601	☐ Electric Driven (Fire)
		602	☐ Propane Engine Driven (Fire)
		603	☐ Jockey (Fire)
		900	☐ Kitchen (Grease Trap Vacuum)
		250	☐ Cooling Tower in-Line
		252	☐ Chilled Water or Glycol in-Line
		254	☐ Refrigerant
		205	☐ Condensate Base Mount
		206	☐ Boiler Feed Steam
		200	☐ Heating In-Line
		5	☐ Circulator Base Mount
		6	☐ Domestic Water (Well)
		202	☐ Oil, Diesel & Turbine Generator
		207	☐ Boiler Feed In-Line
		209	☐ Condensate Transfer (Deaerator)
		308	☐ HVAC Chemical
		203	☐ Oil, Boiler
		208	☐ Boiler Feed Base Mount
		850	☐ Grounds (surface water)
		201	☐ Heating Base Mount
		255	☐ Chemical (Cooling)
		305	☐ HVAC Heat Recovery Base Mount
		506	☐ Chemical Domestic Water
		502	☐ Well Submersible
		251	☐ Cooling Tower Base Mount
		253	☐ Chilled Water or Glycol Base Mount
		501	☐ Potable Water Base Mount Booster
		204	☐ Chemical (Heating)
		650	☐ Hydraulic Elevating Devices
		720	☐ Environmental Sewage Water and Oil
		750	☐ Special Systems
		1	☐ Fuel Transfer
		2	☐ Chemical Feed
		3	☐ Hydraulic
		4	☐ Circulator In-Line

Master Inventory List For RMS PM System

Class Legacy Code	Class Description	Type Legacy Code	Type Description
	Mandated Items Highlighted		
		300	☐ HVAC Chilled In-Line
402	**Pump condensate & Tank**		
		0	☐ General
407	**Heat Pump**		
		2	☐ Split System
		1	☐ Packaged
412	**Catch Basins**		
		0	☐ General
413	**Manhole**		
		0	☐ General
420	**Relay Panel**		
		0	☐ General
429	**Scrubbers & Separators**		
		0	☐ General
430	**Sewage Treatment/Waste Water**		
		4	☐ Detention Basin
		5	☐ Sewage Pond Lagoon
		6	☐ Pump, Sewage Station
		0	☐ Plant
		1	☐ Purifying Station Bio Discs
		2	☐ Field Bed
		3	☐ Settling Basin
431	**Solar Collector**		
		0	☐ General
432	**Soot Blower**		
		1	☐ Fixed

Master Inventory List For RMS PM System

Class Legacy Code	Class Description	Type Legacy Code	Type Description
	Mandated Items Highlighted		
		2	☐ Movable
433	Travelling Screen System		
		0	☐ General
439	Smoke Control Systems		
		0	☐ General
450	Sprinkler		
		1	☐ Sprinkler Wet
		2	☐ Sprinkler Dry
		3	☐ Sprinkler Deluge
		4	☐ Tamper Switch
460	Standpipe and Hoses		
		0	☐ General
470	Starter Contactor		
		2	☐ Manual
		1	☐ Magnetic Contactor
		3	☐ Lighting
471	Starter Combination		
		0	☐ General
472	Variable Speed Drive		
		0	☐ General
475	Water Distiller		
		0	☐ General
479	Superheater		
		2	☐ External
		1	☐ Internal

Master Inventory List For RMS PM System

Class Legacy Code	Class Description	Type Legacy Code	Type Description
	Mandated Items Highlighted		
480	**Tank Storage Gravity**		
		7	☐ Blowdown
		8	☐ Hydraulic Oil
		5	☐ Gravity Water Tank
		6	☐ Water Tower (Fire)
		4	☐ Septic Tank
		3	☐ Domestic Water System
		1	☐ Condensate
		2	☐ Glycol
481	**Tank Storage pressurized**		
		7	☐ Chilled Water Expansion Tank
		6	☐ Vacuum
		3	☐ Propane Tank & Cylinder
		5	☐ Hot/Cold Water reservoir
		1	☐ Expansion/Cushion
		2	☐ Compressed Air
		4	☐ Refrigerant Tank and Cylinder
482	**Fuel Leak Detection**		
		0	☐ General
483	**Tank Fuel Storage**		
		6	☐ Retention vessel
		5	☐ Day Tank
		1	☐ Above Ground Outside
		2	☐ Above Ground Inside
		4	☐ Underground Fiberglass
		3	☐ Underground Steel
484	**Tank Chemical Holding**		
		0	☐ General
487	**Transfer Switch**		
		1	☐ Manual

Master Inventory List For RMS PM System

Class Legacy Code	Class Description	Type Legacy Code	Type Description
	Mandated Items Highlighted		
		0	☐ Automatic
490	Transformer		
		2	☐ Dry Type
		1	☐ Oil Filled
500	Transformer Vault		
		2	☐ Pad Mount
		0	☐ General
502	Gearbox		
		0	☐ General
		6	☐ Brake
		1	☐ Fluid drive
		2	☐ Gearbox
		3	☐ Direct Drive
		4	☐ Variable Speed Drive
		5	☐ Agitator
503	Turbine		
		2	☐ Gas
		1	☐ Steam
504	Cyclone		
		0	☐ General
		1	☐ Dust
		2	☐ Ash
507	Turbocharger		
		0	☐ General
510	Strainers		
		0	☐ General
520	Unit Heaters		

Master Inventory List For RMS PM System

Class Legacy Code	Class Description	Type Legacy Code	Type Description
	Mandated Items Highlighted		
		2	☐ Hot Water
		1	☐ Steam
		3	☐ Gas
		4	☐ Electric
521	**Underground Electrical Services**		
		0	☐ General
522	**Valves (Mixing-Tempering)**		
		1	☐ Tempering Valve
		2	☐ Mixing Valve
		3	☐ Emergency Gas Shut-Off Valve
524	**Uninterruptible Power System**		
		1	☐ Battery
		2	☐ Rotary
525	**Seismic Shutoff Valves**		
		1	General
526	**Valve Steam Pressure Reducing**		
		0	☐ General
530	**Water Cooler & Fountain**		
		1	☐ Refrigerated Drinking Fountain
		2	☐ Central Station
		3	☐ Potable Water Fountain
		4	☐ Potable Cooler & Bottle
545	**Water Softener & Demineralizer**		
		3	☐ Water Demineralizer - Reverse Osmosis
		4	☐ Distiller
		1	☐ Water Softener - Salt
		2	☐ Water Filter - Sand

Master Inventory List For RMS PM System

Class Legacy Code	Class Description	Type Legacy Code	Type Description
	Mandated Items Highlighted		
550	**Water Heater Domestic**		
		6	☐ Instantaneous
		7	☐ Hot Water Heated
		2	☐ Electric (Large over 205 litres)
		4	☐ Oil
		5	☐ Steam
		3	☐ Gas
		1	☐ Electric (Small under 205 litres)
559	**Recovery Systems - Precious Metals**		
		1	☐ General
560	**Water Treatment Systems**		
		11	☐ Humidifier
		12	☐ Reverse Osmosis
		3	☐ Glycol Heating/Cooling
		1	☐ Hot Water Heating
		4	☐ Potable Water
		5	☐ Condensate (Steam)
		8	☐ Laboratory Waste Water
		9	☐ Process Water
		10	☐ Well Water
		2	☐ Steam (Boiler)
		6	☐ Condensate (Cooling Tower)
		7	☐ Chilled Water
561	**Mechanical Screen**		
		1	☐ Mechanically-Operated Rakes
		2	☐ Rotating Screen
562	**Waste Water Treatment Basin**		
		2	☐ Detention Basin
601	**Overhead Electrical Distribution Exterior**		
		0	☐ General

Master Inventory List For RMS PM System

Class Legacy Code	Class Description	Type Legacy Code	Type Description
	Mandated Items Highlighted		
602	Exterior Sub Station		
		0	☐ General
603	Grounding System		
		0	☐ General
604	Aircraft Fuel Dispenser		
		0	☐ General
605	Gas pump		
		1	☐ Electrical
		2	☐ Mechanical
620	Safety Equipment		
		8	☐ Wheelchair
		9	☐ Evacuation Chair
		6	☐ Dome miror
		7	☐ Metal Detector
		0	☐ General
		2	☐ Rescue Retrieval System
		3	☐ Strobe Light
		4	☐ Safety Man Track
		5	☐ Smoke Eliminator Portable
		10	☐ Emergency Stretcher
660	Special Equipment		
		1	☐ Laboratory
		2	☐ Process
		0	☐ General
700	Security		
		19	☐ Confined Space
		11	☐ Guard tour (key/electronic)
		13	☐ Glass Break Indicator

Master Inventory List For RMS PM System

Class Legacy Code	Class Description	Type Legacy Code	Type Description
	Mandated Items Highlighted		
		14	❒ Annunciator Panel
		16	❒ Fire-Safety Plans
		15	❒ Safety Signs
		9	❒ Magnetic Card Acces System
		6	❒ Closed Circuit TV Control System
		7	❒ Security, Monitoring System
		8	❒ Intrusion Alarm System
		10	❒ Video Recorder
		0	❒ General
		1	❒ Alarm Card
		2	❒ Panic Buttons
		3	❒ Emergency Alarm
		4	❒ Building Equipment On Alarm
		5	❒ Security Camera
		12	❒ Motion Detector
701	**Self Contained Breathing Apparatus**		
		0	❒ General
702	**Road Signings**		
		1	❒ Traffic Light
710	**Natural Gas Propane Distribution Components**		
		1	❒ General
755	**Cryogenic Fluid Systems**		
		1	❒ General
800	**Building Interior General**		
		3	❒ Operable Wall - Motorized
		0	❒ All elements
		1	❒ Blind/Drapery
		2	❒ Shelving
801	**Building Exterior General**		

Master Inventory List For RMS PM System

Class Legacy Code	Class Description	Type Legacy Code	Type Description
	Mandated Items Highlighted		
		1	☐ Areaways
		3	☐ Protective Plates
		0	☐ All elements
803	Wall		
		1	☐ Sprayed Fireproofing
		2	☐ Blowout Panels Explosing Venting
804	Antenna/Tower		
		0	☐ General
806	Ladder		
		1	☐ Portable
		0	☐ Fixed
810	Chimneys Stacks		
		1	☐ Bricks
		2	☐ Metal
814	Doors		
		13	☐ Operable Wall
		12	☐ Emergency Exit Fire Door
		11	☐ Motorized Cell Door
		1	☐ Main entrance
		2	☐ Emergency Exit
		3	☐ Automatic Opening
		4	☐ Power Door Operator
		5	☐ Overhead Powered with Safety Device
		6	☐ Overhead Powered
		7	☐ Overhead Manual
		8	☐ Horizontal Sliding Fire Door
		9	☐ Fire Door
		10	☐ Revolving
820	Exterior Stairs Railings		

Master Inventory List For RMS PM System

Class Legacy Code	Class Description	Type Legacy Code	Type Description
Mandated Items Highlighted			
		0	☐ General
830	Foundations Footings Supports		
		1	☐ Concrete
		2	☐ Wood
836	Fence		
		0	☐ General
837	Barrier		
		1	☐ Foot Traffic
		2	☐ Berme
838	Gate		
		4	☐ Parking Access (lift style)
		2	☐ Electro-mechanical Sliding
		3	☐ Manual Flap
		1	☐ Manual Sliding
840	Flag Poles		
		1	☐ Free Standing
		2	☐ Mounted to building
		3	☐ Halliard
850	Grounds		
		8	☐ Well (Artisienne)
		7	☐ Trench
		1	☐ Grounds
		3	☐ Lagoon
		4	☐ Fire Pond Lagoon
		6	☐ Decorative Pond
		2	☐ Trees/Schrubs/Bushes
851	Roads/Parking Areas		
		1	☐ Paved Road

Master Inventory List For RMS PM System

Class Legacy Code	Class Description	Type Legacy Code	Type Description
	Mandated Items Highlighted		
		2	☐ Unpaved Road
		3	☐ Paved Parking Lots
		4	☐ Unpaved Parking Lots
857	**Protective Plates**		
		1	☐ General
869	**Truss**		
		1	☐ Wood
		2	☐ Steel
		3	☐ Concrete
870	**Roof/Canopy**		
		9	☐ Copper
		10	☐ SBS Regular
		11	☐ SBS Inverted
		12	☐ EPDM Inverted
		13	☐ Structural Glass
		1	☐ Wood Shingle
		3	☐ Asphalt Roll
		2	☐ Asphalt Shingle
		4	☐ Built-up
		5	☐ Cement Composition
		6	☐ Steel/Metal
		7	☐ Slate
		8	☐ Tile
871	**Anchor Points/Permanently**	**Installed Suspended Platforms**	
		2	☐ Anchors only
		1	☐ Anchors and Platform
880	**Dam**		
		1	☐ Concrete
		2	☐ Earthen
		3	☐ Wood

Master Inventory List For RMS PM System

Class Legacy Code	Class Description	Type Legacy Code	Type Description
	Mandated Items Highlighted		
881	Bridge		
		2	☐ Steel
		3	☐ Wood
		1	☐ Concrete
		4	☐ Suspension
882	Tunnel		
		1	☐ Tunnel and Underground Structure
883	Wharves/Jetties/Piers		
		6	☐ Ladder
		1	☐ Wood
		2	☐ Concrete
		3	☐ Steel
		4	☐ Infill
		5	☐ Seawall & Breakwater
884	Wind Turbine		
		1	☐ Vertical Axis
		2	☐ Horizontal Axis
890	Storm Drainage System		
		1	☐ Catch Basin
		0	☐ General
900	Cafeteria Kitchen Appliances General		
		6	☐ Pie Machine
		9	☐ Sterilizer
		10	☐ High Pressure Washer
		13	☐ Toaster
		17	☐ Dryer
		20	☐ Coffee Urn
		22	☐ Blender
		28	☐ Juice Press

Master Inventory List For RMS PM System

Class Legacy Code	Class Description	Type Legacy Code	Type Description
Mandated Items Highlighted			
		64	☐ Stove
		63	☐ Skillet Electric
		0	☐ General
		7	☐ Potato Peeler
		8	☐ Table (not heated)
		18	☐ Coffee Maker
		19	☐ Dilacerator
		21	☐ Counter
		23	☐ Bread Slicer
		25	☐ Exhaust Hood
		27	☐ Pressure Washer
		29	☐ Steam Kettle
		32	☐ Pressure Cooker
		33	☐ Pot Cooker
		34	☐ Bainmarie Double Boiler
		37	☐ Display Case
		39	☐ Blender
		40	☐ Mixer
		41	☐ Slicer
		44	☐ Heating Table
		45	☐ Steam Table
		58	☐ Fryer
		59	☐ Deep Fryer
		62	☐ Square Cooker
		1	☐ Washing Machines
		2	☐ Vending Machine
		3	☐ Range Fridge Combination Package
		4	☐ Microwave
		5	☐ Bun Divider
		24	☐ Grinder
		11	☐ Coffee Grinder Mill
		12	☐ Kitchen
		14	☐ Jumper
		15	☐ Food Warmer
		16	☐ Food Chopper

Master Inventory List For RMS PM System

Class Legacy Code	Class Description	Type Legacy Code	Type Description
	Mandated Items Highlighted		
901	Garbage Compactor	0	☐ General
902	Waste Disposal Unit	0	☐ General
903	Refrigerator/Freezer	1	☐ Horizontal Domestic Refrigerator/Freezer
		2	☐ Vertical Domestic Refrigerator/Freezer
		3	☐ Commercial or Laboratory Refrigerator
		4	☐ Commercial or Laboratory Freezer
908	Dishwasher	1	☐ Conveyor
		2	☐ Commercial
910	Kitchen Range Hood Commercial	0	☐ General
912	Ovens Commercial Gas Electric Steam	0	☐ General
915	Steam Kettle	0	☐ General
918	Pressure Cooker Steam	0	☐ General
925	Garbage Can Washer	0	☐ General
930	Ice Cream Cabinet	0	☐ General

Master Inventory List For RMS PM System

Class Legacy Code	Class Description	Type Legacy Code	Type Description
	Mandated Items Highlighted		
935	**Ice Cube Maker**		
		0	☐ General
940	**Food Mixer**		
		0	☐ General
941	**Meat Slicer Saw**		
		0	☐ General
944	**Patty Machine**		
		0	☐ General
955	**Serving Table Heated**		
		0	☐ General
960	**Reach In Pass Through Refrigerator**		
		0	☐ General
965	**Beverage Dispenser**		
		0	☐ General
970	**Vegetable Peeler**		
		0	☐ General
985	**Roof Top Units**		
		0	☐ Heating/Cooling Unit - Gas Fired
990	**Tools**		
		4	☐ IAQ Meter
		5	☐ Particle Meter
		6	☐ Light Meter
		7	☐ VOC Meter
		8	☐ Multimeter
		3	☐ Pneumatic
		1	☐ Electric

Master Inventory List For RMS PM System

Class Legacy Code	Class Description	Type Legacy Code	Type Description
	Mandated Items Highlighted		
		2	☐ Hydraulic
991	Infrared Equipment		
		1	☐ General
992	Controllable Assets		
		1	☐ General
995	Special Equipment		
		1	☐ General
996	Security		
		1	☐ General
997	Tools		
		1	☐ General
998	Firing Range Equipment		
		1	☐ General
1000	Cleaning		
		1	☐ General
1001	Structures		
		1	☐ General
1002	SCIP		
		1	☐ General
1003	Air Craft Fuel Dispenser		
		1	☐ General
1004	Intrared Heater		
		1	☐ General

Master Inventory List For RMS PM System

Class Legacy Code	Class Description	Type Legacy Code	Type Description
	Mandated Items Highlighted		
1005	Water Distiller	1	❐ General
1006	After Cooler/Inter Cooler	1	❐ General
1007	Fuel Leak Detection	1	❐ General
1008	Tunnel	1	❐ General
1009	Intrared Equipment	1	❐ General
1010	Parts	1	❐ General
Bear	Bearings	11	❐ General
Belt	Belt	13	❐ General
CLEA	Cleaning	0	❐ General
CWD	Chilled Water Distribution	0	❐ General
DHW	Domestic Hot Water System	0	❐ General
E	Electrical	0	❐ General

Master Inventory List For RMS PM System

Class Legacy Code	Class Description	Type Legacy Code	Type Description
Mandated Items Highlighted			
FRE	**Firing Range Equipment**		
		0	☐ Firing Range Bullet Trap
		1	☐ Firing Range Shooters Booth
		2	☐ Firing Range Target System
		3	☐ Firing Range Line
Fuse	**Fuse**		
		0	☐ General
HVP	**High Voltage Physical**		
		1	☐ General
Mech	**Mechanical Insp**		
		0	☐ Main
MecR	**Mechanical Room Cleaning**		
		0	☐ General
Patrols	**Patrols Western Region**		
		0	☐ Building Patrol - Various Items
		1	☐ Out Building - Various Items
		2	☐ Garage Doors
		3	☐ Water and Glycol Tests
		4	☐ Monthly Fire Alarm Test
		5	☐ Walk Through Doors
Pull	**Pulley**		
		12	☐ General
Seal	**Seal**		
		14	☐ General
Slee	**Sleeve**		
		0	☐ General

Master Inventory List For RMS PM System

Class Legacy Code	Class Description	Type Legacy Code	Type Description
	Mandated Items Highlighted		
SRV	Safety Relief Valve		
		0	☐ General
WS	Water Supply		
		0	☐ Main Supply
		1	☐ Tap Supply

Part 1 General

1.1 REFERENCE STANDARDS

.1 CSA International

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

.2 National Research Council Canada (NRC)

.1 National Building Code of Canada 2015 (NBC).

.2 National Fire Code of Canada 2015 (NFC).

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00 - Submittal Procedures and 01 74 21 - Construction/Demolition Waste Management Disposal.

.2 Submit demolition drawings:

.1 Before proceeding with demolition of concrete block walls or structure and where required by Authority Having Jurisdiction submit for review by Departmental Representative shoring drawings, prepared by qualified structural engineer registered in the Province of Saskatchewan in Canada, showing proposed method.

.3 Sustainable Design Submittals:

.1 Construction Waste Management:

.1 Submit project Waste Reduction Workplan highlighting recycling and salvage requirements.

.2 Erosion and Sedimentation Control: submit erosion and sedimentation control plan in accordance with Authorities Having jurisdiction.

1.3 SITE CONDITIONS

.1 Take precautions to protect environment.

.2 If material resembling spray or trowel-applied asbestos or other designated substance listed as hazardous be encountered, stop work, take preventative measures, and notify Departmental Representative immediately.

.1 Proceed only after receipt of written instructions have been received from Departmental Representative.

.3 Notify Departmental Representative before disrupting building access and services.

Part 2 Products

2.1 NOT USED

.1 Not used.

Part 3 Execution

3.1 EXAMINATION

.1 Inspect building and site with Departmental Representative and verify extent and location of items designated for removal, disposal, alternative disposal, recycling, salvage and items to remain.

.2 Locate and protect utilities. Preserve active utilities traversing site in operating condition.

.3 Notify and obtain approval of utility companies before starting demolition.

.4 Disconnect, cap, plug or divert, as required, existing public utilities within the property where they interfere with the execution of the work, in conformity with the requirements of the authorities having jurisdiction. Mark the location of these and previously capped or plugged services on the site and indicate location (horizontal and vertical) on the record drawings. Support, shore up and maintain pipes and conduits encountered.

.1 Immediately notify Departmental Representative and utility company concerned in case of damage to any utility or service, designated to remain in place.

.2 Immediately notify the Departmental Representative should uncharted utility or service be encountered and await instruction in writing regarding remedial action.

.3 Provide temporary signage notifying occupants when public utilities and associated spaces are unusable. Warning signs notifying closures are to be posted at least 48 hours prior to work commencing.

3.2 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 to adjacent and landscaping features, structures, utilities, and parts of building to remain in place. Provide bracing and shoring required.

.2 Keep noise, dust, and inconvenience to occupants to minimum.

.3 Protect building systems, services and equipment.

.4 Provide temporary dust screens, covers, railings, supports and other protection as required.

.5 Do Work in accordance with Section 01 35 29.06 - Health and Safety Requirements.

.3 Demolition/Removal:

.1 Remove items as indicated.

.2 Remove parts of existing building to permit new installation.

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 Refer to demolition drawings and specifications for items to be salvaged for reuse.

.4 Waste Management: separate waste materials for recycling and 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 WORK INCLUDED

.1 Form for all cast-in-place concrete indicated on drawings and subsequently remove all such forms.

1.2 DESIGN AND CODE REQUIREMENTS

.1 Formwork and supporting falsework shall be designed and constructed in accordance with the requirements of CAN/CSA S269.3-M92 (R2008) and CAN/CSA A23.1-09 as applicable to the work.

.2 Assume full responsibility for the design and for the adequacy and safety of all formwork and falsework.

.3 The design and erection of formwork and related supporting works shall comply with construction safety legislation and regulations.

1.3 HANDLING AND STORAGE

.1 Deliver, handle and store formwork materials to prevent weathering, warping or damage detrimental to the strength of the materials or to the surface to be formed.

.2 Ensure that formwork surfaces which will be in contact with concrete are not contaminated by foreign matter. Handle and erect the fabricated formwork so as to prevent damage.

Part 2 Products

2.1 QUALITY AND STRENGTH

.1 The quality and strength of formwork material shall comply with the requirements set forth in this Specification and CAN/CSA A23.1-09.

2.2 FINISHES

.1 Form materials for concrete surfaces which will be exposed to view, or which require smooth and uniform surfaces for applied finishes or other purposes, shall consist of square edges, smooth panels of plywood, metal or plastic to approval of the Consultant. The panels shall be square and made in a true plane, clean, free of holes, surface markings and defects.

.2 Square edged, tongue and groove or shiplap lumber may be used to form concrete which will not be exposed to view or which does not require smooth uniform surface for other purposes.

2.3 MATERIALS

.1 Form plywood: exterior grade, Douglas Fir conforming to CSA Standard O121-08. Plywood shall be resin coated one side (in contact with concrete). Use sound undamaged plywood with clean true edges. Make up or patching strips between panels shall be kept to a minimum.

.2 Lumber for forms, falsework, shoring and bracing: conform to CAN/CSA O141-05 (R2009) for Softwood Lumber, and the applicable authorized grading authority. All lumber shall be a grade to which allowable unit stresses may be assigned in accordance with the National Building Code. All lumber shall be grade marked by the authorized grading authority.

.3 Form Ties: Fabricated units having a minimum working strength when assembled of 21 MPa and shall be adjustable in lengths to permit tightening and alignment of forms. Ties shall be made with breakback ends or other means of removing the tie end to a depth of at least 25 mm from the concrete surface, after the forms are removed. Flat tie for Architectural exposed concrete to include plastic cones leaving no metal within 20 mm of surface.

.4 Form release agent: Proprietary material which will not stain the concrete or impair the natural bonding or colour characteristics of coating intended for use on the concrete.

.5 Tubular column forms: round spirally wound laminated fibre forms, internally treated with release material.

.6 Dovetail anchor slots: minimum 0.6 mm galvanized steel with insulation filled slots.

.7 Pre-moulded joint fillers:

.1 Bituminous impregnated fibreboard: ASTM D1751-73.

.2 Vinyl Foam: to ASTM D1752-67 (1973) Type I, flexible grade.

.3 Standard Cork: to ASTM D1752-67 (1973) Type II.

Part 3 Execution

3.1 CONDITION OF SURFACES

.1 Examine the excavations and foundations for adequate working room and support for the work of this section.

.2 Verify lines, levels and centre lines before proceeding with the work and ensure that dimensions agree with drawings.

.3 Report to the Consultant discrepancies in other work which affect the work of this section.

3.2 PREPARATION

.1 Coat the inside surfaces of forms with a form release agent, used in accordance with the manufacturer's instructions.

.2 Apply the agent prior to placing reinforcing steel, anchoring devices and embedded parts.

3.3 ASSEMBLY AND ERECTION

.1 Construct the formwork and shoring and bracing to meet the design and code requirements, accurately so that the resultant finished concrete shall conform to the shapes, lines and dimensions shown on the drawings, within the specified tolerances.

.2 Formwork shall be so arranged and assembled as to permit easy dismantling and stripping so that the concrete will not be damaged during its removal.

.3 Review locations of ties and form panels for exposed concrete work with the Consultant.

.4 Check and correct formwork as required, both horizontally and vertically, during the placing of the concrete.

.5 Construct formwork to maintain the following maximum tolerances:

.1 Deviation from horizontal and vertical lines:
6 mm in 3000 mm
20 mm in 12000 mm.

.2 Deviation of building dimensions indicated on Drawings and position of columns, walls and partitions:
6 mm.

.3 Deviation in cross sectional dimensions of columns or beams or in thickness of slabs and walls:
± 6 mm.

.4 Camber slabs and beams:
10 mm per 3000 mm of span unless indicated on drawings.

3.4 JOINTS IN FORMS

.1 Make form joints tight in order to prevent leakage of mortar.

.2 Clean all edges and contact surfaces before erection.

.3 Where required, install pvc waterstop to manufacturer's instructions and without displacing reinforcement. Do not distort or pierce waterstop.

3.5 SHORING AND BRACING

.1 Provide bracing to ensure the stability of the formwork as a whole.

.2 Prop or strengthen all previously constructed parts liable to be overstressed by construction loads.

.3 Arrange forms to allow stripping without removal of the principal shores, where these are required to remain in place.

3.6 EMBEDDED PARTS AND OPENINGS

.1 Provide formed openings where required for pipes, conduit, sleeves and other work to be embedded in and passing through concrete members. Accurately locate and set in place items which are to be cast directly into the concrete. Co-ordinate the work of other sections and co-operate with the trade involved in the forming and setting of openings, slots, recesses, chases, sleeves, bolts, anchors and other inserts. No such forming or setting of openings, slots, recesses, chases, sleeves, or parts shall be done unless specifically shown on the drawings or approved prior to installation.

.2 Provide temporary ports or openings where required to facilitate cleaning and inspection. Openings at the bottom of forms shall be located so that flushing water will drain from the forms.

.3 Close the temporary ports or openings with tight fitting panels, flush with the inside face of the forms, neatly fitted so that the joints will not be apparent in exposed concrete surfaces.

.4 Do not eliminate or displace reinforcement to accommodate hardware. If inserts cannot be located as specified, obtain approval in writing or all modifications from the Consultant before placing concrete.

3.7 FIELD QUALITY CONTROL

.1 Inspect and check the completed formwork, shoring and bracing to ensure that the work is in accordance with the formwork design, and that the supports, fastenings, wedges, ties and parts are secure. The Engineer responsible for the design of the formwork shall assist in this inspection.

.2 Inform the Consultant when the formwork is complete and has been cleaned. Obtain the approval of the engineer responsible for the design of the formwork and the general approval of the Consultant before placing concrete.

3.8 CLEANING

.1 Clean the forms as erection proceeds to remove foreign matter.

.2 Remove cuttings, shavings and debris from within the forms.

.3 Flush the completed forms with water or air jet to remove remaining foreign matter. Ensure that water and debris drain to the exterior through the clean-out ports.

3.9 REMOVAL OF FORMWORK

.1 Notify the Consultant before removing formwork.

.2 Remove formwork progressively and in accordance with the reference code requirements, and so that no shock loads or imbalanced loads are imposed on the structure.

.3 Do not remove forms and shoring before concrete has attained sufficient strength to ensure safety of structure. If evidence to verify concrete strength is not available, the forms and shores shall not be removed before the following minimum intervals after concrete is placed.

.1 Slabs - 21 days.

.4 Loosen forms carefully. Do not wedge pry bars, hammers or tools against concrete surfaces.

.5 Leave forms loosely in place, against vertical surfaces, for protection until complete removal is approved by Consultant.

.6 Store removed forms, for exposed architectural concrete, in a manner that surfaces to be in contact with fresh concrete will not be damaged. Marked or scored forms will be rejected.

.7 Re-shore structural members where required due to design requirements or construction conditions and as required to permit progressive construction.

.8 Remove forms not directly supporting weight of concrete as soon as stripping operations will not damage concrete.

.9 Re-use of formwork and falsework is subject to the requirements of CAN/CSA A23.1-09.

END OF SECTION

Part 1 General

1.1 WORK INCLUDED

.1 Cast-in-Place Concrete required for this work is indicated in drawings and includes, but is not necessarily limited to:

- .1 Concrete Slabs
- .2 Miscellaneous Concrete
- .3 Finishing of all Formed Concrete Surfaces

1.2 REFERENCES

.1 American Society for Testing Materials International (ASTM)

- .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-08A, Standard Specification for Chemical Admixtures for Concrete.

.2 Canadian General Standards Board (CGSB)

- .1 CAN/CGSB 51.34-M86, Vapour Barrier, Polyethylene Sheet for Use in Building Construction.

.3 Canadian Standards Association (CSA)

- .1 CSA A23.1-09/A23.2-09(R2014), Concrete Materials and Methods of Concrete Construction/Methods of Test for Concrete.
- .2 CSA A23.3-04(R2010), Design of Concrete Structures.
- .3 CSA A3000-13, Cementitious Materials Compendium.

1.3 QUALITY ASSURANCE

.1 Provide at least one person who shall be present at all times during execution of this portion of the Work and who shall be thoroughly trained and experienced in placing the types of concrete specified and who shall direct all work performed under this Section.

.2 For finishing of exposed surfaces of the concrete, use only thoroughly trained and experienced journeyman concrete finishers.

.3 Perform cast-in-place concrete work to requirements of CSA-A23.1.

1.4 PRODUCT HANDLING

.1 Use all means necessary to protect cast-in-place concrete materials before, during and after installation and to protect the installed work and materials of all other trades.

.2 In the event of damage, immediately make all repairs and replacements necessary to approval of the Departmental Representative and at no additional cost to the Departmental Representative.

1.5 INSPECTION AND TESTING

.1 Inspection and testing will be performed by a firm approved by the Departmental Representative and paid for by the Contractor. Unless approved otherwise, the testing agency must perform all aspects of testing including cylinder preparation.

.2 Provide free access to all portions of work and co-operate with appointed firm.

.3 Submit proposed mix design for each class of concrete to Departmental Representative for review, two (2) weeks prior to commencement of work.

.4 Tests of cement and aggregates may be performed to ensure conformance with requirements stated herein.

.5 One concrete test, consisting of three test cylinders, will be taken for every 50 cubic meters or less of each class of concrete placed. One cylinder to be tested at seven (7) days, the remaining two cylinders to be tested at twenty-eight (28) days.

.6 One (1) additional test cylinder will be taken during cold weather concreting and be cured on job site under same conditions of concrete it represents.

.7 One (1) slump test and one (1) air content test will be taken for each set of test cylinders taken.

.8 Testing of concrete will be performed in accordance with CSA-A23.2.

.9 Test results will be issued to the Contractor, Consultant, and Departmental Representative. Test reports are to be numbered consecutively beginning with number one.

.10 Required retesting will be paid for by the Contractor.

.11 The Departmental Representative may order additional testing any time even though the required tests indicate the strength requirements have been met. In this instance, the Departmental Representative will pay for those tests that meet the specified requirements and the Contractor will pay for those that do not.

.12 Non-destructive methods for testing concrete shall be according to CSA A23.2.

Part 2 Products

2.1 CONCRETE MATERIALS

.1 *Cement*: Normal - N and Sulphate Resistant - HS Portland Type, to CSA A3000 - "Portland Cements".

.2 *Fine and Coarse Aggregates*: conforming to CSA-A23.1 - "Concrete Materials and Methods of Concrete Construction". The fine and coarse aggregate for concrete floor slabs and finish toppings shall contain a maximum of 0.4% low density particles as determined by CSA Test A23.2-09 "Low Density Material in Aggregate". Test results shall be submitted to Departmental Representative for review.

.3 *Water*: clean and free from injurious amounts of oil, alkali, organic matter, or other deleterious material.

2.2 ADMIXTURES

.1 Air Entrainment: to ASTM C260 - "Air-Entraining Admixtures for Concrete".

.2 Chemical: to ASTM C494 - "Chemical Admixtures for Concrete"; water reducing, strength increasing type WN - normal setting.

.3 Pozzolanic Mineral: to CSA A3000 "Supplementary Cementing Materials and Their Use in Concrete Construction", fly ash permitted only as approved by Departmental Representative.

2.3 ACCESSORIES

.1 Vapour Barrier: 6 mil polyethylene film, to CAN/CGSB 51.34, Type 1 - low permeance heavy duty.

.2 Curing Compounds: shall conform to the requirements of the latest issue of ASTM Standard C309.

.3 Non-shrink Grout: premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents; capable of developing minimum compressive strength of 20 MPa at 3 days and 50 MPa at 28 days. CPD Non-Shrink Grout by CPD Construction Products or approved substitutions.

.4 Joint Filler: pre-moulded bituminous impregnated cane fibre board Flexcell as manufactured by Sternson or approved substitution.

.5 Vertical Joint Sealant: non-sag polyurethane sealant designed for use on vertical surfaces. Vulkem 116 as manufactured by Mameco Ltd. or approved equal. Install strictly in accordance with manufacturer's recommendations.

.6 Horizontal Joint Sealant: three component chemically curing, self-levelling, polyurethane joint sealant, THC-900 as manufactured by Tremco or approved substitution. Colour selection by Departmental Representative. Install strictly in accordance with manufacturer's recommendations.

.7 Concrete Expansion Anchors: to be Hilti Kwik-Bolt or approved equivalent. Sized as per drawings. Minimum embedment length of all Hilti Kwik-Bolt to be 150 mm unless noted otherwise.

.8 Concrete Inserts with Bolt Extension: Concrete inserts to be Hilti HKD Anchors or approved equivalent, sized as detailed on drawings. Bolt extensions to be mild steel threaded extensions sized as detailed on drawings.

.9 Concrete Patching Material: pre-packaged, polymer modified, cementitious product containing graded natural aggregate, EMACO R300 - Rapid Setting Mortar as manufactured by Master Builders or approved equivalent.

.10 Bonding Agent: Approved high polymer polyvinyl acetate emulsion applied in strict accordance with manufacturer's recommendations for proposed application. Daraweld-C, Acrylbond by Allied or approved equal. Mix bonding agent with Portland cement, sand and water to manufacturer's recommendation to achieve an uniform slurry and scrubbed into the surface. Ensure surface is free from all laitance, dirt, dust, debris, grease or other substances. Clean surface with acid etching and hosing down. Neutralize acid if necessary.

.11 Epoxy Bonding Agent: Approved mineral filled polymer/epoxy adhesive formulated to bond new concrete to cured concrete. Apply in strict conformance with manufacturer's written recommendations for proposed application. ST-432 by Sternson, SIKADUR HI-MOD by Sika, CONCRESIVE 1001-LPL by Adhesive Engineering Company or approved equal.

.12 Cement Grout Capsules: reinforcing steel detailed to be installed in pre-placed concrete to be anchored using Lafarge Fondu Cement Grout Capsules M3RR or approved equal.

2.4 CONCRETE REINFORCING

.1 *All reinforcing steel:* unless noted otherwise on the drawings or herein shall be deformed bars of new billet steel conforming to the current CAN/CSA G.30.18-09 Grade 400, plain finish for all bars. Minimum splice for 10 M bars to be 450 mm. Minimum lap splice for all other bars to be 36 bar diameters or 675 mm, whichever is greater.

.2 *Weldable reinforcing bars:* high strength ductile, deformed bars to CSA G30.18-09, Grade 400.

.3 *Welded wire fabric:* to CSA G30.5-M1983. Provide in the flat sheets only.

.5 *Tie wires:* shall be 1.29 mm or heavier annealed wire or a patented system approved by the Consultant.

.6 *Reinforcing steel supports:* shall conform to ACI Standard 315 unless otherwise approved by the Consultant.

.7 *Mechanical splices:* subject to the approval of the Consultant.

2.5 REINFORCING FABRICATION

.1 Fabricate bends, splices and ties and supply bar supports and accessories in accordance with the requirements of CAN-A23.3-04. Spacing and arrangements of supports in accordance with ACI 315.

.2 All intermediate grade reinforcing bars shall be bent cold without hickeying. All high strength steel shall be preheated.

.3 Reinforcing bars shall not be straightened or rebent.

.4 Location of reinforcement splices not shown on the drawings subject to approval by the Consultant and shall, for beams and slabs be away from points of maximum stress in the steel.

2.6 CONCRETE MIXES

.1 Mechanical mix concrete in accordance with the requirements of CSA-A23.1.

.2 All concrete shall have the following minimum properties.

Based on 2015 National Building Code

Location	Exposure Class	Comp. Strength (MPa) and Age	Aggregate	Air Entrainment	Slump
1. Slabs	N	25 @ 28 d	21	0	80 ± 30
2. Interior Topping	N	25 @ 28 d	10	0	80 ± 30

Minimum cement content for Type 50 cement to be 280 kg/m3.
Maximum free water/cement ratio for Type 50 cement to be 0.5.

Semi-lightweight concrete to have unit weight of 2075 ± 75kg/m3.
Lightweight concrete to have unit weight of 1850 ± 75kg/m3.

.3 Submit proposed mix design to Inspection and Testing Firm, to Consultant, and to Departmental Representative, two (2) weeks prior to commencement of work. Provide certification that mix proportions selected will produce concrete of specified quality and that strength will comply with CSA-A23.1.

.4 Each load of ready-mixed or transit-mixed concrete delivered to the project site shall be accompanied by duplicate delivery slips providing the following information:

.1 Name of ready-mix batch plant

.2 Serial number of ticket

.3 Date and truck number

.4 Name of contractor

.5 Specific designation of project

.6 Specific class of concrete

.7 Amount of concrete in cubic metres

.8 Time of loading or first mixing of aggregate, cement and water.

.5 Use accelerating admixtures in cold weather only when approved by Departmental Representative. If approved, the use of admixture will not relax cold weather placement requirements. Use calcium chloride only as approved by the Departmental Representative.

.6 Use set-retarding admixtures during hot weather only when approved by Departmental Representative.

.7 Use of plasticizers only when approved by Departmental Representative.

.8 Concrete mix for exposed aggregate finish and sandblasted finish shall be designed as a low slump, gap-graded mix with a maximum amount of screened and washed crushed coarse aggregate.

Part 3 Execution

3.1 INSPECTION

.1 Prior to all work of this Section, carefully inspect the installed work of all other trades and verify that all such work is complete to the point where this installation may properly commence.

.2 Verify that all items to be embedded in concrete are in place.

.3 Verify that concrete may be placed to the lines and elevations indicated on the Drawings, with all required clearance from reinforcement.

3.2 DISCREPANCIES

.1 In the event of discrepancy, immediately notify the Departmental Representative.

.2 Do not proceed with installation in areas of discrepancy until all such discrepancies have been fully resolved.

3.3 PREPARATION

.1 Remove all wood scraps and debris from the formed areas in which concrete will be placed.

.2 Thoroughly clean the forms to ensure proper placement and bonding of concrete.

.3 Thoroughly wet the forms, except in freezing weather, or oil them; remove all standing water.

.4 Thoroughly clean all transporting and handling equipment.

3.4 PLACING REINFORCING

.1 Reinforcement of the size and shapes shown on the drawings shall be accurately placed in accordance with the approved shop drawings, the structural drawings and the requirements of the current National Building Code.

.2 Clear distances between parallel bars, except for columns, shall be not less than 1.4 times the diameter of the bar, or 30 mm or 1.4 times the maximum size of the coarse aggregate. Bars placed in two or more layers shall be placed directly above and below each other.

.3 Reinforcing steel shall, where not otherwise shown on the drawings, be protected by the clear cover of concrete over the reinforcement as follows:

.1 Where concrete is formed against earth, not less than 75 mm.

.2 Where concrete placed against forms is to be exposed to the weather or be in contact with the ground, not less than 50 mm for bars larger than 15 M, and not less than 40 mm for bars 15 M and smaller.

.3 In slabs and walls not exposed to the ground or weather, not less than 20 mm.

.4 In beams, girders and columns not exposed to the ground or weather, not less than 40 mm to principal reinforcement, ties and stirrups.

The foregoing clear covers shall be maintained within 5 mm.

.4 Reinforcement shall be adequately supported by metal chairs, spacers or hangers and secured against displacement within the tolerance permitted and in accordance with the latest ACI Standard 315.

.5 Review with the Consultant, placement of reinforcement prior to concreting.

.6 Notify the Consultant twenty-four (24) hours prior to placing concrete.

3.5 PLACING CONCRETE

.1 Place concrete in accordance with requirements of CSA-A23.1 and as indicated on Drawings.

.2 Notify Departmental Representative, Consultant, and Inspection and Testing Firm a minimum of forty-eight (48) hours prior to commencement of concreting operations.

.3 Ensure all anchors, seats, plates and other items to be cast into concrete are placed, held securely and will not cause undue hardship in placing concrete.

.4 Maintain accurate records of poured concrete items. Record date, location of pour, quantity, air temperature and test samples taken.

.5 Ensure reinforcement, inserts, embedded parts, formed joints and fitments are not disturbed during concrete placement.

.6 Prepare previously placed concrete by cleaning with steel brush.

.7 Pour concrete continuously between predetermined construction and control joints. All construction joints subject to approval of the Departmental Representative.

.8 Approval to place concrete shall be contingent on the formwork and reinforcing steel placement and evidence that the Departmental Representative can place the planned casting without stopping.

.9 Excessive honeycomb or embedded debris in concrete is not acceptable. Remove and replace defective concrete. Excessive honeycomb is when eraser end of a pencil fits into cavity.

3.6 COLD WEATHER REQUIREMENTS

.1 When the air temperature is at or below 5°C. or when there is a probability of it falling to this limit during the placing or curing period, cold weather requirements shall be applicable.

.2 Provide heating equipment or heating plant on the job ready for use when concrete is being placed during cold weather. Such equipment shall be adequate for the purpose of maintaining the required temperature during the placing and curing of the concrete. The methods used for heating shall be approved by the Departmental Representative. Equipment inducing carbon monoxide gas in the building shall not be accepted.

.3 Concrete shall not be placed on or against reinforcement, formwork, ground or any surface that is at a temperature less than 5°C.

.4 The temperature of the concrete at all surfaces shall be maintained at not less than 15°C for three (3) days, or at not less than 10°C for five days after placing. Means shall be provided to humidify the air within enclosures and to keep the concrete and formwork continuously moist if dry heat is used. The concrete shall be kept above freezing

temperature for a period of seven (7) days and shall be kept from alternate freezing and thawing for at least fourteen (14) days after placement.

.5 At the end of the specified protection period the temperature of the concrete shall be reduced gradually at a rate not exceeding that shown in CSA-A23.1.

.6 Accelerator or so-called anti-freeze compounds shall not be permitted unless otherwise approved in writing by the Departmental Representative.

.7 All protective coverings shall be kept clear of the concrete and form surfaces to permit free circulation of air and shall be maintained intact for at least twenty-four (24) hours after artificial heat is discontinued.

3.7 HOT WEATHER REQUIREMENTS

.1 When the air temperature exceeds 27°C, hot weather requirements shall be applicable.

.2 Time of initial mixing to complete discharge shall not exceed 1 hour and 15 minutes and concrete placed shall not exceed 27°C.

.3 Concrete forming surfaces and reinforcing steel shall be sprinkled with cool water just prior to placing concrete. Standing water or puddles shall be removed prior to concrete placement.

.4 Special wind protection will be required as directed by the Departmental Representative.

.5 Columns, walls, beams and slabs shall be kept continuously damp for twenty-four (24) hours by normal curing procedures as outlined by this Specification. Slabs cured by the applications of sealing, shall have curing compound applied immediately after finishing of the slab but before evaporation of surface moisture.

.6 The use of water reducing agents shall be subject to the approval of the Departmental Representative when hot weather conditions prevail.

3.8 CONSTRUCTION JOINTS AND WATERSTOPS

.1 The location and detail of all construction joints not detailed on the drawings shall be approved by the Departmental Representative.

.2 Where fresh concrete is to be placed against concrete which has set or has partially set, the surface of the set or partially set concrete shall be roughened, cleaned of all laitance, and thoroughly soaked with water prior to the placement of fresh concrete.

.3 In general, the construction joints in floor and roof systems shall be located in the middle of the spans of slabs, beams and girders. Proper key and dowels or extensions of reinforcing shall be provided at all construction joints.

.4 Concrete placed in wall and column forms shall be struck off flush with the underside of the floor and roof systems.

3.9 DEFECTIVE CONCRETE

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

.2 Concrete not conforming to the lines, details and grade specified herein or as shown on the drawings shall be modified or replaced at the Contractor's expense and to the

satisfaction of the Departmental Representative. Finished lines, dimensions and surfaces shall be correct and true within tolerances specified in the Formwork Section of these Specifications.

.3 Concrete not properly placed resulting in excessive honeycombing and all honeycombing and other defects in critical areas of stress, shall be repaired or replaced at the Contractor's expense and to the satisfaction of the Departmental Representative.

.4 Concrete of insufficient strength or improper consistency shall be, as required by the Departmental Representative, subject to one or more of the following:

.1 Changes in mix proportions for the remainder of the work.

.2 Cores drilled and tested from the areas in question as directed by the Departmental Representative and in accordance with CSA-A23.2. The test results shall be indicative of the in-place concrete.

.3 Load testing of the structural elements in accordance with CSA-A23.3.

.4 The changes in the mix proportions and the testing shall be at the Contractor's expense.

.5 Concrete failing to meet the strength requirements of this Specification shall be strengthened or replaced at the Contractor's expense and to the satisfaction of the Departmental Representative.

3.10 PATCHING CONCRETE

.1 After the removal of the forms concrete surfaces may be subject to inspection by the Departmental Representative.

.2 All exposed metal form ties, nails, wires, shall be removed, fins broken off and all loose concrete removed.

.3 Form tie pockets shall be thoroughly wetted and patched with patching concrete followed by proper curing.

.4 Honeycombed and other defective surfaces shall be chipped away to a depth of not less than 25 mm with the edges perpendicular to the surface, thoroughly wetted and patched with patching concrete followed by proper curing.

.5 Patching concrete shall be thoroughly compacted into place and finished in such a manner as to match the adjoining concrete. The design mix of the patching concrete shall be approved by the Departmental Representative.

3.11 FINISHING OF FORMED SURFACES

.1 On exposed formed concrete surfaces, except at unfinished areas: remove blemishes, formwork joint marks by rubbing with carborundum block and water. Leave finished surfaces smooth, unmarred. Complete rubbing within twenty-four (24) hours for stripping formwork.

3.12 ANCHOR BOLTS AND WELDMENTS

.1 Set anchor bolts and weldments to the following tolerances:

.1 Alignment: ± 3mm of location, plumb and true.

.2 Projection: ± 6mm of elevations called for.

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

.1 ASTM International

.1 ASTM A307-07b, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.

.2 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.

.3 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 W48-06, Filler Metals and Allied Materials for Metal Arc Welding (Developed in co-operation with the Canadian Welding Bureau).

.4 CSA W59-M03(R2008), Welded Steel Construction (Metal Arc Welding) Metric.

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

.1 Material Safety Data Sheets (MSDS).

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Shop Drawings:

.1 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 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 accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Replace defective or damaged materials with new.

Part 2 Products

2.1 MATERIALS

.1 Steel sections and plates: to CSA G40.20/G40.21, Grade 350W.

.2 Welding materials: to CSA W59.

.3 Welding electrodes: to CSA W48 Series.

.4 Bolts and anchor bolts: to ASTM A307.

.5 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 600g/m² to CAN/CSA-G164.

.2 Shop coat primer: in accordance with CAN/CGSB-1.40.

.3 Zinc primer: zinc rich, ready mix to CAN/CGSB-1.181.

2.4 SHOP PAINTING

.1 Apply one shop coat of primer to metal items, with exception of galvanized or concrete encased items.

.2 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.

.3 Clean surfaces to be field welded; do not paint.

2.5 ANGLE LINTELS

.1 Steel angles: prime painted, sizes indicated for openings. Provide 200 mm minimum bearing at ends.

.2 Weld or bolt back-to-back angles to profiles as indicated.

.3 Finish: one coat of shop primer and two coats field paint.

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 in presence of Departmental Representative.

.2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 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 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 Deliver items over for casting into concrete and building into masonry together with setting templates to appropriate location and construction personnel.

.7 Touch-up rivets, field welds, bolts and burnt or scratched surfaces with primer after installation.

3.3 STEEL ANGLE LINTELS

.1 Coordinate installation with Section 04 04 99 - Masonry for Minor Works.

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.

3.5 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 REFERENCE STANDARDS

.1 ASTM International

.1 ASTM A496/A496M-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 S304.1-04(R2009), Design of Masonry Structures.

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

.1 Material Safety Data Sheets (MSDS).

.4 National Research Council Canada (NRC)

.1 National Building Code of Canada 2015 (NBC).

.2 National Fire Code of Canada 2015 (NFC).

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 masonry products and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Submit 1 copy of WHMIS MSDS in accordance with Section 01 35 29.06 - Health and Safety Requirements.

.1 Indicate VOC's in g/L for epoxy coatings and galvanized protective coatings and touch-up products to be applied within building envelope.

.3 Shop Drawings:

.1 Shop drawings consist of bar bending details, lists and placing drawings.

.2 Placing drawings, indicate sizes, spacing, location and quantities of reinforcement and connectors.

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 accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect masonry products from damage.

.3 Replace defective or damaged materials with new.

Part 2 Products

2.1 MASONRY UNITS

.1 Standard concrete block units: to CAN/CSA-A165 Series (CAN/CSA-A165.1).

.1 Classification: H/15/C/M

.2 Size: modular.

.3 Special shapes: provide purpose-made shapes for lintels and bond beams. Provide additional special shapes as required.

.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 (NBC), for fire-resistance ratings indicated.

.3 Size: modular.

.4 Special shapes: provide purpose-made shapes for lintels and bond beams. Provide additional shapes as required.

2.2 REINFORCEMENT AND CONNECTORS

.1 Bar reinforcement: to CAN/CSA-A371, Grade 400.

.2 Wire reinforcement: to CAN/CSA-A371, truss type.

.3 Connectors shall be corrosion resistant: to CAN/CSA-A370.

.4 Ties: hot dip galvanized to CAN/CSA-A370 Table 5.2, steel finish

.1 Unit ties, to CAN/CSA-A370: rectangular, fabricated form cold-drawn steel, size to suit application.

.2 Joint Reinforcement Ties: to CAN/CSA-A370: ladder or truss type, steel wire, hot dip galvanized: to ASTM A641, Class 1 after fabrication. Cold drawn steel wire conforming to ASTM A82.

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: M based on property specifications,

.3 Following applies regardless of mortar types and uses specified above:

.1 Mortar for grouted reinforced masonry: type S based on property specifications.

.4 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 Coatings: VOC limit 100g/L.

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 Departmental Representative.

.2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 INSTALLATION

.1 Do 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.

.3 Jointing: tool where exposed to provide smooth compressed concave surface.

.2 Build masonry plumb, level, and true to line, with vertical joints in alignment. Match existing coursing. Tooth-in where new masonry abuts existing masonry.

.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 Building-in:

.1 Install masonry connectors and reinforcement where new and existing masonry intersects.

.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.

.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.

.4 Provision for movement:

.1 Leave 6 mm space between top of non-load bearing walls and partitions and structural elements. Do not use wedges.

.2 Built masonry to tie in with stabilizers, with provision for vertical movement.

.5 Interface with other work:

.1 Cut openings in existing work as indicated.

.2 Openings in walls: approved Departmental Representative.

.3 Make good existing work. Use materials to match existing.

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.

.2 Prior to placing mortar, obtain Departmental Representative's approval of placement of reinforcement and connectors.

3.5 BONDING AND TYING

.1 Bond existing and new walls using metal connectors in accordance with 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.

.2 Place and grout reinforcement in accordance with CAN/CSA-A179, CAN/CSA-A371 and CSA S304.1.

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.

3.10 SITE TOLERANCES

.1 Tolerances of CAN/CSA-A371 apply.

3.11 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.

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

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

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

3.12 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 REFERENCE STANDARDS

.1 ASTM International

.1 ASTM A653/A653M-11, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvanealled) by the Hot-Dip Process.

.2 ASTM C1396/C1396M-11, Standard Specification for Gypsum Board.

.2 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-51.34-M86, Vapour Barrier, Polyethylene Sheet for Use in Building Construction and amendment.

.3 CSA International

.1 CSA B111-1974(R2003), Wire Nails, Spikes and Staples.

.2 CSA O112.9-10, Evaluation of Adhesives for Structural Wood Products (Exterior Exposure).

.3 CSA O121-08, Douglas Fir Plywood.

.4 CSA O141-05(R2009), Softwood Lumber.

.5 CSA O151-09, Canadian Softwood Plywood.

.6 CSA O325-07, Construction Sheathing.

.4 National Lumber Grades Authority (NLGA)

.1 Standard Grading Rules for Canadian Lumber 2010.

.5 National Research Council Canada (NRC)

.1 National Building Code of Canada 2015 (NBC).

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 wood products and accessories and include product characteristics, performance criteria, physical size, finish and limitations.

1.3 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.

1.4 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 accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect from damage.

.3 Replace defective or damaged materials with new.

Part 2 Products

2.1 FRAMING STRUCTURAL AND PANEL MATERIALS

.1 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.

.2 Framing and board lumber: in accordance with National Building Code of Canada (NBC)

.3 Furring, blocking, nailing strips, rough bucks, and backing:

.1 Board sizes: "Standard" or better grade.

.2 Dimension sizes: "Standard" light framing or better grade.

.3 Post and timbers sizes: "Standard" 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 Gypsum sheathing: to ASTM C1396/C1396M.

2.2 ACCESSORIES

.1 Polyethylene film: to CAN/CGSB-51.34, Type 1, 0.15 mm thick.

.2 Sealants: in accordance with Section 07 92 00 - Joint Sealants.

.3 General purpose adhesive: to CSA O112.9.

.4 Nails, spikes and staples: to CSA B111.

.5 Bolts: 12.5 m diameter unless indicated otherwise, complete with nuts and washers.

.6 Proprietary fasteners: toggle bolts, expansion shields and lag bolts, screws and lead or inorganic fibre plugs, recommended for purpose by manufacturer.

.7 Fastener Finishes:

.1 Galvanizing: to ASTM A653, use galvanized fasteners for all areas.

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 Departmental Representative.

.2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 PREPARATION

.1 Treat surfaces of material with wood preservative, before installation.

.2 Apply preservative by dipping, or by brush to completely saturate and maintain wet film on surface for minimum 3 minute soak on lumber and one minute soak on plywood.

.3 Re-treat surfaces exposed by cutting, trimming or boring with liberal brush application of preservative before installation.

3.3 MATERIAL USAGE

.1 Exterior wall sheathing:

.1 Plywood, DFP or CSP sheathing grade or PP standard sheathing grade.

.2 Electrical equipment mounting boards:

.1 Plywood, DFP or CSP.

3.4 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 spanning members with "crown-edge" up.

.4 Select exposed framing for appearance. Install panel and lumber materials so that grade-marks and other defacing marks are concealed or are removed by sanding where materials are left exposed.

.5 Install furring and blocking as required to space-out and support wall and ceiling finishes, facings, electrical equipment mounting boards, and other work as required.

.6 Install rough bucks, nailers and linings to rough openings as required to provide backing for frames and other work.

.7 Install wood backing, nailers, and other wood supports as required and secure using galvanized fasteners.

.8 Use dust collectors and high-quality respirator masks when cutting or sanding wood panels.

.9 Frame, anchor, fasten, tie and brace members to provide necessary strength and rigidity.

.10 Countersink bolts where necessary to provide clearance for other work.

.11 Use nailing disks for soft sheathing as recommended by sheathing manufacturer.

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 and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

3.6 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 REFERENCE STANDARDS

.1 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-51.34-M86, Vapour Barrier, Polyethylene Sheet, for Use in Building Construction.

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 vapour retarders and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Submit copy of WHMIS MSDS in accordance with Section 01 35 29.06 - Health and Safety Requirements.

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 indoors, in dry location, and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect specified materials from damage.

.3 Replace defective or damaged materials with new.

Part 2 Products

2.1 SHEET VAPOUR BARRIER - CRAWLSPACE

.1 Polyethylene film: 0.36mm thick, fire retardant, high-density cross laminated polyethylene vapour retarder.

.1 Colour: white

.2 Product: Permalon X-200FR or approved alternate.

2.2 ACCESSORIES

.1 Joint sealing tape: mastic tape, air resistant pressure sensitive adhesive tape, as recommended by vapour barrier manufacturer, 150 mm wide for lap joints and perimeter seals, 100 mm wide elsewhere.

.2 Sealant: compatible with vapour retarder materials, recommended by vapour retarder manufacturer.

Part 3 Execution

3.1 INSTALLATION

.1 Ensure services are installed and inspected prior to installation of retarder.

.2 Install sheet vapour retarder on crawlspace substrate to form continuous retarder.

.3 Use sheets of largest practical size to minimize joints.

.4 Ensure surface beneath vapour retarder is smooth, level, and compacted, with no sharp projections.

.5 Inspect for continuity. Repair punctures and tears with mastic tape before work is concealed. Immediately repair holes in vapour retarder once detected.

.6 Seal around columns, piles, pipes, and other penetrations in accordance with manufacturer's written instructions.

3.2 LAP JOINT SEALS

.1 Seal lap joints of sheet vapour retarder with approved sealant and mastic tape.

.1 Ensure vapour retarder surfaces to receive sealant and mastic tape are clean and dry.

.2 Attach first sheet to substrate.

.3 Apply continuous bead of sealant over solid backing at joint.

.4 Lap adjoining sheet minimum 150 mm and press into sealant bead.

.5 Install mastic tape as per manufacturer's written instructions.

.6 Ensure that no gaps exist in sealant bead. Smooth out folds and ripples occurring in sheet over sealant.

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.

.1 Remove insulation material spilled during installation and leave work area ready for application of wall board.

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 Research Council Canada (NRC)

.1 National Building Code of Canada 2015 (NBC).

.3 Underwriter's Laboratories of Canada (ULC)

.1 ULC-S101-14, Standard Methods of Fire Endurance Tests of Building Construction and Materials.

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

.2 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 copy of WHMIS MSDS - Material Safety Data Sheets in accordance with Section 01 35 29.06 - Health and Safety Requirements.

.3 Shop Drawings:

.1 Submit ULC listed assemblies to show location, proposed material, reinforcement, anchorage, fastenings and method of installation.

.2 Construction details should accurately reflect actual job conditions.

.4 Quality assurance submittals: submit following in accordance with Section 01 45 00 - Quality Control.

.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 Manufacturer's Instructions: submit manufacturer's installation instructions and special handling criteria, installation sequence, and cleaning procedures.

1.4 QUALITY ASSURANCE

.1 Qualifications:

.1 Installer: company or person specializing in fire stopping installations approved by manufacturer with 5 years documented experience.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Packing, shipping, handling and unloading:

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.

.2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.3 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 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 in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

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.

.2 Fire stop system rating: as indicted on drawings.

.2 Re-penetrable fire stop system for power and communication cables.

.3 Service penetration assemblies: systems tested to CAN-ULC-S115.

.4 Service penetration fire stop components: certified by test laboratory to CAN-ULC-S115.

.5 Fire-resistance rating of installed fire stopping assembly in accordance with NBC.

.6 Fire stopping and smoke seals at openings intended for ease of re-entry such as cables: elastomeric seal.

.7 Fire stopping and smoke seals at openings around penetrations for pipes, ductwork and other mechanical items requiring sound and vibration control: elastomeric seal.

.8 Primers: to manufacturer's recommendation for specific material, substrate, and end use.

.9 Water (if applicable): potable, clean and free from injurious amounts of deleterious substances.

.10 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.

.11 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 without interruption to vapour barrier.

.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 SPECIAL REQUIREMENTS

.1 Location of special requirements for fire stopping and smoke seal materials at openings and penetrations in fire resistant rated assemblies are as follows:

.1 Designed for re-entry, removable at: electrical and communication penetrations.

3.5 SEQUENCES OF OPERATION

.1 Proceed with installation only when submittals have been reviewed by Departmental Representative.

.2 Install floor fire stopping before interior partition erections.

.3 Mechanical pipe insulation: certified fire stop system component. Ensure pipe insulation installation precedes fire stopping.

3.6 FIELD QUALITY CONTROL

.1 Inspections: notify Departmental Representative when ready for inspection and prior to concealing or enclosing fire stopping materials and service penetration assemblies.

3.7 CLEANING

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

.2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

.3 Remove temporary dams after initial set of fire stopping and smoke seal materials.

3.8 SCHEDULE

.1 Fire stop and smoke seal at:

.1 Penetrations through fire-resistance rated masonry, concrete, and gypsum board partitions and walls.

.2 Top of fire-resistance rated masonry and gypsum board partitions.

.3 Intersection of fire-resistance rated masonry and gypsum board partitions.

.4 Penetrations through fire-resistance rated floor slabs, ceilings and roofs.

.5 Openings and sleeves installed for future use through fire separations.

.6 Around mechanical and electrical assemblies penetrating fire separations.

.7 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 REFERENCE STANDARDS

.1 ASTM International

.1 ASTM E814-13a(2017), Standard Test Method for Fire Tests on Penetration Firestop Systems.

.2 ASTM E1996-17, Standard Specification for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Windborne Debris in Hurricanes.

.2 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-19.13-M87, Sealing Compound, One-component, Elastomeric, Chemical Curing.

.2 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).

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 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 1 copy of WHMIS MSDS in accordance with Section 01 35 29.06 - Health and Safety Requirements.

.3 Manufacturer's Instructions:

.1 Submit instructions to include installation instructions for each product 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 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 accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect joint sealants from damage.

.3 Replace defective or damaged materials with new.

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 Conform to manufacturer’s recommended temperatures, relative humidity, and substrate moisture content foe application and curing of sealants including special conditions governing use.

.3 Ventilate area of work as directed by Departmental Representative by use of approved portable supply and exhaust fans.

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 Type 1 - Urethanes three part:

.1 Non-sag: to CAN/CGSB-19.24, Type 2, Class B, colour as selected by Departmental Representative from standard range of manufacturer's colours.

.2 Type 2 - Urethanes one part:

.1 Non-sag: to CAN/CGSB-19.13, Type 2, colour as selected by Departmental Representative from standard range of manufacturer's colours.

.3 Type 3 - Silicones one part:

.1 To CAN/CGSB-19.13, Type 2, colour as selected by Departmental Representative from standard range of manufacturer's colours.

.4 Type 4 - Elastomeric, single or multicomponent:

.1 To CAN/CGSB-19.13 or CAN/CGSB-19.24, Type S or Type M, Grade NS, Class 12.5

.5 Type 5 - Acoustical sealant and firestopping:

.1 To ASTM E814 and ASTM E1996

.2 Acceptable material: Metacaulk MC-150+.

.6 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/m3density, 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 Perimeters of exterior openings where frames meet exterior facade of building (i.e. brick, block): sealant type: 1 or 2

.2 Exterior sealant: sealant type: 1 or 2 (colour selected by Departmental Representative)

.3 Seal interior perimeters of exterior openings as detailed on drawings: sealant type: 3

.4 Control and expansion joints on the interior of exterior surfaces of unit masonry walls: sealant type: 4

.5 Interior masonry vertical control joints (block-to-block, block-to-concrete, and intersecting masonry walls): sealant type: 4

.6 Joints at tops of non-load bearing masonry walls at the underside of poured concrete: sealant type: 4

.7 Perimeter of ductwork through gypsum board assemblies: sealant type: 5

.8 In additional locations as noted on the drawings: confirm with Consultant.

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 in presence of Departmental Representative.

.2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 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: clean in accordance with Section 01 74 11 - 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 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.

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

1 General

1.1 SECTION INCLUDES

.1 Mechanical Contractor to provide access doors for mechanical components for installation by contractor under section erecting associated walls or ceilings.

1.2 SHOP DRAWINGS

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

.2 Submit catalogue details for each type of door illustrating profiles, dimensions and methods of assembly.

1.3 CLOSEOUT SUBMITTALS

.1 Provide maintenance data for cleaning and maintenance of stainless steel finishes for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

2 Products

2.1 ACCESS DOORS

.1 Sizes: Except as indicated otherwise, to be minimum sizes as follows:
- .1 For service entry: 600 x 600 mm.
- .2 For visual inspection: 300 x 300 mm.

.2 Construction: Rounded safety corners, concealed hinges, screwdriver latch, anchor straps, able to open 180 degrees.

.3 Materials
- .1 Tiled or marble surfaces and other special areas: Stainless steel with brushed satin or polished finish as directed by Departmental Representative.
- .2 Other areas: Prime coated steel.

.4 Access doors in ductwork, refer to 23 33 00 Ductwork Accessories.

3 Execution

3.1 LOCATION

.1 Location: Ensure that equipment is within view and accessible for operating, inspecting, adjusting, servicing without using special tools.

.2 Provide adequately sized access doors for inspection and cleaning before and after filters, coils, fans, automatic dampers, humidifiers, at fire dampers, and elsewhere as indicated. Review locations prior to fabrication.

.3 Provide 100 x 100 mm (4"x 4") quick opening access doors for inspection of balancing dampers.

3.2 LOCATION

.1 Location: Ensure that equipment is within view and accessible for operating, inspecting, adjusting, servicing without using special tools.

END OF SECTION

1. This schedule is to be read in conjunction with the Drawings and Specification Sections.

Room No.	Floor	Base	Walls				Ceiling	Notes:
			N	E	S	W		
Basement								
001	EX	EX	EX	EX	EX	EX/CBE	EXP/GBP	New concrete housekeeping pads Paint columns
002	EX	EX	EX	EX	EX	EX	EX	New concrete housekeeping pad
003	EX	EX	EX	EX	EX	EX	EX	
004	EX	EX	EX	EX	EX	EX	EX	
005	SL/VB	EX	EX	EX/CBE	EX	EX	EX	Regrade existing soil. Provide new crawlspace vapour barrier
006	EX	EX	EX	EX	EX	EX	EX	
007	EX	EX	EX	EX	EX	EX	EX	
008	EX	EX	EX	EX	EX	EX	EX	
009	EX	EX	EX	EX	EX	EX	EX	
Main Floor								
100	EX	EX	EX	EX	EX	EX	EX	
101	EX	EX	EX	EX/CBP	EX	EX	EX	Modify ceiling as required for new ceiling fans
102	EX	EX	EX	EX	EX	EX/CBP	-	
103	EX	EX	EX	EX	EX	EX	EX	
104	EX	EX	EX	EX	EX	EX	EX	
105	EX	EX	EX	EX	EX	EX	EX	
106	EX	EX	EX	EX	EX	EX	EX	
107	EX	EX	EX	EX	EX	EX	EX	Modify ceiling as required for new mechanical transfer ducts & grilles
108	EX	EX	EX	EX	EX	EX	EX	
109	EX	EX	EXP	EXP	EXP	EXP	EXP/GBP	
110	EX	EX	EXP	EXP	EXP	EXP	EXP/GBP	
111	EX	EX	EX	EX	EX	EX	EXP/CEBP	Cement board ceiling
112	EX	EX	EXP	EXP	EXP	EXP	EXP/GBP	
113	EX	EX	EXP	EXP	EXP	EXP	EXP/GBP	
114	EX	EX	EX	EX	EX	EX	EXP/CEBP	Cement board ceiling
115	EX	EX	EXP	EXP	EXP	EXP	EXP/GBP	

Room No.	Floor	Base	Walls				Ceiling	Notes:
			N	E	S	W		
Main Floor continued								
116	EX	EX	EXP	EXP	EXP	EXP	EXP/GBP	
117	EX	EX	EX	EX	EX	EX	EXP/CEBP	Cement board ceiling
118	EX	EX	EX	EX	EX	EX	EX	
119	EX	EX	EX	EX	EX	EX	EX	
120	-	-	-	-	-	-	-	
121	EX	EX	EX	EX	EX	EX	EX	
122	EX	EX	EX	EX	EX	EX	EX	
123	EX	EX	EX	EX	EX	EX	EX	
124	EX	EX	EX	EX	EX	EX	EX	
125	EX	EX	EX	EX	EX	EX	EX	
126	EX	EX	EX	EX	EX	EX	EX	
127	EX	EX	EX	EX	EX	EX	EX	
128	EX	EX	EX	EX	EX	EX	EX	
129	EX	EX	EX	EX	EX	EX	EX	
130	EX	EX	EX	EX	EX	EX	EX	
Second Floor								
201	EX	EX	EX	EX	EX	EX	EX/ATC	Remove and replace ceiling tile as required for mechanical work
202	EX	EX	EX	EX	EX	EX	EX	
203	EX	EX	EX	EX	EX	EX	EX	
204	EX	EX	EX	EX	EX	EX	EX	
205	EX	EX	EX	EX	EX	EX	EX	
206	EX	EX	EX	EX	EX	EX	EX	
207	EX	EX	EX	EX	EX	EX	EX	
208	EX	EX	EX	EX	EX	EX	EX	

List of Abbreviations:

FLOORS		**WALL**	
EX	EXISTING TO REMAIN	CBE	CONCRETE BLOCK - EXPOSED
SL	SOIL	CBP	CONCRETE BLOCK - PAINT
VB	VAPOUR BARRIER (07 26 00)	EX	EXISTING TO REMAIN
		EXP	EXISTING - PAINT
		GBP	GYPSUM BOARD – PAINT
BASE		**CEILING**	
CBP	CONCRETE BLOCK - PAINT	ACT	ACOUSTICAL CEILING TILE
EX	EXISTING TO REMAIN	CEBP	CEMENT BOARD - PAINT
RB	RESILIENT BASE	EX	EXISTING TO REMAIN
		EXP	EXISTING - PAINT
		GBP	GYPSUM BOARD – PAINT
	GENERAL NOTE		
	PATCH, REPAIR AND PAINT ALL WALLS AND CEILINGS THROUGHOUT WHERE THEY ARE AFFECTED BY NEW WORK. REFER ALSO TO STRUCTURAL, MECHANICAL, AND ELECTRICAL DRAWINGS FOR COMPLETE SCOPE OF WORK.		

Part 1 General

1.1 REFERENCE STANDARDS

.1 ASTM International

.1 ASTM C475-02(2007), Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board.

.2 ASTM C840-08, Standard Specification for Application and Finishing of Gypsum Board.

.3 ASTM C954-07, 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.

.4 ASTM C1047-09, Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base.

.5 ASTM C1280-99, Standard Specification for Application of Gypsum Sheathing.

.6 ASTM C1178/C1178M-08, Standard Specification for Glass Mat Water-Resistant Gypsum Backing Board.

.7 ASTM C1325-08a, Standard Specification for Non-Asbestos Fiber-Mat Reinforced Cementitious Backer Units

.8 ASTM C1396/C1396M-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 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-51.34-M86(R1988), Vapour Barrier, Polyethylene Sheet for Use in Building Construction.

.4 Underwriters' Laboratories of Canada (ULC)

.1 CAN/ULC-S102-07, Standard Method of Test of Surface Burning Characteristics of Building Materials and Assemblies.

1.2 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 gypsum board assemblies 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 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 gypsum board assemblies materials level indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect gypsum board 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.

1.4 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 minimum after 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 C1396/C1396M Type X, 12.7 and 16 mm thick, regular, 12.7 and 16 mm thick, 1200 mm wide x maximum practical length, ends square cut, edges bevelled and squared.

.2 Moisture and Mould Resistant board: to ASTM C1396/C1396M, Type X, 12.7 and 16 mm thick.

.3 Glass mat water-resistant gypsum backing board: to ASTM C1178/C1178M.

.4 Cement board: to ASTM C1325, 12.7 and 16 mm thick.

.5 Metal furring runners, hangers, tie wires, inserts, and anchors required for installation to ASTM C841.

.6 Drywall furring channels: 0.5 mm core thickness galvanized steel channels for screw attachment of gypsum board.

.7 Steel drill screws: to ASTM C1002.

.8 Laminating compound: as recommended by manufacturer, asbestos-free.

.9 Casing beads, corner beads, control joints and edge trim: to ASTM C1047, metal, zinc-coated by electrolytic process, 0.5 mm base thickness, perforated flanges, one piece length per location.

.10 Sealants: in accordance with Section 07 92 00 - Joint Sealants.

.1 Acoustic sealant: in accordance with Section 07 92 00 - Joint Sealants.

.11 Polyethylene: to CAN/CGSB-51.34, Type 2.

.12 Joint compound: to ASTM C475, asbestos-free.

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 in presence of Departmental Representative.

.2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 ERECTION

.1 Do application and finishing of gypsum board to ASTM C840 except where specified otherwise.

.2 Do application of gypsum sheathing to ASTM C1280.

.3 Erect hangers and runner channels for suspended gypsum board ceilings to ASTM C840 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, and grilles.

.7 Furr for gypsum board faced vertical bulkheads within and at termination of ceilings.

.8 Furr above suspended ceilings for gypsum board fire and sound stops and to form plenum areas as indicated.

.9 Install wall furring for gypsum board wall finishes to ASTM C840, except where specified otherwise.

.10 Furr openings and around built-in equipment, cabinets, and access panels.

.11 Furr duct shafts, beams, columns, pipes and exposed services where indicated.

.12 Erect drywall resilient furring transversely across studs, spaced maximum 600 mm on centre and not more than 150 mm from ceiling/wall juncture. Secure to each support with 25 mm drywall screw.

3.3 APPLICATION

.1 Apply gypsum board after anchors, blocking, sound attenuation, electrical and mechanical work have been approved.

.2 Apply double and single layer gypsum board to metal furring or framing using screw fasteners, for second layer, screw fasteners. 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 C840.

.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 250 mm with base layer joints.

.3 Apply water-resistant gypsum board in all areas where moisture will be present, such as washrooms, shower area, janitor rooms, etc. Apply water-resistant sealant to edges, ends, cut-outs which expose gypsum core and to fastener heads.

.4 Install ceiling boards in direction that will minimize number of end-butt joints. Stagger end joints at least 250 mm.

.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 150 mm 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 Locate control joints at changes in substrate construction at 10 m spacing on long corridor runs and at approximate 15 m spacing on ceilings.

.5 Install control joints straight and true.

.6 Install access doors to electrical and mechanical fixtures specified in respective sections.

.1 Rigidly secure frames to furring or framing systems.

.7 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.

.8 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 0: no tapping, finishing or accessories required.

.2 Level 1: embed tape for joints and interior angles in joint compound. Surfaces to be free of excess joint compound; tool marks and ridges are acceptable.

.3 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.

.4 Level 3: embed tape for joints and interior angles in joint compound and apply two separate coats of joint compound over joints, angles, fastener heads and accessories; surfaces smooth and free of tool marks and ridges.

.5 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.

.6 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.

.9 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.

.10 Fill screw head depressions with joint and taping compounds to bring flush with adjacent surface of gypsum board, to be invisible after surface finish is completed.

.11 Sand lightly to remove burred edges and other imperfections. Avoid sanding adjacent surface of board.

.12 Completed installation to be smooth, level or plumb, free from waves and other defects and ready for surface finish.

.13 Apply one coat of white primer sealer over surface to be textured. When dry apply textured finish in accordance with manufacturer's instructions.

.14 Mix joint compound slightly thinner than for joint taping.

.15 Apply thin coat to entire surface using trowel or drywall broad knife to fill surface texture differences, variations or tool marks.

.16 Allow skim coat to dry completely.

.17 Remove ridges by light sanding or wiping with damp cloth.

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.

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

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 Levels of finish: interior partitions, ceilings, and bulkheads.

.1 Level 1:

.1 Plenums above suspended ceilings, inside of duct shafts, and other gypsum board wall areas not exposed to view.

.2 Level 4:

.1 Vertical surfaces (walls and partitions) exposed to view.

.2 Ceilings and bulkheads (underside and face) exposed to view

.3 Level 5:

.1 Cement board ceilings exposed to view.

.2 As noted in drawings.

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

.1 Environmental Protection Agency (EPA)

.1 Test Method for Measuring Total Volatile Organic Compound Content of Consumer Products, EPA Method 24 - Surface Coatings.

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

.1 Material Safety Data Sheets (MSDS).

.3 Master Painters Institute (MPI)

.1 The Master Painters Institute (MPI)/Architectural Painting Specification Manual (ASM) - current edition.

.4 National Research Council Canada (NRC)

.1 National Fire Code of Canada 2015 (NFC).

1.2 ADMINISTRATIVE REQUIREMENTS

.1 Scheduling:

.1 Submit work schedule for various stages of painting to Departmental Representative for review. Provide schedule minimum of 72 hours in advance of proposed operations.

.2 Obtain written authorization from Departmental Representative for changes in work schedule.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

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

.2 Submit 1 copy of WHMIS MSDS in accordance with Section 01 35 29.06 - Health and Safety Requirements.

.3 Confirm products to be used are in MPI’s approved product list.

.3 Upon completion, provide 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).

.4 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, coating, and special finish with specified paint or coating in colours, gloss/sheen and textures required to MPI Architectural Painting Specification Manual standards submitted on following substrate materials:

.3 Retain reviewed samples on-site to demonstrate acceptable standard of quality for appropriate on-site surface.

.5 Manufacturer's Instructions:

.1 Provide manufacturer's installation and application instructions.

1.4 CLOSEOUT SUBMITTALS

.1 Provide in accordance with Section 01 78 00 - Closeout Submittals.

.2 Operation and Maintenance Data: Provide operation and maintenance data for painting materials for incorporation into manual.

.3 Include:

.1 Product name, type and use.

.2 Manufacturer's product number.

.3 Colour numbers.

.4 MPI Environmentally Friendly classification system rating.

1.5 MAINTENANCE MATERIAL SUBMITTALS

.1 Extra Stock Materials:

.1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.

.2 Submit 1 four litre can of each type and colour of finish coating and primer. Identify colour and paint type in relation to established colour schedule and finish system.

1.6 QUALITY ASSURANCE

.1 Qualifications:

.1 Contractor: to have a minimum of 5 years proven satisfactory experience. When requested, provide list of last 3 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 interior 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 Standard of Acceptance:

.1 Walls: no defects visible from a distance of 1000 mm at 90 degrees to surface.

.2 Final coat to exhibit uniformity of colour and uniformity of sheen across full surface area.

1.7 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.1 Labels: to indicate:

.1 Type of paint or coating.

.2 Compliance with applicable standard.

.3 Colour number in accordance with established colour schedule.

.3 Storage and Handling Requirements:

.1 Store materials indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Observe manufacturer's recommendations for storage and handling.

.3 Store materials and supplies away from heat generating devices.

.4 Store materials and equipment in well ventilated area with temperature range 7 degrees C to 30 degrees C.

.5 Keep areas used for storage, cleaning and preparation, clean and orderly to approval of Departmental Representative. After completion of operations, return areas to clean condition to approval of Departmental Representative.

.6 Remove paint materials from storage only in quantities required for same day use.

.7 Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling storage, and disposal of hazardous materials.

.8 Fire Safety Requirements:

.1 Provide one 9 kg Type ABC 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 (NFC).

1.8 SITE CONDITIONS

.1 Ambient Conditions:

.1 Heating, Ventilation and Lighting:

.1 Ventilate enclosed spaces in accordance with Section 01 51 00 - Temporary Utilities.

.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 7 days after completion of application of paint.

.4 Co-ordinate use of existing ventilation system with 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.

.7 Temperature, Humidity and Substrate Moisture Content Levels:

.1 Unless pre-approved written approval by Specifying body and 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 12% for concrete and masonry (clay and concrete brick/block). Allow new concrete and masonry to cure minimum of 28 days.

.2 15% for hard wood.

.3 17% for soft wood.

.4 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.

.8 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.

.9 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 Departmental Representative such that painted surfaces will have dried and cured sufficiently before occupants are affected.

Part 2 Products

2.1 PERFORMANCE REQUIREMENTS

.1 Environmental Performance Requirements:

.1 Provide paint products meeting MPI "Environmentally Friendly" E3 or E2 ratings based on VOC (EPA Method 24) content levels.

2.2 MATERIALS

.1 Only 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 Only qualified products with E3 or E2 "Environmentally Friendly" rating are acceptable for use on this project.

.4 Conform to latest MPI requirements for interior painting work including preparation and priming.

.5 Provide paint products meeting MPI "Environmentally Friendly" E3 and E2 ratings based on VOC (EPA Method 24) content levels.

.6 Use MPI listed materials having minimum E2 or E3 rating where indoor air quality (odour) requirements exist.

.7 Paints, coatings, adhesives, solvents, cleaners, lubricants, and other fluids to be:

.1 Water-based.

.2 Non-flammable.

.3 Be manufactured without compounds which contribute to ozone depletion in the upper atmosphere.

.4 Be manufactured without compounds which contribute to smog in the lower atmosphere.

.5 Do not contain methylene chloride, chlorinated hydrocarbons, and toxic metal pigments.

.8 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.

.9 Water-borne paints and stains, recycled water-borne surface coatings and water borne varnishes to meet minimum "Environmentally Friendly" E2 rating.

2.3 COLOURS

.1 Departmental Representative will provide Colour Schedule after Contract award.

.2 Colour schedule will be based upon selection of 4 base colours and 3 accent colours. No more than 7 colours will be selected for entire project and no more than 2 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 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.

.6 For deep and ultra deep colours; 4 coats may be required.

2.4 MIXING AND TINTING

.1 Perform colour tinting operations prior to delivery of paint to site. Obtain written approval from Departmental Representative for tinting of painting materials.

.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. Strain as necessary.

2.5 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 Gloss level ratings of painted surfaces herein and as noted on Finish Schedule.

2.6 INTERIOR PAINTING SYSTEMS

.1 Concrete masonry units: smooth and split face block and brick:

.1 INT 4.2D - High performance architectural latex (over latex block filler) Gloss Level 5 - Semi-Gloss Finish. Premium grade, 1 coat primer, two top coats.

.2 Structural steel and metal fabrications: columns, beams, joists:

.1 INT 5.1Q – Latex (over Q.D. alkyd primer) Gloss Level 5 - Semi-Gloss Finish. Premium grade, 1 coat primer, two top coats.

.3 Galvanized metal: doors, frames, railings, misc. steel, pipes, overhead decking, and ducts.

.1 INT 5.3M - High performance architectural latex (over W.B. galvanized primer) Gloss Level 5 - Semi-Gloss Finish. Premium grade, 1 coat primer, two top coats.

.4 Plaster and gypsum board: gypsum wallboard, drywall, "sheet rock type material", and textured finishes:

.1 INT 9.2B - High performance architectural latex (over latex primer/sealer) Gloss Level 5 - Semi-Gloss Finish. Premium grade, 1 coat primer, two top coats.

.2 INT 9.2F - Epoxy-Modified Latex (tile-like), (over latex primer/sealer). Gloss Level 5 - Semi-Gloss Finish. Premium grade, 1 coat primer, two top coats.

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 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable to be painted in accordance with manufacturer's written instructions.

.1 Visually inspect substrate in presence of Departmental Representative.

.2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

.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 Concrete Block: 12%.

.4 Hard Wood: 15%.

.5 Soft Wood: 17%.

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 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, millwork, and 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 Departmental Representative.

.3 Clean and prepare surfaces in accordance with MPI Architectural Painting Specification Manual requirements. Refer to MPI Manual regarding specific requirements and as follows:

.1 Remove dust, dirt, and other surface debris by wiping with dry, clean cloths.

.2 Wash surfaces with a biodegradable detergent 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 pre-treatment as soon as possible after cleaning and before deterioration occurs.

.5 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.

.6 Carried out during shop priming: 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 and vacuum cleaning.

.7 Touch up of shop primers with primer as specified.

.8 Do not apply paint until prepared surfaces have been accepted by Departmental Representative.

3.5 APPLICATION

.1 Method of application to be as approved by Departmental Representative. Apply paint by air sprayer, brush, and roller. 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 projecting ledges.

.9 Finish top, bottom, edges and cutouts of doors after fitting as specified for door surfaces.

.10 Wood, drywall, plaster, stucco, concrete, concrete masonry units and brick; if sprayed, must be back rolled.

3.6 MECHANICAL/ELECTRICAL EQUIPMENT

.1 Paint finished area exposed conduits, piping, hangers, ductwork and other mechanical and electrical equipment with colour and finish to match adjacent surfaces, except as indicated.

.2 Other unfinished areas: leave exposed conduits, piping, hangers, ductwork and other mechanical and electrical equipment in original finish and touch up scratches and marks.

.3 Do not paint over nameplates.

.4 Keep sprinkler heads free of paint.

.5 Paint disconnect switches for fire alarm system and exit light systems in red enamel.

.6 Paint natural gas piping yellow.

.7 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.

.8 Do not paint interior transformers and substation equipment.

3.7 FIELD QUALITY CONTROL

.1 Where "special" painting, coating or decorating system applications (i.e. elastomeric coatings) or non-MPI listed products or systems are to be used, paint or coating manufacturer will provide as part of this 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 Departmental Representative.

.2 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 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 Field inspection of painting operations to be carried out be Consultant and Departmental Representative.

.4 Advise Departmental Representative when surfaces and applied coating is ready for inspection. Do not proceed with subsequent coats until previous coat has been approved.

.5 Cooperate with inspection firm and provide access to areas of 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 reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

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 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 Departmental Representative.

END OF SECTION

1 General

1.1 REFERENCES

.1 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.

.2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
- .1 Material Safety Data Sheets (MSDS).

.3 National Fire Protection Association (NFPA)
- .1 NFPA 10-2006, Standard for Portable Fire Extinguishers.

1.2 SUBMITTALS

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

.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 in accordance with Section 02 81 01 - Hazardous Materials.

.3 Provide shop drawings.

.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 incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

2 Products

2.1 MULTI-PURPOSE DRY CHEMICAL EXTINGUISHERS

.1 Cartridge operated type with hose and shut-off nozzle, ULC labelled for A, B and C class protection.
- .1 Sizes: Refer to equipment schedule.

2.2 CARBON DIOXIDE

.1 Extinguishers Insulated handle, hose and horn discharge assembly, self-closing lever or squeeze-grip operation, fully charged, ULC labelled for B and C class protection.
- .1 Sizes: Refer to equipment schedule.

2.3 EXTINGUISHER BRACKETS

.1 Type recommended by extinguisher manufacturer.

2.4 CABINETS

.1 Semi-recessed, as indicated, constructed of 1.6 mm thick steel, 180 degrees opening door of 2.5 mm thick steel with latching device.

.2 Cabinet to maintain fire resistive rating of construction in which they occur.

.3 Cabinet door: with 5 mm full glass panel.

.4 Finish:
- .1 Tub: prime coated.
- .2 Door and frame: No.4 satin finish stainless steel.

2.5 IDENTIFICATION

.1 Identify extinguishers in accordance with recommendations of ANSI/NFPA 10.

.2 Attach bilingual label to extinguishers, indicating month and year of installation. Provide space for service dates.

2.6 FIRE SAFETY BLANKETS

.1 1800 x 1800 mm of silicone coated fibre glass in metal container.

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 or mount extinguishers in cabinets or on brackets as indicated on drawings and / or required by authority having jurisdiction.

.2 Install fire safety blankets as indicated.

END OF SECTION

Part 1 - General

1.1 RELATED WORK

.1	Access Doors	Division 08
.2	Fire Extinguishers	Division 10
.3	Fire Suppression	Division 21
.4	Plumbing	Division 22
.5	Heating, Ventilating and Air Conditioning	Division 23
.6	Integrated Automation	Division 25

1.2 INTENT

.1 Provide a complete and fully operational mechanical system with facilities and services to meet requirements described herein and in complete accord with applicable codes and ordinances.

.2 Contract documents for mechanical scope are diagrammatic and approximately to scale unless detailed otherwise. They establish scope, material and installation quality and are not detailed installation instructions.

.3 Should any discrepancies occur on drawings or in specifications which leaves doubt as to the intent and meaning of the drawings and specifications, obtain a ruling from the designer before submitting tender. If this is not done, it will be assumed that the most expensive alternate has been allowed for.

.4 Follow manufacturer's recommended installation details and procedures for equipment supplemented by details given herein and on plans subject to approval of the Departmental Representative.

.5 Install equipment generally in locations and routes shown, close to building structure with minimum interference with other services or free space. Remove and replace improperly installed equipment to satisfaction of the Departmental Representative at no extra cost.

.6 Provide labour and materials required to install, test and place into operation complete mechanical system. Provide additional material for modifications required to correct minor job conflictions.

.7 Connect to equipment furnished in other Sections and by Departmental Representative, including uncrating equipment, moving in place and installing complete, start-up and test.

1.3 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.
- .3 Store and manage hazardous materials in accordance with cepa, tdga AND Regional and Municipal Regulations.

.2 Waste Management and Disposal:
- .1 Due to location, recycling is not required. Remove from site and dispose of packaging materials at appropriate disposal facilities.

.2 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.

.3 Handle and dispose of hazardous materials in accordance with CEPA, TDGA, Regional and Municipal regulations.

.4 Provide manifests describing and listing waste created. Transport containers by approved means to licenced landfill for burial**.**

1.4 MATERIALS

.1 Replace materials or workmanship below specified quality and relocate work wrongly placed to satisfaction of the Departmental Representative.

.2 Materials and equipment installed shall be new, full weight and of the best quality specified. Use same brand or manufacturer for each specific application. Statically and dynamically balance rotating equipment for minimum vibration and low operating noise level.

.3 Each major component of equipment shall have manufacturer's name, address, catalog and serial number in a conspicuous place.

.4 Install materials and equipment in a neat and workmanlike manner by competent specialists.

1.5 CUTTING AND PATCHING

.1 Locate and provide holes and sleeves, cutting and fitting required for mechanical work. Relocate improperly located holes and sleeves at no extra cost.

.2 Drill for expansion bolts, hanger rods, brackets, and supports.

.3 Do no cutting or burning of structural members of building frame without obtaining prior written approval from the Departmental Representative.

.4 Provide openings and holes required in precast members for mechanical work. Cast holes larger than 100 mm (4") in diameter. Field-cut smaller than 100 mm (4").

.5 All patching of finished construction of building shall be performed under the sections of specifications covering these materials.

1.6 SEMI-FINAL AND FINAL INSPECTIONS

.1 Perform the following items prior to semi-final inspection.

.1 Heating and air conditioning systems capable of operation with alarm controls functional and automatic controls in operation generally, but not necessarily finally calibrated.

.2 Necessary tests on equipment made including those required by authorities and certificates of approval obtained.

.3 Rough balance of air and water systems completed.

.4 Valve tagging completed and equipment identified. Equipment and piping painted and escutcheons installed.

.5 Equipment lubricated as per manufacturer's data.

.6 Warranty forms have been mailed to manufacturer. Provide copy of original warranty for equipment which has warranty period longer than one year.

.7 Systems chemically cleaned, flushed and water treatment initiated. Provide report from manufacturer's representative to confirm status of treatment.

.8 Submit sample of Operating/Maintenance Manuals. Arrange Operating and Maintenance Instructions and submit schedule for approval.
.9 Review and ensure access doors are suitably located and equipment easily accessible including plumbing cleanouts.
.10 Have noise and vibration control devices and flexible connections inspected by manufacturer's representative and submit written report.
.11 Equipment alignment carried out by qualified millwright and certified report submitted.
.12 Check operations of plumbing systems and fixtures and ensure fixtures are solidly supported.
.13 Fan plenums cleaned, temporary filters removed and permanent filters installed.

.2 Provide declaration in writing that semi-final deficiencies and the following items have been completed prior to the final inspection:
.1 Equipment cleaned inside, outside and lubricated. Plumbing fixtures and brass cleaned.
.2 Final balancing completed and rough data of balance reports submitted.
.3 Final calibration of controls completed.

1.7 SHOP DRAWINGS

.1 Submittal procedures in accordance with Division 1.

.2 Submit materials and equipment by manufacturer, trade name and model number. Include copies of applicable brochure or catalog material. Do not assume applicable catalogues are available in the Departmental Representative's office. Maintenance and operating manuals are not suitable submittal material.

.3 Clearly mark each sheet of printed submittal material (using arrows, underlining or circling) to show particular sizes, types, model numbers, ratings, capacities and options actually being proposed. Cross out non-applicable material. Specifically note on the submittal specified features such as special tank linings, pump seals, materials or painting. Shop drawings will be rejected out of hand if contractor has not properly marked the submittal.

.4 Include dimensional data for roughing in and installation, technical data sufficient to check that equipment meets requirements of drawings and specifications, wiring, piping, and service connection data, motor sizes complete with voltage ratings and schedules as applicable.

.5 Shop drawings to show all information identified under individual product specifications and in general shall show the following:
.1 Mounting arrangements.
.2 Operating and maintenance clearances.
.3 Detailed drawings of bases, supports, and anchor bolts.
.4 Acoustical sound power data, where applicable.
.5 Points of operation on performance curves.
.6 Manufacturer to certify current model production.
.7 Certification of compliance to applicable codes.

.6 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.

1.8 OPERATING AND MAINTENANCE MANUALS

.1 Provide services of qualified and experienced personnel to prepare proper documentation and to instruct the Operating Staff in the operation and preventative maintenance of each piece of equipment and system supplied and installed. Complete and turn over documentation prior to final inspection.

.2 Provide 215 mm x 280 mm (8-1/2" x 11") capacity extension type catalogue binders bound with heavy fabric, hot stamped in gold lettering front and spine. Refer to Division 1 for colour and quantity.

.3 Each binder shall be indexed according to the following indexing system:

.4 Tab-1.0 Mechanical Systems: Title page with clear plastic protection cover.

.5 Tab-1.1 List of Mechanical Drawings.

.6 Tab-1.2 Description of Systems: Provide complete description of each system. Include detailed system description and components comprising that system, explanation of how each component interfaces with others to complete the system, location of each thermostat, controller or operating setpoints. Refer to 21 05 01, 1.1.5 for additional required information.

.7 Tab-1.3 Operation Division: Provide complete and detailed operation of each major component. Include how to energize and exact location of switches and controls, how the component interfaces with other components, operation of controls, including the operational sequence, operational characteristic changes for summer or winter operation, and how to accomplish the changeover, complete troubleshooting sequence, setpoints cannot be maintained, and safeguards to check if equipment goes off line. Refer to 21 05 01, 1.1.5 for additional required information.

.8 Tab-1.4 Maintenance and Lubrication Division: Provide detailed preventative maintenance and lubrication schedule for each of the major components to include daily, weekly, monthly, semi-annual and yearly checks and tasks. Explain how to proceed with each task required for each piece of typical equipment such as bearings, drives, motors and filters. Compile this information for each typical piece of equipment separate from the shop drawings section. Refer to 21 0-5 01, 1.1.5 for additional required information.

.9 Tab-1.5 List of Equipment Suppliers and Contractors: Provide complete list of equipment suppliers and contractors, including address and telephone number. Outline procedures for purchasing parts and equipment. Include steps to take in order to purchase new parts.

.10 Tab-Certification (2.0, 2.1, etc.): Include copy of test data degreasing and flushing of heating system analysis of system water taken at time system was put into operation, hydrostatic or air tests performed on piping systems, equipment alignment certificates, copy of balancing data for air and water systems, copy of valve tag identification and pipe colour code, inspection approval certificates for plumbing system, hot air heating and ventilation systems and fire damper schedule.

.11 Tab-Shop Drawings and Maintenance Bulletins (3.0, 3.1, etc.): Provide materials as received in compliance with clause "Shop Drawings".

.12 The divider tabs shall be laminated mylar plastic, and coloured according to section. The colouring is as follows: Mechanical Systems - 1.0 - 1.5 - Orange, Certification - 2.0 - 2.4 - Green, Shop Drawings and Maintenance - 3.0 - 3.17 - Yellow. Plastic tabs with typed insertions will not be accepted.

.13 Submit documents to the Departmental Representative for approval prior to being turned over to the Departmental Representative. At completion of project, hold a Seminar to instruct the Operating Staff in operation and preventative maintenance of each piece of equipment and system supplied and installed.

.14 Provide one digital copy on compact disk of the final operation and maintenance manual in each of the manuals (six in total).

1.9 RECORD DRAWINGS

.1 Refer to Division 1.

.2 Keep on site, an extra set of white prints and specifications recording changes and deviations daily. Allow for the work required to transfer site changes to Departmental Representative's original tracings and for providing the Departmental Representative with set of sepias marked "Record Drawings". Co-ordinate through Departmental Representative's office. Addenda corrections and Departmental Representative initiated construction changes to original tracings will be the responsibility of the Departmental Representative.

.3 Contractor shall utilize a different colour water proof ink for each service.

.4 Contractor shall ensure that white prints are available on site for reference purposes and inspection.

.5 Record drawings shall identify location of fire dampers, major control lines, access doors, tagged valves and actual room names or numbers.

.6 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).

.7 Submit to Departmental Representative for approval and make corrections as directed.

1.10 IDENTIFICATION

.1 Refer to Section 23 05 54, Mechanical Identification.

1.11 TEMPORARY FACILITIES

.1 Refer to General Requirements - Division 01.

1.12 SUPERVISION

.1 Refer to General Requirements - Division 01.

1.13 TEMPORARY HEAT AND/OR VENTILATION

.1 Refer to General Requirements - Division 01.

.2 Do not use the permanent system for temporary heating or ventilation purposes, without written permission from the Departmental Representative.

.3 Thoroughly clean and overhaul permanent equipment used during the construction period, replacing worn or damaged parts. Exchange equipment or components operating improperly at final inspection with new equipment or components.

.4 Use of permanent systems for temporary heat shall not modify the terms of warranty.

.5 Operate heating systems under conditions which ensure no temporary or permanent damage. Operate fans at proper resistance with filters installed. Change filters at regular intervals. Operate with proper safety devices and controls installed and fully operational. Operate water systems with proper water treatment.

.6 Where air systems are used during temporary heating, provide filter media on return and exhaust air outlets. Clean duct systems which have become dirty.

.7 When permanent systems are used for temporary heat, provide alarm indicating system failure. Connect alarm to independent alarm company system.

.8 Replace mechanical seals in pumps used for temporary heating purposes with new mechanical seals, regardless of condition.

.9 Provide one year warranty from date of Substantial Completion.

1.14 EQUIPMENT PROTECTION AND CLEAN-UP

.1 Protect equipment and materials in storage on site, during and after installation until final acceptance. Leave factory covers in place and take special precautions to prevent entry of foreign material into working parts of piping and duct systems.

.2 Protect equipment with polyethylene covers and crates.

.3 Operate, drain and flush out bearings and refill with new change of oil, before final acceptance.

.4 Thoroughly clean piping, ducts and equipment of dirt, cuttings and other foreign substances.

.5 Protect bearings and shafts during installation. Grease shafts and sheaves to prevent corrosion. Supply and install necessary extended nipples for lubrication purposes.

1.15 TEMPORARY OR TRIAL USAGE

.1 Temporary or trial usage by the Departmental Representative of mechanical equipment supplied under contract and claimed complete before final acceptance shall not represent acceptance.

.2 Repair or replace permanent equipment used temporarily.

.3 Take responsibility for damage caused by defective materials or workmanship during temporary or trial usage.

1.16 ELECTRICAL MOTORS

.1 Supply mechanical equipment complete with electrical motors.

.2 Provide NEMA premium efficiency motors to CEMA and CSA standards for hard, continuous service, designed to limit temperature rise to 40 deg.C (100 deg.F) for open housing and 50 deg.C (125 deg.F) for drip proof housing, and operate at 1800 RPM unless otherwise specified.

.3 Motors shall have ball or roller type bearings with grease lubrication fittings.

.4 Motors used in conjunction with variable frequency drives shall be suitable for inverter duty, as specified by NEMA MGI-1993, Part 31. Refer to electrical specifications for inverters.

.5 Refer to electrical specification for voltage, phase and cycle.

1.17 ACCESS DOORS

.1 Supply access doors for furred ceilings, ducts or spaces for servicing equipment and accessories or for inspection of safety, operating and fire devices for installation under section erecting the walls or ceilings.

.2 Provide access doors in ductwork in accordance with Section 23 33 00 - Air Duct Accessories

.3 Provide service access door in accordance with Section 08 31 00.01 - Access Doors - Mechanical.

1.18 WASTE MANAGEMENT AND DISPOSAL

.1 Packing, shipping, handling and unloading:
- .1 Deliver, store and handle all mechanical components in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Deliver, store and handle all materials in accordance with manufacturer’s written instructions.
- .3 Store and manage hazardous materials in accordance with cepa, tdga AND Regional and Municipal Regulations.

.2 Waste Management and Disposal:
- .1 Remove from site and dispose of packaging materials at appropriate recycling facilities.
- .2 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.
- .3 Divert unused metal materials from landfill to metal recycling facility as approved by Departmental Representative.
- .4 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.
- .5 Fold up metal and plastic banding, flatten and place in designated area for recycling.
- .6 Handle and dispose of hazardous materials in accordance with CEPA, TDGA, Regional and Municipal regulations.
- .7 Disposal of asbestos waste generated by removal activities must comply with Federal, Provincial, Territorial and Municipal regulations. Dispose of asbestos waste in sealed double thickness 6 ml bags or leak proof drums. Label containers with appropriate warning labels.
- .8 Provide manifests describing and listing waste created. Transport containers by approved means to licenced landfill for burial.

1.19 COMMISSIONING

.1 Mechanical Contractor is responsible to ensure all mechanical systems are fully commissioned and detailed commissioning forms are completed and reviewed with Departmental Representative. Refer to Sections 01 91 13 General Commissioning (Cx) Requirements, 01 91 33 Commissioning Forms, 01 91 41 Commissioning Training for details on Mechanical Contractors responsibilities in addition to all commissioning activities identified under Division 21, 22, 23 and 25. As part of the commissioning process, the contractor is required to complete the Site Standard Equipment Labelling and Tracking sheets for the equipment supplied as part of the project, the tracking sheets will be provided by the owner.

1.20 INSTRUCTION OF OPERATING STAFF

.1 Provide trained personnel to instruct operating staff on maintenance, adjustment and operation of mechanical equipment. Instruct staff on changes or modification in equipment made under terms of guarantee.

.2 Supply tools, equipment and personnel to demonstrate and instruct operating and maintenance personnel in operating, controlling, adjusting, trouble-shooting and servicing of all systems and equipment during regular work hours, prior to acceptance.

.3 Where specified elsewhere in Mechanical manufacturers to provide demonstrations and instructions.

.4 Use operation and maintenance data manual for instruction purposes. On completion of instruction, turn one manual over to chief operating personnel, the balance to Departmental Representative.

.5 Record every instruction and training session on digital video.

.6 Time allocated for Instruction:

Chemical	One (1) hour instruction plus Monthly visits
Fire Protection	One (1) hour instruction
Pumps	One-half (1/2) hour instruction per pump type.
Tanks	One-half (1/2) hour instruction
Fans	One (1) hours instruction
AHU	One (1) hours instruction
Heat Exchanger	Two (2) hours instruction
Controls	Total training to be 40 hours comprised of instruction time and troubleshooting. Each and every formal training session shall be recorded on film. Training to be broken out as follows:

.1 Two (2) sessions lasting four (4) hours each (8 hours in total) before substantial completion. Each session to cover same material to different sets of trainees.

.2 Two (2) sessions lasting four (4) hours each (8 hours in total) after Project Completion. Each session to cover same material to different sets of trainees. These sessions to cover any remaining material, review as-built conditions, any modifications made since initial training and to address field questions from first session.

.3 One four (4) hour follow up session to all trainees after two months of operation. Follow up session to cover all questions/concerns raised by operating staff.

.4 All remaining time (20 hours) to be allocated to trouble shooting issues and addressing questions from operators that arise during first year of operation.

1.21 SUBSTANTIAL COMPLETION

.1 The mechanical portion of the project shall be deemed substantially complete when ALL mechanical systems are operational as designed. In addition, the air and/or water balance must be completed with the report submitted and approved by the Departmental Representative and the temperature control system must be complete, as designed, operational, with all control components calibrated and the maintenance manuals in final form must be submitted. The date will be established by the Departmental Representative and will set the date for the start of the one (1) year warranty on all mechanical systems.

1.22 EXCESSIVE ADMINISTRATION

.1 Following the "Substantial Completion" Inspection a "Final" Inspection will be conducted and a follow up inspection will be conducted to "check off" all outstanding mechanical deficiencies.

.2 If the mechanical portion of the project is not 100 percent complete at the time of the deficiency “checkoff” inspection, the cost of the failed deficiency “check-off” inspection and any and all additional inspections will be back charged directly to the Mechanical Contractor.

.3 The cost of each excessive inspection will be $750.00 plus travel, and will be deducted directly from the total Mechanical Contract amount.

.4 If the contractor fails the deficiency “checkoff” inspection, no additional money will be released and a subsequent inspection will be scheduled when the Contractor re-verifies that they are 100% complete.

.5 This process will repeat until the contractor can demonstrate that the project is 100% complete with all deficiencies rectified.

1.23 ALTERNATE AND SEPARATE PRICES

.1 Referenced specification sections and drawings contain pertinent requirements for materials and methods to achieve work described herein.

.2 Coordinate pertinent related work and modify surrounding work as required to complete project under each alternate designated.

.3 Alternate products may vary in operation or construction, but shall meet or exceed the requirements of the specifications, drawings and the specified equipment for performance capacities, controllability and equipment options.

.4 Revisions required to adapt equipment other than that specified shall be made without extra charge to the Departmental Representative.

1.24 ALTERNATE MATERIALS & EQUIPMENT

.1 The design is based on the materials and equipment as specified. Any alternate materials or equipment that meet or exceed the performance, quality and design intent of that specified will be accepted unless specifically noted otherwise under this article.

.2 If alternate material or equipment will alter the design intent, make proposals to supply said materials or equipment in writing to the Departmental Representative at least ten working days prior to closing date of tender for Mechanical Trade. Any material or equipment that alters the design intent must be formally approved to be accepted.

.3 All proposed equipment is subject to the requirements of the drawings and specifications. Revisions required to adapt equipment other than that specified shall be made without extra charge to the contract. All suppliers, except those specified, shall guarantee in writing that their individual proposed products meet or exceed the performance and quality of specified products. If the departmental representative determines at any time that the equipment or material being supplied does not meet or exceed the performance, quality or design intent of that being specified, the contractor shall replace the article in question with a suitable product at the contractors expense.

.4 The following products shall be supplied as specified, there is no other products/ manufacturers that will be accepted:

.1 Controls shall be an extension of the existing front end controls at the Central Heating Plan (either Andover or Honeywell)

.2 Any other products specifically noted to be supplied as specified.

1.25 PRESSURE VESSELS

.1 In accordance with provincial regulations, Contractor must have a valid Contractor's licence issued by the provincial authority (TSASK) in order to construct, install, alter or repair a boiler, pressure vessel, fitting, pressure piping system or refrigeration plant governed by the authority.

.2 Contractor must have a Quality Control manual registered with the provincial authority.

.3 The Contractor shall have welding procedures registered with the provincial authority in accordance with provincial regulations and post copies of the procedures on site.

.4 The Contractor shall fill out and submit to the Technical Safety Authority of Saskatchewan (TSASK) all required forms pertaining to boiler and pressure vessel removal, alteration or installation. The Contractor shall communicate and coordinate with the Owner to ensure that all required forms are filled out and submitted to TSASK. The Contractor shall verify with TSASK that all forms were received by them accordingly. An installation or repair/alteration permit shall be filled out fully and appropriately by the contractor for each pressure vessel that is not exempt according to TSASK. Pressure vessels include boilers, expansion tanks, hydraulic/air/dirt separators, etc. This information shall be included in the maintenance manuals. The contractor shall include in the project for all necessary and appropriate inspection and licensing fees required by, but not limited to, TSASK requirements

Part 2 - Materials

2.1 NOT USED

.1 Not Used

Part 3 - Execution

3.1 NOT USED

.1 Not Used.

END OF SECTION

1 General

1.1 REFERENCES

.1 Federal Sprinkler Standard, FCC#403 - Sprinkler Systems.

.2 American National Standards Institute/National Fire Prevention Association (ANSI/NFPA)
- .1 ANSI/NFPA 13- 2013, Installation of Sprinkler Systems.

.3 Underwriters Laboratories of Canada (ULC)
- .1 ULC S543- 1984, Internal Lug Quick Connect Couplings for Fire Hose.

1.2 SHOP DRAWINGS AND PRODUCT DATA

.1 Submit shop drawings and product data in accordance with Section 01 33 00 - Submittal Procedures and in accordance with ANSI/NFPA 13, working plans and design requirements.

.2 Sprinklers shall be referred to on drawings, submittals and other documentation, by the sprinkler identification or model number as specifically published in the appropriate agency listing or approval. Trade names or other abbreviated designations shall not be allowed.

1.3 ENGINEERING DESIGN CRITERIA

.1 Design system in accordance with required and advisory provisions of ANSI/NFPA 13, using following parameters:
- .1 Hazard:
  - .1 To suit occupancy as indicated.
- .2 Pipe size and layout:
  - .1 Hydraulic design.
  - .2 Sprinkler head layout: to ANSI/NFPA 13.
- .3 Water supply:
  - .1 Conduct flow and pressure test of water supply in vicinity of project to obtain criteria for bases of design in accordance with ANSI/NFPA 13.Base design for bidding in accordance with the following:The existing sprinkler system design calculations.
- .4 Zoning:
  - .1 As per existing zoning.

.2 Include with each system materials, accessories, and equipment inside and outside building to provide each system complete and ready for use.

.3 Design and provide each system to give full consideration to blind spaces, piping, electrical equipment, ducts, and other construction and equipment in accordance with detailed shop drawings

.4 Locate sprinkler heads in consistent pattern with ceiling grid, lights, and air supply diffusers.

.5 Devices and equipment for fire protection service: ULC approved for use in wet pipe sprinkler systems.

.6 Location of Sprinkler Heads:
- .1 Locate heads in relation to ceiling and spacing of sprinkler heads not to exceed that permitted by NFPA 13 required hazard occupancy.
- .2 Uniformly space sprinklers on branch.

.7 Water Distribution:
- .1 Make distribution uniform throughout the area in which sprinkler heads will open.
- .2 Discharge from individual heads in hydraulically most remote area to be 100% of specified density.

.8 Density of Application of Water:
- .1 Size pipe to provide specified density when system is discharging total maximum required flow.
- .2 Sprinkler Discharge Area:
  - .1 Area: hydraulically most remote area as defined in NFPA 13.
- .3 Outside Hose Allowances:
  - .1 Include allowance in hydraulic calculations for required outside hose streams.
- .4 Friction Losses:
  - .1 Calculate losses in piping in accordance with Hazen-Williams formula with 'C' value of 120 for steel piping, 150 for copper tubing, and 140 for cement-lined ductile-iron piping.

1.4 CLOSEOUT SUBMITTALS

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

1.5 EXTRA MATERIALS

.1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.

.2 Provide spare sprinklers and tools as required by ANSI/NFPA 13.

2 Products

2.1 PIPE, FITTINGS AND VALVES

.1 Pipe:
- .1 Steel Pipe: ASTM A53 or A120, Schedule to match existing, with malleable iron or forged steel welding type fittings, screwed or welded.

.2 Fittings and joints to ANSI/NFPA 13:
- .1 Ferrous: screwed, welded, flanged or roll grooved.
  - .1 Grooved joints shall consist of two ductile iron housing segments, pressure responsive gasket, and zinc-electroplated steel bolts and nuts.

.1 Rigid Type: Housings shall be cast with offsetting angle-pattern bolt pads to provide rigidity. Couplings shall be fully installed at visual pad-to-pad offset contact. (Tongue and recess type couplings, or any coupling that requires exact gapping of bolt pads on each side of the coupling at specified torque ratings, are not allowed.) Victaulic Style 009-EZ, 005, and 07.

.2 Flexible Type: For use in locations where vibration attenuation and stress relief are required, and for seismic applications. Victaulic Style 77.

.2 Copper tube: screwed, soldered, brazed, or roll grooved.

.1 Grooved joints shall be manufactured to copper-tube dimensions, with housings cast with offsetting angle-pattern bolt pads. Victaulic Style 606.

.3 Provide welded, threaded, grooved-end type fittings into which sprinkler heads, sprinkler head riser nipples, or drop nipples are threaded.

.4 Plain-end fittings with mechanical couplings and fittings which use steel gripping devices to bite into pipe when pressure is applied will not be permitted.

.5 Rubber gasketted grooved-end pipe and fittings with mechanical couplings are permitted in pipe sizes 32 mm and larger.

.6 Fittings: ULC approved for use in wet pipe sprinkler systems.

.7 Ensure fittings, mechanical couplings, and rubber gaskets are supplied by same manufacturer.

.8 Side outlet tees using rubber gasketted fittings are not permitted.

.9 Sprinkler pipe and fittings: metal.

.3 Valves:

.1 ULC listed for fire protection service.

.2 Up to NPS 2: bronze, screwed or grooved ends, OS & Y; gate or indicating ball valve. Victaulic Style 728.

.3 NPS 2 1/2 and over: cast ductile iron, flanged or roll grooved ends, indicating butterfly valve. Victaulic Style 705W.

.4 Swing or spring-actuated check valves. Victaulic Series 717.

.5 Ball drip.

.6 Gate valves: open by counterclockwise rotation.

.7 Provide rising stem valve beneath each alarm valve in each riser when more than one alarm valve is supplied from same water supply pipe.

.8 Check valves: flanged clear opening swing-check type with flanged inspection and access cover plate for sizes 10 cm and larger.

.9 Provide gate valve in piping protecting elevator hoistways.

.4 Pipe hangers:

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

.2 Refer to 23 05 05 and 23 05 29 for more detail.

2.2 GATE VALVES

.1 50 mm and under: Bronze body, bronze trim, non-rising stem, handwheel, inside screw, double disc, solder or threaded ends. To ASTM B61.

.2 Over 50 mm: Iron body, bronze trim, rising stem, handwheel, OS&Y, double disc or wedge, flanged or grooved ends. Victaulic series 771.

.3 Valves: Bear UL label or marking, manufacturer's name and pressure rating on valve body.

2.3 GLOBE VALVES

.1 Valves Up to 50 mm: Bronze body, bronze trim, rising stem and handwheel, inside screw, renewable composition disc, solder or screwed ends, with back seating capacity. To ASTM B61.

.2 Valves Over 50 mm: Iron body, bronze trim, rising stem, handwheel, OS&Y, plug-type disc, flanged ends, renewable seat and disc.

.3 Valves: Bear UL label or marking, manufacturer's name and pressure rating on valve body.

2.4 BALL VALVES

.1 Valves 50 mm (2") nominal and under: bronze to ASTM B584, chrome-plated brass ball, stainless steel stem, with weatherproof actuator, handwheel, supervisory switches, and grooved or threaded. UL/FM approved. Victaulic Series 728.

2.5 BUTTERFLY VALVES

.1 Valves: UL/FM approved, Iron Body, Bronze disc, resilient replaceable liner seat, wafer or lug ends, extended neck, handwheel and gear drive.

.2 Weatherproof actuator with handwheel, supervisory switches.

.3 Victaulic Series 705W.

2.6 SWING CHECK VALVES

.1 Valves Up to 50 mm: Bronze swing disc, renewable disc and seat, flanged ends to ASTM B61. Design for either horizontal or vertical mounting.

.2 Valves over 50mm: UL/ULC/FM pattern, iron body, bronze mounted, regrind-renew bronze or elastomer coated ductile iron disc and seat ring, bolted cap or one-piece body, flanged or grooved ends. Design for either horizontal or vertical mounting with stainless steel spring and shaft. Victaulic Series 717

2.7 SPRINKLER VALVE

.1 Sprinkler valve shall be existing.

2.8 ABOVE GROUND PIPING SYSTEMS

.1 Provide fittings for changes in direction of piping and for connections.
- .1 Make changes in piping sizes through tapered reducing pipe fittings, bushings will not be permitted.
- .2 Perform welding in shop; field welding will not be permitted.
- .3 Conceal piping in areas with suspended ceiling and as indicated on drawings.

2.9 SPRINKLER HEADS

.1 General: to ANSI/NFPA 13 and ULC listed for fire services.

.2 New sprinkler heads to match equivalent types. Confirm on site.

.3 Temperature rating on fusible links shall suit specific hazard area with minimum of safety 10 deg.C.

.4 Sprinklers shall be listed with and bear certification marking of nationally recognized testing agency.

.5 Sprinklers with O-rings are not allowed.

.6 Provide minimum 12 mm (1/2") nominal diameter discharge orifice, except when approved by authorities having jurisdiction.

.7 Provide chrome plated finish for sprinklers in all areas: except mechanical rooms where bronze finish is acceptable.

.8 All pendant type heads to be semi-recessed where possible.

.9 All sprinkler heads located in Mechanical Rooms, Storage Rooms, IT/Equipment and other areas susceptible to damage to be complete with wire guards.

.10 Sprinkler heads shall be located in the centre half or quarter point of ceiling tiles.

.11 Provide quick response heads in all light hazard areas.

.12 Sprinkler body shall be integrally cast with hex-shaped wrench boss to reduce the risk of damage during installations.

.13 Wrenches shall be provided by the sprinkler manufacturer that directly engage the hex-shaped wrench boss integrally cast in the sprinkler body

.14 Provide security sprinkler heads in provost area.

2.10 UPRIGHT SPRINKLER HEAD

.1 Provide glass bulb type in areas indicated on drawings or specified. Bronze in mechanical rooms, chrome elsewhere.

2.11 PENDANT SPRINKLER HEAD

.1 Provide semi-recessed polished chrome glass bulb type in areas indicated on drawings or specified.

2.12 SIDE WALL SPRINKLER HEAD

.1 Provide polished chrome glass bulb type in areas indicated on drawings or specified.

2.13 WET SPRINKLER SYSTEM

.1 Modify existing wet sprinkler system to suit revised space criteria. System shall utilize the existing components including:
- .1 Alarm valve.
- .2 Indicating control valves.
- .3 Inside electric gongs and circuit closer.
- .4 Specified water gauges.
- .5 Piping and fittings.
- .6 Valves.
- .7 Hangers.
- .8 Floor and ceiling escutcheon plates.
- .9 Backflow Preventer
- .10 Outside water gongs and circuit closer (this is required by authority)
- .11 Outside electric gongs and circuit closer

2.14 MAKE-UP PRESSURE PUMP

.1 Existing to remain.

2.15 FIRE DEPARTMENT CONNECTION

.1 Existing to remain.

2.16 SUPERVISORY SWITCHES

.1 Existing to remain.

2.17 SIGNS

.1 Signs for control drain and test valves: to ANSI/NFPA 13.

2.18 SPARE PARTS CABINET

.1 Ensure existing cabinet is maintained, relocate if required. Number and types of extra sprinkler heads as specified in NFPA 13 based on revised areas only.

2.19 INSPECTOR'S TEST CONNECTION

.1 Existing to remain.

2.20 ESCUTCHEON PLATES

.1 Provide one piece type metal plates for piping passing through walls, in exposed spaces.

.2 Provide polished stainless steel plates in finished spaces.

.3 Provide paint finish on metal plates in unfinished spaces.

3 Execution

3.1 GENERAL INSTALLATION

.1 Install piping in accordance with NFPA 13 for sprinkler systems and in accordance with manufacturer's recommendations.

.2 Allow for expansion and contraction when installing pipe hangers.

.3 Install signs required by local Fire Protection Department.

.4 Mechanical grooved joints may be used instead of threaded or welded joints.

.5 Grooved joints shall be installed in accordance with the manufacturer’s latest published installation instructions. Grooved ends shall be clean and free from indentations, projections, and roll marks in the area from pipe end to groove. Gaskets shall be of an elastomer grade suitable for the intended service, and shall be moulded and produced by the coupling manufacturer.

.6 Die cut screw joints with full cut standard taper pipe threads with read lead and linseed oil or other non-toxic joint compound applied to male threads only.

.7 Provide gate valves or approved butterfly valves, low points of piping and apparatus.

.8 Provide drain valves at main shut-off valves, low points of piping and apparatus.

3.2 SYSTEM TESTS

.1 Hydrostatically test entire system. Test shall be witnessed by Fire Marshall.

3.3 INSPECTION

.1 Do not recess, paint or conceal piping accessories or work prior to inspection and approval by authorities having jurisdiction or authorized representative.

3.4 FIRE DEPARTMENT CONNECTION

.1 Existing to remain as is.

.2 During construction, make one standpipe outlet available on each floor without delay, for department use.

3.5 FIELD QUALITY CONTROL

.1 Subject systems and equipment to operational test.

.2 Hydrostatically test water supply connections and fire department connections at 345 mm (13") in excess of normal working pressure but not less than 1400 kPa (203 psi) for 2 hours without loss under supervision.

.3 Upon complete installation of piping and apparatus for sprinkler systems, test joints for tightness and good condition of piping. When testing with water, install pressure gauge at highest point of installation. If impossible to test whole installation in single operation, subdivide into several zones and test each zone in manner described.

.4 The grooved coupling manufacturer's factory trained representative shall provide on-site training for Contractor's field personnel in the use of grooving tools and installation of grooved joint products. The representative shall periodically visit the job site and review Contractor is following best recommended practices in grooved product installation. (A distributor's representative is not considered qualified to conduct the training or job site visits).

.5 During tests, stop any leaks and remove and repair any defective part. Perform test over again until satisfactory results are obtained.

.6 Provide hydraulic pump, temporary connections and labour required for tests.

3.6 SPRINKLER SYSTEM

.1 Install horizontal valves with stems upright where space allows.

.2 Do not allow sprinklers that have been dropped, damaged, or show a visible loss of fluid. Never install sprinklers with cracked bulbs.

.3 Sprinkler bulb protector shall be removed by hand after installation. Do not use tools or any other devices to remove the protector that could damage the bulb in any way.

.4 Centre sprinkler heads in two directions in ceiling tile and provide piping offsets as required.

.5 Apply strippable tape or paper cover to ensure concealed sprinkler head cover plates do not receive field paint finish.

3.7 PROTECTION OF COMPLETE WORK

.1 Paint exposed steel pipe and fittings, except special finishes, in accordance with Architectural Specifications.

.2 Assume responsibility for protecting sprinkler heads during painting. Replace damaged and painted components.

.3 Provide red wire guards for sprinkler heads in mechanical and electrical rooms and around ventilation equipment, and all other areas required by code or intended usage. Provide wire guards in gymnasiums.

END OF SECTION

1 General

1.1 RELATED REQUIREMENTS

.1 Materials and installation for domestic water service used in the following:
- .1 Hard domestic hot and cold water services inside building.
- .2 Soft tubing inside building.
- .3 Soft buried tubing outside building, as in between potable water source and meter inside building.

.2 Sustainable requirements for construction, verification and operation.

1.2 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 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.
- .2 Rating System Addenda for New Construction and Major Renovations LEED Canada-NC Version 1.0-Addendum 2007.
- .3 LEED Canada-CI Version 1.0-2007, LEED (Leadership in Energy and Environmental Design): Green Building Rating System Reference Guide For Commercial Interiors.

.5 Canadian Standards Association (CSA International)
- .1 CSA B242-05, Groove and Shoulder Type Mechanical Pipe Couplings.

.6 Department of Justice Canada (Jus)
- .1 Canadian Environmental Protection Act, 1999, c. 33 (CEPA).

.7 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
.1 Material Safety Data Sheets (MSDS).

.8 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.

.9 National Research Council (NRC)/Institute for Research in Construction
.1 NRCC 38728, National Plumbing Code of Canada (NPC) - 1995.

.10 Transport Canada (TC)
.1 Transportation of Dangerous Goods Act, 1992, c. 34 (TDGA).

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:
.1 Provide manufacturer's printed product literature and 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.

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 Above ground: High-density crosslinked polyethylene manufactured using the high-pressure peroxide method of crosslinking (PEXa). Pipe shall conform to ASTM F876, ASTM F877 CSA B137.5, NSF/ANSI 14 and NSF/ANSI61.
.1 Pipe shall be rated for continuous operation of 100 psi gauge pressure at 180 deg.F temperature (y690 kPa at 82 deg.C), and 80 psi gauge pressure at 200 deg.F temperature (550 kPa at 93 deg.C).
.2 Pipe shall be certified by PPI to standard TR-3, with applicable plumbing and mechanical code certifications.
.3 Pipe to be manufactured during a high-pressure peroxide method with a minimum degree of crosslinking of 70-89% when tested in accordance with ASTM D2765, Method B.
.4 Pipe to be tested for resistance to hot chlorinated water in accordance with ASTM F2023. Pipe to have a minimum extrapolated time-to-failure of 50 years, calculated in accordance with Section 13.3 of F2023 and listed as “3306” per the ASTM F876 standard.
.5 PEX pipe to have a co-extruded UV Shield made from UV-resistant polyethylene providing a minimum UV resistance of 6 months when tested according to ASTM F2657.

.6 Pipe to have a Flame Spread Index and a Smoke Developed Index listing to ASTM E84 (in U.S.) or CAN/ULC S102.2 (in Canada).

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 1/2 and smaller: wrought copper to ANSI/ASME B16.22; with 301stainless steel internal components and EPDM seals. Suitable for operating pressure to 1380 kPa.

.7 PEX Fittings - Fitting Materials: Fittings shall be manufactured of Engineered Polymer (EP). Lead free brass materials are allowed only for transition fittings. Fitting connections shall be made to the requirements of ASTM F1960. Fittings shall be supplied by the PEX tubing manufacturer. PEX-a cold expansion type fittings shall be an assembly consisting of insert and PEX-a cold expansion ring.

2.3 JOINTS

.1 Rubber gaskets, latex-free mm thick: to AWWA C111.

.2 Bolts, nuts, hex head and washers: to ASTM A307, heavy series.

.3 Solder: 95/5.

.4 Teflon tape: for threaded joints.

.5 Grooved couplings: designed with angle bolt pads to provide rigid joint, complete with EPDM gasket.

.6 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, regrind 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 Bronze 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.

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.

3.3 ROUTES AND GRADES

.1 Route piping in orderly manner and maintain proper grades. Install to conserve headroom and interfere as little as possible with use of space. Run exposed piping parallel to walls. Group piping wherever practical at common elevations. Install concealed pipes close to the building structure to keep furrings to a minimum.

.2 Slope water piping 25 mm in 12 m (1" in 40') and arrange to drain at low points.

.3 On closed systems, equip low points with 20 mm (3/4") drain valves and hose nipples. Provide, at high points, collecting chambers and high capacity float operated automatic air vents.

.4 Make reductions in water pipes with eccentric reducing fittings installed to provide drainage and venting.

.5 Grade horizontal drainage and vent piping 22 mm per meter (1/4" per foot) minimum unless otherwise indicated on drawings.

3.4 VALVES

.1 Isolate equipment, fixtures and branches with gate valves.

.2 Balance recirculation system using lockshield globe valves. Mark settings and record on as-built drawings on completion.

.3 Install valves with stems upright or horizontal, not inverted.

.4 Install gate, ball and butterfly valves for isolating service, to isolate equipment, part of systems or vertical risers.

.5 Install globe, ball or angle valves for throttling service and control device or meter bypass.

.6 Use plug cocks in water systems for throttling service. Use non-lubricated plug cocks only when shut-off or isolation valves are also provided.

.7 Provide drain valves at main shut-off valves, low points of piping and apparatus.

3.5 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.

3.6 FLUSHING AND CLEANING

.1 Disinfect and rinse entire system to requirements of authority having jurisdiction and RCMP site standards.

.2 Flush entire system for 8 hours. 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. Let system flush for additional 2 hours, then draw off another sample for testing.

.3 Upon completion, provide laboratory test reports on water quality for Departmental Representative approval. Include one copy of approved test reports in Operation and Maintenance Manual.

3.7 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.

3.8 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 Monitor piping HWS and HWC piping systems for freedom of movement, pipe expansion as designed.
.4 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 Verify performance of temperature controls.
.3 Verify compliance with safety and health requirements.
.4 Confirm water quality consistent with supply standards, and ensure no residuals remain as result of flushing or cleaning.

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.

END OF SECTION

1 General

1.1 SUMMARY

.1 Section Includes:
- .1 The installation of drainage waste and vent piping. Sustainable requirements for construction and verification.

1.2 REFERENCES

.1 American Society for Testing and Materials International, (ASTM).
- .1 ASTM B32-03, Specification for Solder Metal.
- .2 ASTM B306-02, Specification for Copper Drainage Tube (DWV).
- .3 ASTM C564-03a, 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-B70-02, Cast Iron Soil Pipe, Fittings and Means of Joining.
- .3 CAN/CSA-B125-01, Plumbing Fittings.

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.

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.
  - .2 Wrought copper: to CAN/CSA-B125.
- .2 Solder: 95:5, type TA, to ASTM B32.

2.2 CAST IRON PIPING AND FITTINGS

.1 Above ground sanitary, storm and vent: to CAN/CSA-B70.
- .1 Joints.
  - .1 Hub and spigot.
    - .1 Caulking lead: to CSA B67.
  - .2 Mechanical joints.
    - .1 Neoprene or butyl rubber compression gaskets with stainless steel clamps.

3 Execution

3.1 INSTALLATION

.1 In accordance with Section 23 05 05 - Installation of Pipework.

.2 Install in accordance with Provincial Plumbing Code and local authority having jurisdiction.

3.2 TESTING

.1 Pressure test modified pipe.

.2 Hydraulically test to verify grades and freedom from obstructions.

END OF SECTION

1 General

1.1 SUMMARY

.1 Section Includes:
  .1 The installation of drainage waste and venting piping - plastic.
.2 Sustainable requirements for construction and verification.

1.2 REFERENCES

.1 American Society for Testing and Materials International, (ASTM).
  .1 ASTM D2564-02, Specification for Solvent Cements for Poly (Vinyl-Chloride) (PVC) Plastic Piping Systems.

.2 Canadian Standards Association (CSA International).
  .1 CSA-Series B1800-02, Plastic Nonpressure Pipe Compendium.
  .2 CSA-B181.2-02, PVC Drain, Waste and Vent Pipe and Pipe Fittings.
  .3 CSA-B182.1-02, Plastic Drain and Sewer Pipe and Pipe Fittings.

2 Products

2.1 PIPING AND FITTINGS

.1 For buried and or above ground DWV piping to:
  .1 CSA-B181.1.
  .2 CSA-B181.2.
  .3 CSA-B182.1.

2.2 JOINTS

.1 Solvent weld for PVC: to ASTM D2564.

3 Execution

3.1 INSTALLATION

.1 In accordance with Section 23 05 05 - Installation of Pipework.

.2 Install in accordance with Provincial Plumbing Code and local authority having jurisdiction.

.3 Refer to 23 05 05 Installation of Pipework for fire stopping requirements.

3.2 TESTING

.1 Pressure test modified pipe systems.

.2 Hydraulically test to verify grades and freedom from obstructions.

END OF SECTION

1 General

1.1 SUMMARY

.1 Section Includes:
- .1 Use of mechanical systems during construction.

1.2 USE OF SYSTEMS

.1 Use of new permanent heating and ventilating systems for supplying temporary heat or ventilation is permitted only under following conditions and with the express written permission of Departmental Representative:
- .1 Entire system is complete, pressure tested, cleaned, flushed out.
- .2 Specified water treatment system has been commissioned, water treatment is being continuously monitored.
- .3 Building has been closed in, areas to be heated/ventilated are clean and will not thereafter be subjected to dust-producing processes.
- .4 There is no possibility of damage.
- .5 Supply ventilation systems are protected by 80% filters, inspected daily, changed every week or more frequently as required.
- .6 Return systems have approved filters over openings, inlets, outlets.
- .7 Systems will be:
  - .1 Operated as per manufacturer's recommendations and instructions.
  - .2 Operated by Contractor.
  - .3 Monitored continuously by Contractor.
- .8 Warranties and guarantees are not relaxed.
- .9 Regular preventive and other manufacturers recommended maintenance routines are performed by Contractor at own expense and under supervision of Departmental Representative.
- .10 Refurbish entire system before static completion; clean internally and externally, restore to "as- new" condition, replace filters in air systems.

.2 Filters specified in this Section are over and above those specified in other Sections of this project.

.3 Exhaust systems are not included in approvals for temporary heating ventilation.

.4 Contractor shall not assume at time of bidding that permission will be given to use permanent heating and/or ventilation systems.

2 Products

2.1 NOT USED

3 Execution

3.1 NOT USED

END OF SECTION

1 General

1.1 REFERENCES

.1 Canadian General Standards Board (CGSB)
  .1 CAN/CGSB-1.181-99, Ready-Mixed Organic Zinc-Rich Coating.

1.2 REGULATORY REQUIREMENTS

.1 Conform to ASME B31.9 - Building Services Piping.

.2 Contractor to supply shop drawings for all grooved end components. Do piping system work including hangers in accordance with ANSI B31.1. Install all grooved end components as per manufacturer's latest recommendations. All grooved joint couplings, fittings, valves and specialties shall be the products of a single manufacturer. Grooving tools shall be of the same manufacturer as the grooved components.

.3 All castings used for coupling housings, fittings, valve bodies, etc., shall be date stamped for quality assurance and traceability.

1.3 WELDING

.1 Welding materials and labour must conform to ASME Code and the Provincial Board of Labour Regulations.

.2 Use welders fully qualified and licensed by Provincial Authorities.

1.4 SUBMITTALS

.1 Submit shop drawings to requirements of Section 01 33 00.

.2 Submit shop drawings and product data for manufactured products and assemblies required for this project. Include data on pipe material, pipe fittings, valves and accessories.

.3 Shop drawings shall clearly indicate product description, make, model, dimensions, component sizes, rough-in requirements, location, type, size, service clearances, finishes, and pressure rating.

.4 Submit copies of valve "ordering schedule" for approval before ordering valves.

1.5 QUALITY ASSURANCE

.1 Gas piping shall meet the requirements of CSA Standard B149.1, Installation Code for Natural Gas Burning Appliances and Equipment.

.2 Domestic water, drainage and vent piping shall meet the requirements of the National Building Code and the Provincial and Municipal Codes.

.3 Automatic sprinkler system piping shall conform to the requirements of NFPA No. 13.

.4 Contractor to supply shop drawings for all grooved end components. Do piping system work including hangers in accordance with ANSI B31.1-1983. Install all grooved end components as per manufacturer's latest recommendations. All grooved joint couplings, fittings, valves and specialties shall be the products of a single manufacturer. Grooving tools shall be of the same manufacturer as the grooved components.

.5 All castings used for coupling housings, fittings, valve bodies, etc., shall be date stamped for quality assurance and traceability.

2 Products

2.1 PIPE

.1 Heating Water (to 110 Deg.C)
- .1 Steel Pipe: ASTM A53 or A120, Schedule 80 Black, with malleable iron (1034 KpA) or forged steel welding type fittings (2065 KpA), screwed, grooved mechanical, or welded. For pipe sizes 300mm (12") and larger, wall thickness to be 9.5mm (3/8")
- .2 Copper Pipe: Type L hard copper, with cast brass or wrought copper fittings, 95/5 solder

.2 Equipment Drains/Overflow
- .1 Steel Pipe: ASTM A53 or A120, Schedule 80 galvanized, with galvanized cast iron or malleable iron fittings, screwed joints or grooved mechanical couplings.
- .2 Plastic Pipe buried or crawlspace may be PVC Pipe: Schedule 40 or SDR 21 or 26, with PVC fittings, solvent weld or grooved mechanical joints.
- .3 Plastic Pipe in ceiling space shall be fire rated PVC Pipe: Schedule 40 or SDR 21 or 26, with fire rated PVC fittings, solvent weld or grooved mechanical joints. Rating to meet 25/50 flame and smoke spread.
- .4 Copper Pipe: Type L hard copper, with cast brass or wrought copper fittings, 95/5 solder.

.3 Sanitary Drainage and Vent (unburied)
- .1 Cast iron pipe and fittings; hub-and spigot, neoprene gaskets; or hubless with neoprene gaskets and stainless steel clamp-and-shield assemblies.
- .2 Type "M" or "DWV" copper with cast brass, or bronze or wrought copper fittings; 95/5 solder joints or grooved mechanical.
- .3 Plastic PVC-XFR-15/50 or CPVC pipe and fittings; solvent weld joints or grooved mechanical.

.4 Water Piping (buried)
- .1 Copper tubing type K annealed; wrought copper fittings 95/5 solder or silver braze joints.
- .2 Plastic "BLUE BRUTE" pipe and fittings; solvent weld joints.
- .3 All piping and fitting shall be rated to a minimum of 1034 kPa (150 PSI)

.5 Water Piping (unburied)
- .1 Type L hard copper; with cast brass or wrought copper fittings; 95/5 solder joints.
- .2 Stainless steel pipe, Schedule 40; Vic Press Pipe.
- .3 Cross Linked Polyethylene (PEX) pipe.

.6 Storm Water Piping (unburied)
- .1 Plastic PVC-XFR-15/50 or CPVC pipe and fittings; solvent weld joints or grooved mechanical.

.7 Steam Piping (to 689 kPa or 100 PSIG)
- .1 Steel Pipe: ASTM A53, Schedule 80, 10 mm wall for sizes 300 mm and over, black.
- .2 Fittings: ASTM B16.3 malleable iron Class 300 for pipe sizes 50mm (2") and under, or ASTM A234 forged steel Class 300 for pipe sizes over 50mm (2").
- .3 Joints: Threaded for pipe sizes 50mm (2") and smaller
- .4 Joints: Welded for pipe sizes over 50mm (2")

.8 Steam Condensate Piping
- .1 Steel Pipe: ASTM A53, Schedule 80, 10 mm wall for sizes 300 mm and over, black.
- .2 Fittings: ASTM A234 forged steel Class 125.
- .3 Joints: welded.

.9 Chilled Water Piping:
- .1 Steel Pipe: ASTM A53 or A120, Schedule 40 Black, with malleable iron (1034 KpA) or forged steel welding type fittings (2065 KpA), screwed, grooved mechanical, or welded. For pipe sizes 300mm (12") and larger, wall thickness to be 9.5mm (3/8").
- .2 Copper Pipe: Type L hard copper, with cast brass or wrought copper fittings, 95/5 solder.

.10 Use factory fabricated butt welded fittings for welded steel pipes.

.11 Use long radius elbows for steel and cast iron water piping.

3 Execution

3.1 CONNECTIONS TO EQUIPMENT

.1 In accordance with manufacturer's instructions unless otherwise indicated.

.2 Use valves and unions or flanges (as indicated) 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.

3.2 CLEARANCES

.1 Provide clearance around systems, equipment and components for observation of operation, inspection, servicing, maintenance and as recommended by manufacturer.

.2 Provide space for disassembly, removal of equipment and components as recommended by manufacturer or as indicated (whichever is greater) without interrupting operation of other system, equipment, components.

3.3 DRAINS

.1 Install piping with grade in direction of flow except as indicated.

.2 Install drain valve complete with isolation at low points in piping systems, at equipment and at section isolating valves.

.3 Pipe each drain valve discharge separately to nearest floor drain where indicated. 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.

3.4 AIR VENTS

.1 Install manual air vents at high points in piping systems complete with isolation valve and u-bend copper tubing to allow discharge to bucket.

.2 Install automatic air valve at each air separator and where indicated.

.3 Install isolating valve at each automatic air valve.

.4 Install drain piping to approved location and terminate where discharge is visible.

3.5 DIELECTRIC COUPLINGS

.1 General: Compatible with system, to suit pressure rating of system.

.2 Locations: Where dissimilar metals are joined.

.3 NPS 2 and under: isolating unions or bronze valves.

.4 Over NPS 2: Isolating flanges.

3.6 ROUTE AND GRADES

.1 Route piping in orderly manner and maintain proper grades. Install to conserve headroom and interfere as little as possible with use of space. Run exposed piping parallel to walls. Group piping wherever practical at common elevations. Install concealed pipes close to the building structure to keep furrings to a minimum.

.2 Slope water piping 25 mm in 12 m and arrange to drain at low points.

.3 On closed systems, equip low points with 20 mm drain valves and hose nipples. Provide, at high points, collecting chambers and high capacity float operated automatic air vents.

.4 Make reductions in water pipes with eccentric reducing fittings installed to provide drainage and venting.

.5 Grade horizontal drainage and vent piping 20 mm per meter minimum.

.6 Slope steam piping 12 mm in 3 m (½" in 10') in direction of flow and condensate return piping 20 mm in 3 m (3/4" in 10'). Provide drop trap assembly at low points and points where condensate may back-up in front of control valves. Run condensate lines from traps to nearest condensate receiver. Where condensate lines form a trap, provide vent loop over the trapped section.

3.7 PIPEWORK INSTALLATION

.1 Screwed fittings jointed with Teflon tape.

.2 Protect openings against entry of foreign material.

.3 Install to isolate equipment and allow removal without interrupting operation of other equipment or systems.

.4 Assemble piping using fittings manufactured to ANSI standards.

.5 Saddle type branch fittings may be used on mains if branch line is no larger than half the size of main.

.1 Hole saw (or drill) and ream main to maintain full inside diameter of branch line prior to welding saddle.

.2 Do not project brach pipe inside the main pipe.

.6 Install exposed piping, equipment, rectangular cleanouts and similar items parallel or perpendicular to building lines.

.7 Install concealed pipework to minimize furring space, maximize headroom, conserve space.

.8 Slope piping, except where indicated, in direction of flow for positive drainage and venting.

.9 Install, except where indicated, to permit separate thermal insulation of each pipe.

.10 Provide clearance for proper installation of insulation and for access to valves, air vents, drains and unions. Valves to be complete with valve handle extensions where insulation is thicker than 25mm, extension to suit insulation thickness.

.11 Group piping wherever possible.

.12 Ream pipes, remove scale, welding slag and other foreign material, inside and outside before assembly.

.13 Use eccentric reducers at pipe size changes to ensure positive drainage and venting.

.14 Install piping to allow for expansion and contraction without unduly stressing pipe or equipment connected.

.15 Screw joint steel piping up to and including 38 mm. Weld piping 63 mm and larger, including branch connections. Screw or weld 50 mm piping.

.16 Make screwed joints with full cut standard taper pipe threads with red lead and linseed oil or other approved non-toxic joint compound applied to male threads only.

.17 Clamp cast iron water pipe at fittings with 20 mm rods and properly anchor and support.

.18 Use grooved mechanical couplings and mechanical fasteners in accessible locations, risers, pipe chases, and in other locations as approved by Departmental Representative. Use flexible couplings at pumps, coils and all vibration isolated equipment in lieu of flexible connectors, all other couplings to be rigid.

.1 Grooved joints shall be installed in accordance with the manufacturer's latest published installation instructions.

.2 The grooved coupling manufacturer's factory trained representative shall provide on-site training for Contractor's field personnel in the use of grooving tools and installation of grooved joint products. The representative shall periodically visit the job site and review Contractor is following best recommended practices in grooved product installation. (A distributor's representative is not considered qualified to conduct the training or job site visits.)

.19 Make connections to equipment and branch mains with unions or flanges, as indicated:

.1 Unions are not required in installations using grooved mechanical joint couplings (The couplings shall serve as disconnect points.)

.20 Provide non-conducting type connections wherever jointing dissimilar metals in systems. Brass adaptors and valves are acceptable. Refer to dielectric couplings.

.21 Pressfit piping and fittings are not permitted.

.22 Install piping to allow for expansion and contraction without unduly stressing pipe or equipment connected.

.1 For mechanical pipe jointing systems, use adequate numbers of Victaulic Style 77 flexible couplings in header piping to accommodate thermal growth and contraction, and for the elimination of expansion loops. (In accordance with Victaulic instructions and as approved by the Departmental Representative.) Where expansion loops are required, use Victualic Style 77 couplings on the loops.

.23 Install piping material specified as inside the building to 2.4 meters outside of building.

.24 Use of PVC or other plastic pipe allowed where approved by the authority having jurisdiction. Plastic pipe run in plenum spaces or exposed shall have flame and smoke rating for that purpose. Plastic pipe to be complete with ULC labelled intumescent fire stopping wherever penetrating fire separations.

.25 Valves:

.1 Shall be flanged for steam and condensate 38 mm and larger.

.2 Install in accessible locations.

.3 Remove interior parts before soldering.

.4 Install with stems upright or horizontal, not inverted.

.5 Valves accessible for maintenance without removing adjacent piping.

.6 Install globe valves in bypass around control valves.

.7 Use ball valves up to 50 mm or butterfly valves 63 mm and larger at branch take-offs for isolating purposes except where otherwise specified.
.8 Install butterfly valves on chilled water and related condenser water systems only.
.9 Install butterfly valves between weld neck flanges to ensure full compression of liner.
.10 Install ball valves for glycol service and domestic water.
.11 Install gate valves on steam and condensate.
.12 Use chain operators on valves NPS 2-1/2 and larger where installed more than 2400 mm above floor in Mechanical Rooms.
.13 Install gate, ball and butterfly valves for isolating service, to isolate equipment, part of systems or vertical risers.
.14 Install globe, ball or angle valves for throttling service.
.15 Use plug cocks in water systems for throttling service. Use non-lubricated plug cocks only when shut-off or isolation valves are also provided.
.16 Grooved end triple service valves shall be 2068 kPa bubble tight dead end shutoff and non-slamming backflow prevention. Victualic Tri-Service valve assembly.
.17 Use butterfly valves in fire protection systems where approved.
.18 Provide drain valves at main shut-off valves, low points of piping and apparatus.
.19 Valve operators to be complete with extensions on systems with insulation thicker than 25mm, extension to suit insulation thickness.

.26 Check Valves:
.1 Install silent check valves on discharge of pumps and in vertical pipes with downward flow and elsewhere as indicated.
.2 Install swing check valves in horizontal lines on discharge of pumps and elsewhere as indicated.
.3 Provide spring loaded check valves on discharge of condensate pumps and condenser water.

.27 Provide thermometers, thermometer wells, and DDC sensor wells where thermometers are indicated on drawings and schematics.

.28 Provide plug cocks at all pressure tapping locations.

.29 PEX pipe installed in service space or exposed (i.e. not inslab) shall be routed plumb complete with channel to ensure pipe does not sag. Routing channels shall be installed outside of pipe insulation with supports connected to channel and pipe with insulation strapped down to channel.

3.8 SLEEVES

.1 General: Install where pipes pass through masonry, concrete structures, fire rated assemblies, and elsewhere as indicated.

.2 Material: Schedule 40 black steel pipe.

.3 Construction: Foundation walls and where sleeves extend above finished floors to have annular fins continuously welded on at mid-point.

.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: Provide space for firestopping. Maintain fire rating integrity.
- .3 Sleeves installed for future use: Fill with lime plaster or other easily removable filler.
- .4 Ensure no contact between copper pipe or tube and sleeve.

3.9 ESCUTCHEONS

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

.2 Construction: One piece type with set screws. Chrome or nickel plated brass or type 302 stainless steel.

.3 Sizes: Outside diameter to cover opening or sleeve. Inside diameter to fit around pipe or outside of insulation if so provided.

3.10 PREPARATION FOR FIRESTOPPING

.1 Material and installation within annular space between pipes, ducts, insulation and adjacent fire separation to Section 07 84 00 - Firestopping.

.2 Uninsulated unheated pipes not subject to movement: No special preparation.

.3 Uninsulated heated pipes subject to movement: Wrap with non-combustible smooth material to permit pipe movement without damaging firestopping material or installation.

.4 Insulated pipes and ducts: Ensure integrity of insulation and vapour barriers.

3.11 FLUSHING OUT OF PIPING SYSTEMS

.1 In accordance with Section 23 08 02 - Cleaning and Start-up of Mechanical Piping Systems. Before start-up, clean interior of piping systems in accordance with requirements of Section 01 74 11-Cleaning supplemented as specified in relevant sections of Mechanical.

.2 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 Departmental Representative 48 hours minimum prior to performance of pressure tests.

.2 Pipework: Test as specified in relevant sections of Mechanical or to 1.5 times maximum operating pressure. All installed piping to be tested unless noted otherwise.

.3 Maintain specified test pressure without loss for 4 hours minimum unless specified for longer period of time in relevant sections of Mechanical.

.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 Departmental Representative.

.6 Pay costs for repairs or replacement, retesting, and making good. Departmental Representative to determine whether repair or replacement is appropriate.

.7 Insulate or conceal work only after approval and certification of tests by Departmental Representative.

END OF SECTION

1 General

1.1 SUMMARY

.1 Section Includes:
- .1 Electrical motors, drives and guards for mechanical equipment and systems.
- .2 Supplier and installer responsibility indicated in Motor, Control and Equipment Schedule on electrical drawings and related mechanical responsibility is indicated on Mechanical Equipment Schedule on mechanical drawings.
- .3 Control wiring and conduit is specified in Division 26 except for conduit, wiring and connections below 50 V which are related to control systems specified in Division 22, 23 and 25. Refer to Division 26 for quality of materials and workmanship. Sustainable requirements for construction and verification.

1.2 REFERENCES

.1 American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE)
- .1 ASHRAE 90.1, Energy Standard for Buildings Except Low-Rise Residential Buildings (IESNA cosponsored; ANSI approved; Continuous Maintenance Standard).

.2 Electrical Equipment Manufacturers' Association Council (EEMAC)

.3 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
- .1 Material Safety Data Sheets (MSDS).

1.3 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.
- .2 Shop Drawings: submit drawings stamped and signed by professional engineer registered or licensed in Province of Saskatchewan.

.3 Closeout Submittals
- .1 Provide maintenance data for motors, drives and guards for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.4 QUALITY ASSURANCE

.1 Regulatory Requirements: work to be performed in compliance with CEPA, CEAA, TDGA, and applicable Provincial /Territorial regulations.

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

2 Products

2.1 GENERAL

.1 Motors: premium efficiency, in accordance with local Hydro company standards and to ASHRAE 90.1.

.2 Must be inverter duty for all variable frequency drive applications.

.3 Must be CSA approved.

2.2 MOTORS

.1 Provide motors for mechanical equipment as specified.

.2 Motors 373 W (1/2 HP) and under: speed as indicated, continuous duty, built-in overload protection, resilient mount, single phase, 120 V, unless otherwise specified or indicated.

.3 Motors 373 W (3/4 HP) and larger: EEMAC Class B, squirrel cage induction, speed as indicated, continuous duty, drip proof, ball bearing, maximum temperature rise 40 degrees C, 3 phase, 208V, unless otherwise indicated.

2.3 TEMPORARY MOTORS

.1 If delivery of specified motor will delay completion or commissioning work, install motor approved by Departmental Representative for temporary use. Work will only be accepted when specified motor is installed.

2.4 BELT DRIVES

.1 Fit reinforced belts in sheave matched to drive. Multiple belts to be matched sets.

.2 Use cast iron or steel sheaves secured to shafts with removable keys unless otherwise indicated.

.3 For motors under 7.5 kW (10 HP) : standard adjustable pitch drive sheaves, having plus or minus 10% range. Use mid-position of range for specified r/min.

.4 For motors 7.5 kW (10 HP) and over: sheave with split tapered bushing and keyway having fixed pitch unless specifically required for item concerned. Provide sheave of correct size to suit balancing.

.5 Correct size of sheave determined during commissioning.

.6 Minimum drive rating: 1.5 times nameplate rating on motor. Keep overhung loads within manufacturer's design requirements on prime mover shafts.

.7 Motor slide rail adjustment plates to allow for centre line adjustment.

.8 Supply one set of spare belts for each set installed in accordance with Section 01 78 00 - Closeout Submittals.

2.5 DRIVE GUARDS

.1 Provide guards for unprotected drives.

.2 Guards for belt drives;
- .1 Expanded metal screen welded to steel frame.
- .2 Minimum 1.2 mm thick sheet metal tops and bottoms.
- .3 38 mm diameter holes on both shaft centres for insertion of tachometer.
- .4 Removable for servicing.

.3 Provide means to permit lubrication and use of test instruments with guards in place.

.4 Install belt guards to allow movement of motors for adjusting belt tension.-

.5 Guard for flexible coupling:
- .1 "U" shaped, minimum 1.6 mm thick galvanized mild steel.
- .2 Securely fasten in place.
- .3 Removable for servicing.

.6 Unprotected fan inlets or outlets:
- .1 Wire or expanded metal screen, galvanized, 19 mm mesh.
- .2 Net free area of guard: not less than 80% of fan openings.
- .3 Securely fasten in place.
- .4 Removable for servicing.

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 Fasten securely in place.

.2 Make removable for servicing, easily returned into, and positively in position.

3.3 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

1 General

1.1 SECTION INCLUDES

.1 Materials and installation for flexible connections, expansion joints, anchors and guides for building services piping.
.2 Sustainable requirements for construction, verification and operation.

1.2 REFERENCES

.1 American Society for Testing and Materials International, (ASTM).
  .1 ASTM A53/A53M-02, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
  .2 ASTM A105/A105M-03, Standard Specification for Carbon Steel Forgings, for Piping Applications.

1.3 SUBMITTALS

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

.2 Submit product data and indicate for items as applicable:
  .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.

.3 Submit maintenance data in accordance with Section 01 78 00 - Closeout Submittals.

.4 Data to include:
  .1 Servicing requirements, including special requirements, stuffing box packing, lubrication and recommended procedures.

1.4 HEALTH AND SAFETY

.1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

1.5 GENERAL REQUIREMENTS

.1 Verify, prior to installation, required anchors and expansion joints to adequately protect system.

.2 Base expansion calculations on -10 deg.C installation temperature to 100 deg.C for hot water heating and low pressure steam and 60 deg.C for domestic hot water, plus 30% safety factor.

2 Products

2.1 SLIP TYPE EXPANSION JOINTS

.1 Application: for axial pipe movement, copper and steel to be 50 mm and under.

.2 Repacking: under full line pressure.

.3 Body and packing housings: Class 300, 2MPa 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, PTFE or graphite impregnated non-asbestos.

.9 Thermal plastic packing: PTFE or 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, copper and steel pipe 64 and over.

.2 Maximum working pressure: 862 kPa WSP, 1380 kPa WOG.

.3 Maximum operating temperature: 204 degrees C at WSP, 121 deg.C at WOG.

.4 Type A: controlled flexing, factory tested to 1 1/2 times maximum working pressure. Furnish test certificates.

.5 Type B: externally pressurized, designed to eliminate pressure thrust, factory tested to 1-1/2 times maximum working pressure. Furnish 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 Butt weld flanges to match pipe.

.9 Liner:
- .1 Austenitic stainless steel in direction of flow.

.10 Shroud:
.1 Carbon steel, painted.

2.3 GROOVED PIPE EXPANSION JOINTS

.1 Grooved end expansion joints for steel piping:
.1 Packless, gasketed, slip expansion joints: 2400 kPa maximum working pressure, steel pipe fitting consisting of telescoping body and slip-pipe sections, PTFE modified polyphenylene sulfide coated slide section, with grooved ends. Suitable for axial end movement to 80 mm Victaulic Style 150.
.2 Expansion joint consisting of a series of grooved end pipe nipples joined in tandem with Victaulic Style 77 flexible couplings. Total joint movement dependent on the number of couplings and nipples used. Victualic Series 155.

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: bronze corrugated for copper pipe, inner hose stainless steel corrugated for steel pipe.

.4 Braided wire mesh bronze outer jacket, for copper pipe.

.5 Braided wire mesh stainless steel after jacket for steel pipe.

.6 Diameter and type of end connection: as indicated under Section 23 05 01.

.7 Operating conditions:
.1 Working pressure: 1034 kPa minimum.
.2 Working temperature: 232 degrees C minimum.
.3 To match system requirements.

2.5 ANCHORS AND GUIDES

.1 Anchors:
.1 Provide as indicated.
.2 Concrete: to Section 03 30 00 - Cast-in-Place.
.3 Reinforcement: to Section 03 20 33 - Concrete Reinforcing.

.2 Alignment guides:
.1 Provide as indicated.
.2 To accommodate specified thickness of insulation.
.3 Vapour barriers, jackets to remain uninterrupted.

3 Execution

3.1 INSTALLATION

.1 Install expansion joints and flexible connections in accordance with manufacturer's instructions.

.2 Install pipe anchors and guides as indicated and required. Anchors to withstand 150% of axial thrust.

.3 Provide flexible pipe connectors on pipes connected to all equipment supported by vibration isolation and where shown on drawings and schematics.

.4 Provide structural work and equipment required to control expansion and contraction of piping, loops, pipe offsets, and swing joints and provide corrugated bellows type expansion joints where indicated or required.

.5 Install flexible connectors at right angles to displacement. Install one end immediately adjacent to isolated equipment and anchor at other end.

.6 Rigidly anchor pipe to building structure at points shown and where required, where necessary provide pipe guides so that movement takes place along axis of pipe.

.7 Three Victualic Style 77 couplings may be used in lieu of a flexible connector for vibration attenuation and stress relief. The couplings shall be placed in close proximity to the source of the vibration.

.8 Rigidly anchor pipe to building structure at points shown, and where necessary provide pipe guides so that movement takes place along axis of pipe only.

3.2 CLEANING AND START-UP

.1 In accordance with Section 23 08 02 - Cleaning and Start-up of Mechanical Piping Systems.

3.3 PERFORMANCE VERIFICATION

.1 In accordance with Section 23 08 01 - Performance Verification: Mechanical Piping Systems.

END OF SECTION

1 General

1.1 REFERENCES

.1 American National Standards Institute/American Society of Mechanical Engineers (ANSI/ASME)
- .1 ANSI/ASME B31.1-1998, Power Piping.
- .2 ANSI/ASME B31.3-2000, Process Piping Addenda A.
- .3 ANSI/ASME B31.3-2001, Process Piping Addenda B.
- .4 ANSI/ASME Boiler and Pressure Vessel Code-1998:
  - .1 Section I: Power Boilers.
  - .2 Section V: Nondestructive Examination.
  - .3 Section IX: Welding and Brazing Qualifications.

.2 American National Standards Institute/American Water Works Association (ANSI/AWWA)
- .1 ANSI/AWWA C206-97, Field Welding of Steel Water Pipe.

.3 American Welding Society (AWS)
- .1 AWS C1.1-2000, Recommended Practices for Resistance Welding.
- .2 AWS Z49.1-1999, Safety Welding, Cutting and Allied Process.
- .3 AWS W1-2000, Welding Inspection Handbook..

.4 Canadian General Standards Board (CGSB)
- .1 CAN/CGSB-48.2-92, Spot Radiography of Welded Butt Joints in Ferrous Materials.

.5 Canadian Standards Association (CSA International)
- .1 CSA W47.2-M1987 (R1998), Certification of Companies for Fusion Welding of Aluminum.
- .2 CSA W48 series-01, Filler Metals and Allied Materials for Metal Arc Welding.
- .3 CSA B51-97, Boiler, Pressure Vessel and Pressure Piping Code.
- .4 CSA-W117.2-01, Safety in Welding, Cutting and Allied Processes.
- .5 CSA W178.1-02, Certification of Welding Inspection Organizations.
- .6 CSA W178.2-01, Certification of Welding Inspectors.

1.2 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 Furnish welder's qualifications to 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.

1.3 QUALITY ASSURANCE

.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.

2 Products

2.1 ELECTRODES

.1 Electrodes: in accordance with CSA W48 Series.

3 Execution

3.1 WORKMANSHIP

.1 Welding: in accordance with ANSI/ASME B31.1, 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.

3.2 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.

3.3 INSPECTION AND TESTS - GENERAL REQUIREMENTS

.1 Review weld quality requirements and defect limits of applicable codes and standards with Departmental Representative before work is started.

.2 Formulate "Inspection and Test Plan" in co-operation with 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.

3.4 SPECIALIST EXAMINATIONS AND TESTS

.1 Hydrostatically test welds to requirements of ANSI/ASME B31.1.

.2 Visual examinations: include entire circumference of weld externally and wherever possible internally.

.3 Failure of visual examinations:
- .1 Upon failure of welds by visual examination, perform additional testing as directed by Departmental Representative of total of up to 10% of welds, selected at random by Departmental Representative by radiographic particle tests.

.4 Full radiographic tests for piping systems.
- .1 Spot radiography to CAN/CGSB-48.2.
  - .1 Conduct spot radiographic tests of up to 10% of welds, selected at random by 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 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.

.5 Magnetic particle tests for piping systems.

3.5 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 particle tests.

3.6 REPAIR OF WELDS WHICH FAILED TESTS

.1 Re-inspect and re-test repaired or re-worked welds at Contractor's expense.

END OF SECTION

1 General

1.1 SUMMARY

.1 Section Includes:
  .1 Bronze - valves.
.2 Sustainable requirements for construction and verification.

1.2 REFERENCES

.1 American National Standards Institute (ANSI)/ American Society of Mechanical Engineers (ASME).
  .1 ANSI/ASME B1.20.1-1983 (R2001), Pipe Threads, General Purpose (Inch).
  .2 ANSI/ASME B16.18-2001, Cast Copper Alloy Solder Joint Pressure Fittings.

.2 American Society for Testing and Materials International, (ASTM).
  .1 ASTM A276-04, Specification for Stainless Steel Bars and Shapes.
  .2 ASTM B62-02, Specification for Composition Bronze or Ounce Metal Castings.
  .3 ASTM B283-99a, Specification for Copper and Copper Alloy Die Forgings (Hot-Pressed).
  .4 ASTM B505/B505M-02, 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-80-2003, Bronze Gate Globe, Angle and Check Valves.
  .3 MSS-SP-110-1996, Ball Valves, Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.

1.3 SUBMITTALS

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

.2 Product Data: submit WHMIS MSDS - Material Safety Data Sheets in accordance with Section 02 81 01 - Hazardous Materials.
  .1 Submit shop drawings and product data in accordance with Section 01 33 00 - Submittal Procedures.
  .2 Submit data for valves specified in this section.

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

1.4 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.

2 Products

2.1 MATERIALS

.1 Valves:
- .1 Except for specialty valves, to be single manufacturer.
- .2 All 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 Provide flanged ends as indicated under 23 05 05, Installation of Pipework.

.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, composition to suit service conditions, 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 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.

.7 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.

.8 Ball Valves:
.1 NPS 2 and under:
.1 Body and cap: cast high tensile brass to C37700.
.2 Pressure rating: Class 150 WSP/600 WOG.
.3 Connections: Screwed ends to ANSI B1.20.1 and with hexagonal shoulders or solder ends to ANSI.
.4 Stem: tamperproof ball drive.
.5 Stem packing nut: external to body.
.6 Ball and seat: replaceable solid hard chrome full port ball and teflon seals.
.7 Stem seal: TFE with external packing nut.
.8 Operator: removable lever handle.

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 or flanges at each piece of equipment arranged to allow servicing, maintenance, and equipment removal. Refer to 23 05 05 - Installation of Pipework.

END OF SECTION

1 General

1.1 SUMMARY

.1 Section Includes:
  .1 Valves, gate, globe, and check.
.2 Sustainable requirements for construction and verification.

1.2 REFERENCES

.1 American National Standards Institute (ANSI)/American Society of Mechanical Engineers (ASME).
  .1 ANSI/ASME B16.1-1998, Cast Iron Pipe Flanges and Flanged Fittings.

.2 American Society for Testing and Materials International (ASTM).
  .1 ASTM A49-01, Specification for Heat-Treated Carbon Steel Joint Bars.
  .2 ASTM A126-95 (2001), Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
  .3 ASTM B61-93, Specification for Steam or Valve Bronze Castings.
  .4 ASTM B62-93, Specification for Composition Bronze or Ounce Metal Castings.
  .5 ASTM B85-03, Specification for Aluminum-Alloy Die Castings.
  .6 ASTM B209-04, Specification for Aluminum and Aluminum-Alloy Sheet and Plate.

.3 Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS).
  .1 MSS SP-70-1998, Cast Iron Gate Valves, Flanged and Threaded Ends.
  .2 MSS SP-71-1997, Grey Iron Swing Check Valves, Flanged and Threaded Ends.
  .3 MSS SP-82-1992, Valve Pressure Testing Methods.
  .4 MSS SP-85-2002, Cast Iron Globe and Angle Valves, Flanged and Threaded Ends.

1.3 SUBMITTALS

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

.2 Product Data: submit WHMIS MSDS - Material Safety Data Sheets in accordance with Section 02 81 01 - Hazardous Materials.
  .1 Submit shop drawings and product data in accordance with Section 01 33 00 - Submittal Procedures.
  .2 Submit data for valves specified in this section.

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

1.4 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.

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 with 2 mm raised face with serrated finish 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 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 bosses in body and bonnet for taps and drains, full length disc guides designed to ensure correct re-assembly. Class 300.
- .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.

.2 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 300.
- .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 globe valve as Section 23 05 05 - Installation of Pipework.

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. Wall thicknesses to ANSI B16.1 and ULC 262 (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: 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.
.12 Operator: handwheel.
.13 Bypass: complete with union and NPS globe 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, Class 300.
.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.

2.5 BYPASSES FOR GATE AND GLOBE VALVES

.1 Locations: on valves as indicated.

.2 Position of bypass valve on main valves.

.3 Size of bypass valve:
.1 Main valve up to NPS 8: NPS 3/4.

.4 Type of bypass valves:
.1 On gate valve: globe, with composition disc, bronze trim, to Section 23 05 23.01 - Valves - Bronze. Pressure rating to match main valve.
.2 On globe valve: globe, with composition disc, bronze trim, to Section 23 05 23.01 - Valves - Bronze. Pressure rating to match main valve.

2.6 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 boiler rooms and mechanical equipment rooms.

2.7 CHECK VALVES

.1 Swing check valves, Class 300:
- .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: 300 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.

3 Execution

3.1 INSTALLATION

.1 Install rising stem valves in upright position with stem above horizontal.

.2 Install valves with unions or flanges at each piece of equipment arranged to allow servicing, maintenance and equipment removal. Refer to Section 23 05 05 Installation of Pipework.

END OF SECTION

1 General

1.1 SUMMARY

.1 Section Includes:
- .1 Valves Cast Steel, gate, globe, and check.

1.2 REFERENCES

.1 American National Standards Institute (ANSI)/American Society of Mechanical Engineers (ASME).
- .1 ANSI/ASME B16.5-2003, Pipe Flanges and Flanged Fittings.
- .2 ANSI/ASME B16.10-1992, Face-to-Face and End-to-End Dimensions Valves.
- .3 ANSI/ASME B16.25-1997, Buttwelding Ends.
- .4 ANSI/ASME B16.34-1996, Valves - Flanged, Threaded and Welding End.

.2 American Petroleum Institute (API).
- .1 API 598-1996, Valve Inspection and Testing.

.3 American Society for Testing and Materials International, (ASTM).
- .1 ASTM A49-01, Specification for Heat-Treated Carbon Steel Joint Bars.
- .2 ASTM A193/A193M-04, Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service.
- .3 ASTM A194/A194M-03b, Specification for Carbon and Alloy Steel Nuts for Bolts for High-Pressure and High-Temperature Service.
- .4 ASTM A216/A216M-1993 (03), Specification for Steel Castings, Carbon Suitable for Fusion Welding for High-Temperature Service.
- .5 ASTM B85-03, Specification for Aluminum-Alloy Die Castings.

.4 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-61-2003, Pressure Testing of Steel Valves.

1.3 SUBMITTALS

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

.2 Product Data: submit WHMIS MSDS - Material Safety Data Sheets in accordance with Section 02 81 01 - Hazardous Materials.
- .1 Submit shop drawings and product data in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit data for valves specified this section.
- .3 Submit product data in accordance with Section 01 33 00 - Submittal Procedures.

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

1.4 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.

2 Products

2.1 MATERIAL

.1 Valves:
- .1 Except for specialty valves, to be of single manufacturer.
- .2 Valves to be individually tested.

.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 flexible wedge disc, flanged or butt-weld ends, Class 300:
- .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 this section.

2.3 GLOBE VALVES

.1 NPS 2 1/2 - 12, rising stem, OS&Y, flanged or butt-weld ends, Class 300:

.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 or ball type with 35 degrees taper seat.

.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 this section.

2.4 VALVE OPERATORS

.1 Handwheel: on all valves except as specified.

.2 Handwheel with chain operators: on valves installed more than 2400 mm above floor in Boiler Rooms and Mechanical Equipment Rooms.

2.5 BYPASSES FOR GATE AND GLOBE VALVES

.1 Locations: on valves as indicated.

.2 Position of bypass valve on main valves.

.3 Size of bypass valve:

.1 Main valve up to NPS 8: NPS 3/4.

.4 Type of bypass valves:

.1 On gate valve: globe, with composition disc, bronze trim, to Section 23 05 22 - Valves - Bronze.

.2 On globe valve: globe, with composition disc, bronze trim, to Section 23 05 22 - Valves - Bronze.

2.6 CHECK VALVES

.1 NPS 2 1/2 and over, flanged or butt-weld ends, Class 300: 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: cast carbon steel.
- .8 Hinge pin: stainless steel (410).

2.7 SILENT CHECK VALVES

.1 Construction:
- .1 Body: Cast steel to ASTM A216 WCB with integral seat.
- .2 Pressure rating: Class 300.
- .3 Connections: Flanged or Wafer 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.

3 Execution

3.1 INSTALLATION

.1 Install in accordance with manufacturer's recommendations in upright position with stem above horizontal.

.2 Install valves with unions or flanges to each piece of equipment arranged to allow servicing, maintenance, and equipment removal. Refer to Section 23 05 05 Installation of Pipework.

END OF SECTION

1 General

1.1 SUMMARY

.1 Section Includes:
  .1 Plug Valves - Lubricated plug valves, Eccentric plug valves.
.2 Sustainable requirements for construction and verification.

1.2 REFERENCES

.1 American National Standards Institute (ANSI)/ American Society of Mechanical Engineers (ASME).
  .1 ANSI/ASME B1.20.1-1983 (R2001), Pipe Threads, General Purpose (Inch).
  .2 ANSI/ASME B16.1-1998, Cast Iron Pipe Flanges and Flanged Fittings.
  .3 ANSI/ASME B16.11-2001, Forged Fittings, Socket-Welding and Threaded.
  .4 ANSI/ASME B16.25-1997, Buttwelding Ends.
  .5 ANSI/ASME B16.34-1996, Valves - Flanged, Threaded and Welding End.
  .6 ANSI/ASME B16.10-2000, Face to Face and End to End Dimensions of Valves.

.2 American Society for Testing and Materials International (ASTM).
  .1 ASTM A126-95 (2000), Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
  .2 ASTM B62-02, Specification for Composition Bronze or Ounce Metal Castings.
  .3 ASTM B209-04, Specification for Aluminum and Aluminum-Alloy Sheet and Plate.

.3 Manufacturer's Standardization Society of the Valves and Fittings Industry Inc. (MSS).
  .1 MSS SP-78-1998, Cast Iron Plug Valves, Flanged and Threaded Ends.

1.3 SUBMITTALS

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

.2 Product Data: submit WHMIS MSDS - Material Safety Data Sheets in accordance with Section 02 81 01 - Hazardous Materials.
  .1 Submit shop drawings and product data in accordance with Section 01 33 00 - Submittal Procedures.
  .2 Submit product data in accordance with Section 01 33 00 - Submittal Procedures.
  .3 Submit data for valves specified this Section.

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

1.4 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.

2 Products

2.1 MATERIAL

.1 Valves:
  .1 Except for specialty valves, to be of single manufacturer.
  .2 Products to have CRN registration number.

2.2 ECCENTRIC PLUG VALVES

.1 General:
- .1 Dead-tight shut-off on liquids and gases at pressure differentials up to 1.2 MPa in forward direction, 520 kPa in reverse direction.

.2 Up to NPS 2, screwed ends:
- .1 Body: cast iron to ASTM B209 Class B.
- .2 Plug:
  - .1 NPS 1/2 and 3/4: bronze to ASTM B62.
  - .2 NPS 1 to NPS 2: bronze to ASTM B62.
- .3 Bearings: permanently lubricated, bronze to ASTM B62 in upper and lower journals.
- .4 Seals: double-seal consisting of:
  - .1 Plastic seat coating between plug and body.
  - .2 Resilient seal moulded into groove in plug face.
  - .3 Seal materials: BUNA Stem seals with Neoprene (gas service) plug seals.
  - .4 VITON stem seals with Fluorinated hydrocarbon plug seals (over 149 deg.C).
  - .5 Isobutene Isoprene stem seal with isobutene-isoprene plug seals (up to 121 deg.C)
- .5 End connections: screwed.
- .6 Operators: lever with adjustable memory stop.

.3 NPS 2 1/2 to NPS 4, flanged ends:
- .1 Body: cast iron to ASTM B209 Class B.
- .2 Plug: nickel-plated cast iron to ANSI.
- .3 Bearings: permanently lubricated, bronze to ASTM B62 in upper and lower journals.
- .4 Seals: double-seal consisting of:
  - .1 Plastic seat coating between plug and body.
  - .2 Resilient seal moulded into groove in plug face.
  - .3 Seal materials: BUNA Stem seals with Neoprene plug seals (gas service)
  - .4 VITON stem seals with Fluorinated hydrocarbon plug seals (over 149 deg.C).
  - .5 Isobutene Isoprene stem seal with isobutene-isoprene plug seals (up to 121 deg.C)
- .5 End connections: flanged to ANSI B16.1 or roll grooved.
- .6 Operators: lever.

2.3 LUBRICATED PLUG VALVES

.1 Principle of operation:
- .1 Special sealing compound used to effect tight seal. When line pressure applied to valve in closed position, parallel plug forced against downstream side of valve. The metal-to-metal contact and sealing compound ensures leak-tight seal.

.2 Testing to specifications: MSS SP-78 for non-shock pressure at specified temperature.

.3 End connections:
- .1 NPS 1/2 to 2: screwed ends.
- .2 NPS 2½ to 12: flanged ends.

.4 Valve:
- .1 Body: cast iron to ASTM A126 Class B semi-steel.
- .2 Pressure rating: NPS 1/2 to 12:
  - .1 Screwed end valves: screwed to NPT standards.

.2 Flanged end valves: flanged to ANSI B16.1 Class 300. Flanged valves NPS 2-8 face dimensions in accordance with ANSI B16.10 short pattern, making them interchangeable with Class 300 flanged cast iron gate valves.

.3 Hydrostatic tests: body 300 psig. Seat: 100 psig.

.3 Plug: tapered, with regular pattern port - 90 degrees from full open to fully closed, complete with PFTE thrust ring: 100% full port.

.4 Number of ports: as required.

.5 Ends: with ends screwed to ANSI B1.20.1, butt welding to ANSI B16.25, socket-welding to ANSI B16.11.

.6 Lubrication system, nickel-plated.

.7 Lubricant: to suit type, temperature and pressure of contained fluid.

.8 Provide sealing compound injection gun designed for use with pre-packed sealing compound cartridges and valve fitted with button head nipples and combination sealing screws.

.9 Feeding system: lubricant forced into lubrication grooves between seating surfaces of plug and body to form positive seal, leakproof operation, and corrosion preventing film. Lubricant receptacle to hold additional lubricant. Lubricant screw for lubrication. Check valve to prevent reverse flow of lubricant. O-rings between body and plug.

.5 Operator:

.1 Up to NPS 5: manual lever.

.6 3 port and 4 port valves:

.1 To be supplied transflow pattern, to allow reduced flow through ports during rotation of plug from one position to another.

.2 Limit stops: to be provided.

.7 Accessories: lubricant gun.

3 Execution

3.1 INSTALLATION OF LUBRICATED PLUG VALVES

.1 Install with line pressure acting to hold plug against body ports which are to be cut-off from higher pressure.

END OF SECTION

1 General

1.1 SUMMARY

.1 Section Includes:
  .1 Butterfly Valves.
.2 Sustainable requirements for construction and verification.

1.2 REFERENCES

.1 American National Standards Institute (ANSI)/American Society of Mechanical Engineers (ASME).
  .1 ANSI/ASME B1.20.1-1983 (R2001), Pipe Threads, General Purpose (Inch).
  .2 ANSI/ASME B16.1-1998, Cast Iron Pipe Flanges and Flanged Fittings.
  .3 ANSI/ASME B16.5-03, Pipe Flanges and Flanged Fittings.
  .4 ANSI/ASME B16.11-01, Forged Fittings, Socket-Welding and Threaded.
  .5 ANSI/ASME B16.25-1997, Buttwelding Ends.
  .6 ANSI/ASME B16.34-1996, Valves - Flanged, Threaded and Welding Ends.

.2 American National Standards Institute (ANSI)/American Petroleum Institute (API).
  .1 ANSI/API 609-1997, Lug- and Water-Type Butterfly Valves.

.3 American Society for Testing and Materials International, (ASTM).
  .1 ASTM A126-95 (01), Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
  .2 ASTM B62-02, Specification for Composition Bronze or Ounce Metal Castings.
  .3 ASTM B209M-04, Specification for Aluminum and Aluminum-Alloy Sheet and Plate.

.4 Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS).
  .1 MSS SP-67-02, Butterfly Valves.

1.3 SUBMITTALS

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

.2 Product Data: submit WHMIS MSDS - Material Safety Data Sheets in accordance with Section 02 81 01 - Hazardous Materials.
  .1 Submit shop drawings and product data in accordance with Section 01 33 00 - Submittal Procedures.
  .2 Submit product data in accordance with Section 01 33 00 - Submittal Procedures.
  .3 Submit data for valves specified this section.

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

1.4 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.

2 Products

2.1 BUTTERFLY VALVES - RESILIENT SEAT - 300 PSIG

.1 Sizes: Lug type: NPS 2 to 48.

.2 Pressure rating: 300 psig at 135 degrees C.

.3 Lug body: 300 ANSI bolt pattern.

.4 Full lug body (threaded).

.5 Application: for on-off service.

.6 Operators:
- .1 NPS 2 - 6: Handles capable of locking in any of ten (10) positions - 0 degrees to 90 degrees. Handle and release trigger - ductile iron. Return spring and hinge pin: carbon steel. Latch plate and mounting hardware: cadmium plated carbon steel.
- .2 Install parallel or perpendicular to pipeline.

.7 Designed to comply with MSS SP-67 and API 609.

.8 Compatible with ANSI B16.1 Class 250 (iron) and ANSI B16.5 Class 300 (steel) flanges.

.9 Construction:
- .1 Body: ductile iron.
- .2 Disc: aluminum bronze.
- .3 Seat: EPDM.
- .4 Shaft: NPS 2 - 12: 416 stainless steel.
- .5 Taper pin: 316 SS.
- .6 Blowout proof stem.
- .7 O-Ring: Buna-N.
- .8 Bushings: teflon.
- .9 Disc shall not be pinned to shaft.
- .10 Bubble tight shutoff with downstream flanges removed, class 6 shutoff.

2.2 MOUNTING FLANGES

.1 Class 300 steel to B16.5 pipe flanges.

2.3 ELECTRIC ACTUATORS

.1 Operation: designed to provide precise quarter turn electric operation.
- .1 Torque range: up to 1.130 N-m and speed ranges from 10 seconds to 30 seconds to move from fully open to fully closed.
- .2 Gear train within actuator to provide smooth continuous rotary power stroke for accurate automatic valve positioning. Factory-set, field adjustable cam-actuated travel limit switches to provide precise control of shaft rotation.

.2 Construction:
- .1 Castings: heavy duty industrial grade for rugged use.
- .2 Actuators: continuous duty with high efficiency single phase reversing capacitor motor with thermal overload protection.
- .3 Gears and pinions constructed from hardened steel.
- .4 Gear train to be permanently lubricated.
- .5 Mechanical brake to ensure that gear is locked in precise position.

.3 Electrical:
- .1 Standard voltage: 120 VAC. 60 Hz.
- .2 Control options: 4-20 Ma DC or 0-10 V DC.
- .3 CSA approved.
- .4 Electrical rating: NEMA IV.

3 Execution

3.1 PREPARATION

.1 Valve and mating flange preparation.
- .1 Inspect adjacent pipeline, remove rust, scale, welding slag, other foreign material.
- .2 Ensure that valve seats and pipe flange faces are free of dirt or surface irregularities which may disrupt flange seating and cause external leakage.
- .3 Install butterfly valves with disc in almost closed position.
- .4 Inspect valve disc seating surfaces and waterway and eliminate dirt or foreign material.

3.2 INSTALLATION OF VALVES

.1 Install in accordance with manufacturer's instructions.

.2 Do not use gaskets between pipe flanges and valves unless instructed otherwise by valve manufacturer.

.3 Verify suitability of valve for application by inspection of identification tag.

.4 Mount actuator on to valve prior to installation.

.5 Handle valve with care so as to prevent damage to disc and seat faces.

.6 Valves in horizontal pipe lines should be installed with stem in horizontal position to minimize liner and seal wear.

.7 Ensure that valves are centered between bolts before bolts are tightened and then opened and closed to ensure unobstructed disc movement. If interference occurs due, for example to pipe wall thickness, taper bore adjacent piping to remove interference.

3.3 ACTUATOR INSTALLATION

.1 Electrical connections to be made by actuator manufacturer.

.2 Cycle valve operation from fully closed to fully open then back to fully closed.

.3 At same time, check travel stop settings for proper disc alignment.

END OF SECTION

1 General

1.1 SUMMARY

.1 Section Includes:
- .1 Concrete housekeeping pads, hangers and supports for mechanical piping, ducting and equipment.

.2 Sustainable requirements for construction and verification.

1.2 REFERENCES

.1 American National Standards Institute/American Society of Mechanical Engineers (ANSI/ASME)
- .1 ANSI/ASME B31.1-04, Power Piping.

.2 American Society for Testing and Materials International (ASTM)
- .1 ASTM A125-1996 (R2001), Specification for Steel Springs, Helical, Heat-Treated.
- .2 ASTM A307-04, Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
- .3 ASTM A563-04a, Specification for Carbon and Alloy Steel Nuts.

.3 Factory Mutual (FM)

.4 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
- .1 Material Safety Data Sheets (MSDS).

.5 Manufacturer's Standardization Society of the Valves and Fittings Industry (MSS)
- .1 MSS SP58-2002, Pipe Hangers and Supports - Materials, Design and Manufacture.
- .2 ANSI/MSS SP69-2003, Pipe Hangers and Supports - Selection and Application.
- .3 MSS SP89-2003, Pipe Hangers and Supports - Fabrication and Installation Practices.

.6 Underwriter's Laboratories of Canada (ULC)

1.3 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 and prevent vibration.
- .5 Provide for vertical adjustments after erection and during commissioning. Amount of adjustment in accordance with MSS SP58.
- .6 Pipe supports shall meet the requirements of ASME B31.1 Power Piping and ASME B31.9 Building Services Piping.
- .7 Automatic sprinkler pipe supports shall meet the requirements of NFPA No. 13, Standard for Installation of Sprinkler Systems.
- .8 Install supports of strength and rigidity to suit loading without unduly stressing building. Locate adjacent to equipment to prevent undue stresses in piping and equipment.

.9 Select hangers and supports for the service and in accordance with the manufacturer's recommended maximum loading. Hangers shall have a safety factor of 5 to 1.
.10 Fasten hangers and supports to building steel in accordance with the requirements of Structural or inserts in concrete construction. Equipment, piping and ductwork shall be supported from the top chords of trusses/beams, supporting off bottom is not permitted.
.11 Provide and set sleeves required for equipment, including openings required for placing equipment.
.12 Obtain approval prior to drilling for inserts and supports for piping systems.
.13 Obtain approval prior to using percussion type fastenings.
.14 Use of other piping or equipment for hanger supports is not permitted.
.15 Use of perforated band iron, wire or chain as hangers is not permitted.

1.4 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.

2 Products

2.1 GENERAL

.1 Fabricate hangers, supports and sway braces in accordance with ASME B31.1, ASME B31.9 and MSS SP58.

.2 Use components for intended design purpose only. Do not use for rigging or erection purposes.

.3 Design hangers so they cannot become disengaged by movements of supported pipe.

2.2 PIPE HANGERS

.1 Finishes:
.1 Pipe hangers and supports: galvanized after manufacture.
.2 Use electro-plating galvanizing process or hot dipped galvanizing process.
.3 Ensure steel hangers in contact with copper piping are copper plated.

.2 Upper attachment structural: suspension from lower flange of I-Beam:
.1 Cold piping NPS 2 maximum: malleable iron C-clamp with hardened steel cup point setscrew, locknut and carbon steel retaining clip.
.1 Rod: to be 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 and MSS-SP69.

.3 Upper attachment structural: suspension from upper flange of I-Beam:
.1 Cold piping NPS 2 maximum: ductile iron top-of-beam C-clamp with hardened steel cup point setscrew, locknut and carbon steel retaining clip, 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 Shop and field-fabricated assemblies:
- .1 Trapeze hanger assemblies: Steel channels with welded spacers and hanger rods, cast iron roll and stand for hot pipe sizes 150 mm and over.
- .2 Steel brackets: Welded and wrought steel clamp.

.6 Hanger rods: threaded rod material to MSS SP58:
- .1 Ensure that hanger rods are subject to tensile loading only.
- .2 Provide linkages where lateral or axial movement of pipework is anticipated.
- .3 Threaded both ends, one end or continuous.

.7 Pipe attachments: material to MSS SP58:
- .1 Attachments for steel piping: carbon steel black.
- .2 Attachments for copper piping: copper plated black steel.
- .3 Use insulation shields for hot pipework.
- .4 Oversize pipe hangers and supports.

.8 Adjustable clevis: material to MSS SP69 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.

.9 Yoke style pipe roll: carbon steel yoke, rod and nuts with cast iron roll, to MSS SP69.

.10 U-bolts: carbon steel to MSS SP69 with 2 nuts at each end to ASTM A563.
- .1 Finishes for steel pipework: black.
- .2 Finishes for copper, glass, brass or aluminum pipework: black, with formed portion plastic coated.

.11 Pipe rollers: cast iron roll and roll stand with carbon steel rod to MSS SP69.

.12 Wall Support:
- .1 Up to 75 mm: Cast iron hook.
- .2 100 mm and over: Welded steel bracket and wrought steel clamp.

.13 Floor Support:
- .1 Pipe sizes up to 100 mm and all cold pipe sizes: Cast iron adjustable pipe saddle, locknut nipple, floor flange and concrete pier to steel support.
- .2 Hot pipe sizes 150 mm and over: Adjustable cast iron roll and stand, steel screws and concrete pier or steel support.

.14 Insulation:
- .1 Supports shall be coordinated with requirements of insulation. Oversized hangars are required for all pipe systems that require insulation with a vapour barrier to maintain integrity of vapour barrier.
- .2 Oversized hangars shall also be required for steam pipe systems.

2.3 WIRE ROPE PIPE AND DUCT HANGERS

.1 Wire Rope Suspension Systems:

.1 Wire rope suspension systems shall be ULC, CSA and SMACNA approved and tested.

.2 Wire suspensions systems shall consist of a pre-formed wire rope sling with either a ferruled loop, permanently fixed threaded ¼" (or 3/8") stud, or permanently fixed nipple end with toggle, at one end or hook or eyelet. The end fixings and the wire must be of the same manufacturer. The system is secured and tensioned with a hanger self-locking grip at the other end. System shall incorporate pipe hangars. Pipe hangars shall not penetrate vapour barrier of chilled water pipe insulation.

.3 Only wire and or supports supplied and or approved, shall be used with the system installed.

.4 The Contractor shall select the correct specification of wire hanger to use for supporting each particular service from table 1 below. Each size is designated with a maximum Safe Working Load Limit (which incorporates a 5:1 safety factor). The correct specification of wire hanger required is determined using the following formula:

Weight per metre of object suspended (kg) x Distance between suspension points (m) = Weight loading per hanger suspension point (kg)

Table 1 Wire Hanger Safe Working Loads

Size	Working Load Limit (kg)	Working Load Limit (lbs)
No. 1	0 - 10 kg	0 - 22 lbs
No. 2	10.5 - 45.5 kg	23 - 100 lbs
No. 3	46 - 91 kg	101 - 200 lbs
No. 4	95.5 - 225 kg	210 - 495 lbs
No. 5	225.5 - 325 kg	496 - 715 lbs

.5 Where the installed wire rope is not vertical then the working load limit shall be reduced in accordance with the recommendations given in the manufacturer's handbook.

.6 The Contractor shall select and use the correct length of wire rope required to support the service.

.7 No in-line joins shall be permitted in the rope.

.8 Solid trapeze hangars may be used to suspend piping routed together, where wire support can be coordinated with ceiling and still ensure pipes are routed at highest point possible (tight to beams).

2.4 RISER CLAMPS

.1 Steel or cast iron pipe: black 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 50 00 - Metal Fabrications.

2.9 EQUIPMENT ANCHOR BOLTS AND TEMPLATES

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

2.10 HOUSEKEEPING 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.

2.11 SLEEVES

.1 Pipes through floors: Form with 18 gauge galvanized steel.

.2 Pipes through beams, walls, fire proofing, footings, potentially wet floor: Form with steel pipe or 18 gauge galvanized steel.

.3 Size large enough to allow for movement due to expansion and to provide for continuous insulation.

2.12 OTHER EQUIPMENT SUPPORTS

.1 Fabricate equipment supports from structural grade steel meeting requirements of Section 05 50 00 - Metal Fabrications.

.2 Submit structural calculations with shop drawings.

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, at all vibration isolated equipment 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.

.8 Installation of Exposed Pipe and Duct Hangers:
- .1 Exposed pipe and duct shall be any pipe/duct visible to the occupants. This does not include piping and ductwork routing above dropped ceilings.
- .2 Exposed Pipe and Duct hangers shall be a Wire Rope Suspension System.

3.3 INSERTS

.1 Use inserts for suspending hangers for reinforced concrete slabs and sides of reinforced concrete beams wherever practicable.

.2 Set inserts in position in advance of concrete work. Provide reinforcement rod in concrete for inserts carrying pipe over 100 mm.

.3 Where concrete slabs form finished ceiling, finish inserts flush with slab surface.

.4 Where inserts are omitted, drill through concrete slab from below and provide rod with recessed square steel plate and nut above slab.

3.4 HANGER SPACING

.1 Plumbing piping: to Canadian Plumbing Code, Provincial Code, authority having jurisdiction.

.2 Fire protection: to applicable Fire Code.

.3 Copper piping: up to NPS 1/2: every 1.5 m.

.4 Flexible joint roll groove pipe: in accordance with table below, but not less than one hanger at joints.

.5 Within 300 mm of each elbow.

Maximum Pipe Size : NPS	Maximum Spacing Steel	Maximum Spacing Copper	Rod Diameter
up to 32 mm	1.8 m	1.8 m	9.5 mm
38 mm	1.8 m	1.8 m	9.5 mm
50 mm and 63 mm	3.0 m	3.0 m	9.5 mm
75 mm - 100 mm	3.6 m	3.0 m	15.8 mm
150 mm - 200 mm	4.3 m	4.3 m	22.2 mm

.6 Install hangers to provide a minimum 12 mm clear space between finished covering and adjacent work.

3.5 HANGER INSTALLATION

.1 Install hanger so that rod is vertical under operating conditions.

.2 Adjust hangers to equalize load.

.3 Support from structural members. Where structural bearing does not exist or inserts are not in suitable locations, provide supplementary structural steel members.

.4 Use hangers which are vertically adjustable 38 mm minimum after piping is erected.

.5 Support horizontal soil pipe near each hub, with 1.5 m maximum spacing between hangers.

.6 Support vertical piping at every other floor. Support vertical soil pipe at each floor at hub.

.7 Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.

.8 Where practical, support riser piping independently of connected horizontal piping.

.9 Hangers: Pipe sizes 12 mm to 38 mm: Adjustable wrought steel ring.

.10 Hangers: Pipe sizes 50 mm to 100 mm and Cold Pipe Sizes: Adjustable wrought steel clevis.

3.6 SLEEVES

.1 Set sleeves in position in advance of concrete work. Provide suitable reinforcing around sleeves.

.2 Extend sleeves through potentially wet floors 25 mm above finished floor level. Caulk sleeves full depth and provide floor plate.

.3 Where piping passes through floor, ceiling or wall close off space between pipe or duct and construction with non-combustible insulation. Provide tight fitting metal caps on both sides and caulk.

.4 Install chrome plated escutcheons where piping passes through finished surfaces.

.5 All penetrations through fire rated walls, floors or partition assemblies shall be sealed/fire stopped with fire stop materials that will remain in place and prevent the passage of smoke, toxic gases, flame, etc., when subjected to the standard test method Can 4-S115, "Standard Method of Fire Tests for Firestop Systems" for a period of time equal to fire protection rating required for the grade of fire separation of the penetrated wall or floor.

.6 Acceptable Product: According to instructions provided, all penetrations in fire rated walls, floors, or partition assemblies shall be sealed/fire stopped with:
- .1 3M Brand Intumescent, "Fire Barrier" Caulk CP-25, Putty 303, Penetration Sealing Systems 7902 or 7904 Series, Composite Sheet CS-195, or Wrap Strip FS-195.
- .2 Tremco Firestop Systems: Fyresil, Fyreshield for penetrations and perimeters. Dymeric ULC, THC 900 ULC

3.7 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.

3.8 FINAL ADJUSTMENT

.1 Adjust hangers and supports:
- .1 Ensure that rod is vertical under operating conditions.
- .2 Equalize loads.

.2 Adjustable clevis:
- .1 Tighten hanger load nut securely to ensure proper hanger performance.
- .2 Tighten upper nut after adjustment.

.3 C-clamps:
.1 Follow manufacturer's recommended written instructions and torque values when tightening C-clamps to bottom flange of beam.

.4 Beam clamps:
.1 Hammer jaw firmly against underside of beam.

END OF SECTION

1 General

1.1 SECTION INCLUDES

.1 Inertia bases.
.2 Vibration isolation.

1.2 PERFORMANCE REQUIREMENTS

.1 Provide vibration isolation on all mechanical motor driven equipment plus connected piping and ductwork.

.2 Supply vibration isolation equipment and materials by one supplier. Consider side loading of equipment and inertia bases when calculating maximum loads on isolators.

.3 Ensure equipment is sufficiently rigid for isolator point loading.

.4 Provide and install mechanical equipment so that Average Noise Criteria Curves, as outlined in ASHRAE Guide, are not exceeded.

.5 Consider upper floor locations critical unless otherwise indicated.

.6 Use concrete inertia bases where indicated and for fans having static pressure in excess of 0.85 kPa or motors in excess of 30 kW, and on base mounted pumps over 7.5 kW.

1.3 SUBMITTALS

.1 Section 01 33 00: Procedures for submittals.

.2 Shop Drawings: Indicate inertia bases and locate vibration isolators, with static and dynamic load on each.

.3 Product Data: Provide schedule of vibration isolator type with location and load on each.

.4 Manufacturer's Installation Instructions: Indicate special procedures and setting dimensions.

.5 Manufacturer's Certificate: Certify that isolators are properly installed and adjusted to meet or exceed specified requirements.

1.4 PROJECT RECORD DOCUMENTS

.1 Section 01 78 00: Submittals for project closeout.

.2 Record actual locations of isolation including attachment points.

2 Products

2.1 VIBRATION ISOLATORS

.1 Open Spring Isolators:
- .1 Spring Isolators:
  - .1 For Exterior and Humid Areas: Provide hot dipped galvanized housings and neoprene coated springs.
  - .2 Code: Colour code springs for load carrying capacity.
- .2 Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection.
- .3 Spring Mounts: Provide with levelling devices, minimum 6 mm thick neoprene sound pads, and zinc chromate plated hardware.
- .4 Sound Pads: Size for minimum deflection of 1.2 mm; meet requirements for neoprene pad isolators.

.2 Restrained Spring Isolators:
- .1 Spring Isolators:
  - .1 For Exterior and Humid Areas: Provide hot dipped galvanized housings and neoprene coated springs.
  - .2 Code: Colour code springs for load carrying capacity.
- .2 Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection.
- .3 Spring Mounts: Provide with levelling devices, minimum 6 mm thick neoprene sound pads, and zinc chromate plated hardware.
- .4 Sound Pads: Size for minimum deflection of 1.2 mm; meet requirements for neoprene pad isolators.
- .5 Restraint: Provide heavy mounting frame and limit stops.

.3 Closed Spring Isolators:
- .1 Spring Isolators:
  - .1 For Exterior and Humid Areas: Provide hot dipped galvanized housings and neoprene coated springs.
  - .2 Code: Colour code springs for load carrying capacity.
- .2 Type: Closed spring mount with top and bottom housing separated with neoprene rubber stabilizers.
- .3 Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection.
- .4 Housings: Incorporate neoprene isolation pad meeting requirements for neoprene pad isolators, and neoprene side stabilizers with minimum 7 mm clearance.

.4 Restrained Closed Spring Isolators:
- .1 Spring Isolators:
  - .1 For Exterior and Humid Areas: Provide hot dipped galvanized housings and neoprene coated springs.
  - .2 Code: Colour code springs for load carrying capacity.
- .2 Type: Closed spring mount with top and bottom housing separated with neoprene rubber stabilizers.
- .3 Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection.

.4 Housings: Incorporate neoprene isolation pad meeting requirements for neoprene pad isolators, and neoprene side stabilizers with minimum 7 mm clearance and limit stops.

.5 Spring Hanger:
- .1 Spring Isolators:
  - .1 For Exterior and Humid Areas: Provide hot dipped galvanized housings and neoprene coated springs.
  - .2 Code: Colour code springs for load carrying capacity.
- .2 Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection.
- .3 Housings: Incorporate neoprene isolation pad meeting requirements for neoprene pad isolators.
- .4 Misalignment: Capable of 20 degree hanger rod misalignment.

.6 Neoprene Pad Isolators:
- .1 Rubber or neoprene waffle pads.
  - .1 30 durometer.
  - .2 Minimum 13 mm thick.
  - .3 Maximum loading 275 kPa.
  - .4 Height of ribs: maximum 0.7 times width.
- .2 Configuration: Single layer.

.7 Rubber Mount or Hanger: Moulded rubber designed for 13 mm deflection with threaded insert.

.8 Glass Fibre Pads: Neoprene jacketed pre-compressed moulded glass fibre.

3 Execution

3.1 INSTALLATION

.1 Install to manufacturer's written instructions.

.2 Install isolation for mechanical motor driven equipment throughout, unless specifically noted otherwise

.3 Install spring hangers without binding.

.4 On closed spring isolators, adjust so side stabilizers are clear under normal operating conditions.

.5 Prior to making piping connections to equipment with operating weights substantially different from installed weights, block up equipment with temporary shims to final height. When full load is applied, adjust isolators to load to allow shim removal.

.6 Provide pairs of horizontal limit springs on fans with more than 1.5 kPa static pressure, and on hanger supported, horizontally mounted axial fans.

.7 Provide resiliently mounted equipment, piping, and ductwork with seismic snubbers. Provide each inertia base with minimum of four seismic snubbers located close to isolators. Snub equipment designated for post disaster use to 1.5 mm maximum clearance. Provide other snubbers with clearance between 4 mm and 7 mm.

.8 Support piping connections to isolated equipment resiliently for scheduled distance.
- .1 Up to 100 mm Diameter: First three points of support.
- .2 125 to 200 mm Diameter: First four points of support.
- .3 250 mm Diameter and Over: First six points of support.
- .4 Static deflection of first point shall be twice deflection of equipment. The next two hangers closest to vibration source shall have the greater deflection of 25 mm static deflection or static deflection of isolated equipment. Select remaining isolators for minimum 25 mm static deflection or 1/2 static deflection of isolated equipment.

.9 Connect wiring to isolated equipment with flexible hanging loop.

3.2 MANUFACTURER'S FIELD SERVICES

.1 Examine systems to Section 01 45 00.

.2 Inspect isolated equipment after installation and submit report. Include static deflections.

3.3 EQUIPMENT ISOLATION SCHEDULE

	ISOLATED EQUIPMENT	BASE Thickness	ISOLATOR Type	Deflection
.1	Fans	Steel	Spring	2"

END OF SECTION

1 General

1.1 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 ASME A13.1 - Scheme for the Identification of Piping Systems.

1.3 SUBMITTALS

.1 Section 01 33 00: Procedures for submittals.

.2 Submit list of wording, symbols, letter size, and colour coding for mechanical identification.

.3 Submit valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.

.4 Product Data: Provide manufacturers catalogue literature for each product required.

1.4 PROJECT RECORD DOCUMENTS

.1 Section 01 78 00: Submittals for project closeout.

.2 Record actual locations of tagged valves.

2 Products

2.1 LANGUAGE

.1 Identification in English.

2.2 PIPING SYSTEMS GOVERNED BY CODES

.1 Identification of Natural gas: to CSA/CGA B149.1 and authority having jurisdiction.

.2 Identification of Sprinkler System: to NFPA 13

2.3 NAMEPLATES

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

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

.3 Sizes: Conform to following table using a maximum of 25 characters per line.

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

Description: Laminated three-layer plastic with engraved black letters on light contrasting background colour.

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

.5 Identification nomenclature shall follow National Maintenance Management System (NMMS) guidelines:
- .1 Use arrangement of Main identifier, Source identifier, Destination identifier.
- .2 Equipment in Mechanical Rooms:
  - .1 Main identifier: size #9.
  - .2 Source and Destination identifiers: size #6.
- .3 Contractor shall coordinate equipment tags with completion of NMMS inventory sheets as part of commissioning and ensure equipment reference number matches on both documentation and equipment tag.

2.4 TAGS

.1 Plastic Tags: Laminated three-layer plastic with engraved black letters on light contrasting background colour. Tag size minimum 40 mm diameter.

.2 Control Tag: Laminated plastic card with black letters on light contrasting background colour in multiple lines. Tag size minimum 85mm x 55mm. Inscriptions to include function and (where appropriate) fail-safe position

.3 Metal Tags: Brass with stamped letters; tag size minimum 40 mm diameter with smooth edges.

.4 Chart: Typewritten letter size list in anodized aluminum frame.

2.5 STENCILS

.1 Stencils: With clean cut symbols and letters of following size:
- .1 20-30 mm Outside Diameter of Insulation or Pipe: 200 mm long colour field, 15 mm high letters.
- .2 40-50 mm Outside Diameter of Insulation or Pipe: 200 mm long colour field, 20 mm high letters.
- .3 65-150 mm Outside Diameter of Insulation or Pipe: 300 mm long colour field, 30 mm high letters.
- .4 200-250 mm Outside Diameter of Insulation or Pipe: 600 mm long colour field, 65 mm high letters.

.5 Over 250 mm Outside Diameter of Insulation or Pipe: 800 mm long colour field, 90 mm high letters.
.6 Ductwork and Equipment: 65 mm high letters.

.2 Stencil Paint: As specified in Section 09 91 230.

2.6 PIPE MARKERS

.1 Colour: Conform to ASME A13.1.

.2 Plastic Pipe Markers: Factory fabricated, flexible, semi- rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid being conveyed.

.3 Plastic Tape Pipe Markers: Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings.

.4 Underground Plastic Pipe Markers: Bright coloured continuously printed plastic ribbon tape, minimum 150 mm wide by 0.10 mm thick, manufactured for direct burial service.

2.7 CEILING TACKS

.1 Description: Steel with 20 mm diameter colour coded head.

.2 Colour code as follows:
.1 Yellow - HVAC equipment
.2 Red - Fire dampers/smoke dampers
.3 Green - Plumbing valves
.4 Blue - Heating/cooling valves

2.8 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: where required to Workplace Hazardous Materials Information System (WHMIS) regulations.

.3 Legend: 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 Extent of background colour marking.

.7 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 plastic-coated cloth or 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

.8 Colours and Legends:

.1 Where not listed, obtain direction from 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
City water	Green	CITY WATER
Chilled Water Supply	Green	CH.WTR.SUPPLY
Chilled Water Return	Green	CH.WTR.RETURN
Heating water Supply	Yellow	HEATING SUPPLY
Heating water Return	Yellow	HEATING RETURN
Steam High and Low	Yellow	H.P. Steam and L.P. 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 soft water	Green	DOM. HSW
Dom. Hot water recirculation	Green	DOM. HW CIRC
Domestic cold hard water supply	Green	DOM. CHW
Domestic cold soft water supply	Green	DOM. CSW
Sanitary	Green	SAN
Plumbing vent	Green	SAN. VENT
Natural gas	to Codes	
Gas regulator vents	to Codes	
Fire protection water	Red	FIRE PROT. WTR
Sprinklers	Red	SPRINKLERS

2.9 IDENTIFICATION OF DUCTING 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

2.10 VALVES AND CONTROLLERS

.1 Valves to be complete with brass tags with 12 mm stamped identification data filled with black paint coordinated with Valve Tag List.

.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.

.3 Controllers to be complete with controls laminated identification tag.

.4 Identify all control systems components including but not limited to equipment, components, controls, sensors with control tags specified in this section.

2.11 FIRE DAMPERS

.1 All new fire dampers shall be tagged with unique tag (FD-1, FD-2 etc.), 12 mm stamped identification data filled with black paint. Contractor shall compile a Fire Damper Tag List and include in O&M. List to identify fire damper tag and location in building.

2.12 EQUIPMENT WITHIN CEILING SPACE

.1 Provide identification (equipment labels and colour coded dots) on the ceiling for all equipment concealed within a ceiling space in addition to identification on equipment.

.2 Equipment Labels:
- .1 Colours: Black lettering on transparent background.
- .2 Height of letter: 5 mm.
- .3 T-bar ceilings: Label shall be located on the metal ceiling grid beside the ceiling tile that provides service access to the equipment. The label shall include the equipment tag and an arrow indicating the ceiling tile to remove for servicing and access to the equipment.
- .4 Solid ceilings: Label shall be located on the trim of the access panel used for servicing the equipment and include the equipment tag.

.3 Colour Coded Dots:
- .1 Confirm site standard colour coding with the Departmental Representative prior to commencing work. Coordinate with all trades.
- .2 Provide a Legend in the operating and maintenance manual identifying the colour coding utilized on site.
- .3 T-bar ceilings: Dot shall be located on the metal ceiling grid beside the ceiling tile that provides service access to the equipment.
- .4 Solid ceilings: Dot shall be located on the trim of the access panel used for servicing the equipment.

3 Execution

3.1 PREPARATION

.1 Degrease and clean surfaces to receive adhesive for identification materials.

.2 Prepare surfaces to Section 09 91 23 for stencil painting.

3.2 INSTALLATION

.1 Perform work in accordance with CAN/CGSB-24.3 except as specified otherwise.

.2 Install plastic nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.

.3 Install tags with corrosion resistant chain.

.4 Apply stencil painting to Section 09 91 23.

.5 Install plastic pipe markers to manufacturer's written instructions.

.6 Install plastic tape pipe markers complete around pipe to manufacturer's written instructions.

.7 Install underground plastic pipe markers 150 to 200 mm below finished grade, directly above buried pipe.

.8 Identify equipment including air handling units, pumps, heat transfer equipment, tanks, and water treatment devices with plastic nameplates. Small devices, such as small in-line pumps, may be identified with tags.

.9 Identify control panels and major control components outside panels with control tags.

.10 Identify thermostats relating to terminal boxes or valves with nameplates.

.11 Identify valves in main and branch piping with tags.

.12 Identify air terminal units and radiator valves with numbered tags.

.13 Tag automatic controls, instruments, and relays. Key to control schematic.

.14 Identify piping, concealed or exposed, with plastic pipe markers. Identify service, flow direction, and pressure. Install in clear view and align with axis of piping. Location of identification not to exceed 6 m on straight runs including risers and drops, adjacent to each valve and Tee, adjacent to each change in direction, at each side of penetration of structure or enclosure, and at each obstruction. Provide additional identification 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

.15 Identify ductwork with stencilled painting. Identify with air handling unit identification number and area served. Locate identification at air handling unit, at each side of penetration of structure or enclosure, and at each obstruction.

.16 Provide ceiling tacks to locate valves or dampers above T-bar type panel ceilings. Locate in corner of panel closest to equipment.

.17 Identify electric starting switches and remote push button stations with nametags.

.18 Provide identification on the ceiling for all equipment concealed within a ceiling space in addition to identification on the equipment.

.19 Tag new fire dampers sequentially and record on Fire Damper Tag List.

.20 All equipment shall be complete with a label that follows the NMMS reference #.

3.3 VALVE, 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 Owner. Provide one copy (reduced in size if required) in each operating and maintenance manual.

.3 Number valves in each system consecutively.

END OF SECTION

1 General

1.1 SECTION INCLUDES

.1 Testing, adjustment and balance of air systems.
.2 Testing, adjustment and balance of water systems.

1.2 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.

1.3 QUALIFICATIONS OF TAB PERSONNEL

.1 Submit names of personnel to perform TAB to Consultant within 90 days of award of contract.

.2 Personnel performing TAB shall be qualified to standards of AABC and/or NEBB

.3 Provide documentation confirming qualifications, successful experience.

.4 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.

.5 Recommendations and suggested practices contained in the TAB Standard: mandatory.

.6 Use TAB Standard provisions, including checklists, and report forms to satisfy Contract requirements.

.7 Use TAB Standard for TAB, including qualifications for TAB Firm and Specialist and calibration of TAB instruments.

.8 Where instrument manufacturer calibration recommendations are more stringent than those listed in TAB Standard, use manufacturer's recommendations.

.9 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.

1.4 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.

1.5 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 EXCEPTIONS

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

1.7 PRE-TAB REVIEW

.1 Review contract documents before project construction is started confirm in writing to Consultant adequacy of provisions for TAB and other aspects of design and installation pertinent to success of TAB.

.2 Review specified standards and report to Consultant 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.

1.8 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.

1.9 OPERATION OF SYSTEMS DURING TAB

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

1.10 START OF TAB

.1 Notify Consultant 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.

1.11 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 %.

1.12 ACCURACY TOLERANCES

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

1.13 INSTRUMENTS

.1 Use accurate instruments for measurements. Prior to TAB, submit to Consultant 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 to Consultant.

.4 Provide calibration histories for each instrument. Re-calibration or use of other instruments may be requested when accuracy of readings is questionable.

1.14 SUBMITTALS

.1 Submit, prior to commencement of TAB:

.2 Submit proposed methodology and procedures for performing TAB if different from referenced standard.

1.15 PRELIMINARY TAB REPORT

.1 Submit for checking and approval of Consultant, prior to submission of formal TAB report, sample of rough TAB sheets. Include:
- .1 Details of instruments used.
- .2 Details of TAB procedures employed.
- .3 Calculations procedures.
- .4 Summaries.

1.16 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 4 copies of TAB Report to Consultant for verification and approval, in English in D-ring binders, complete with index tabs.

1.17 VERIFICATION

.1 Reported results subject to verification by Consultant.

.2 Provide personnel and instrumentation to verify up to 30 % of reported results.

.3 Number and location of verified results as directed by Consultant.

.4 Pay costs to repeat TAB as required to satisfaction of Consultant.

1.18 SETTINGS

.1 After TAB is completed to satisfaction of Departmental 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.

1.19 COMPLETION OF TAB

.1 TAB considered complete when final TAB Report received and approved by Consultant.

1.20 AIR SYSTEMS

.1 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.

.2 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.

.3 Locations of systems measurements to include as appropriate: main ducts, main branch, sub-branch, run-out (or grille, register or diffuser).

1.21 OTHER TAB REQUIREMENTS

.1 Measurement of noise from equipment specified in Division 23.
- .1 As specified elsewhere or as required to prove Noise Performance when operating performance is questioned.

1.22 CLOSEOUT SUBMITTALS

.1 Section 01 33 00: Submission procedures.

.2 Provide copies of complete final TAB report for Operation and Maintenance manual

1.23 BALANCE REPORTS

.1 Balance reports to include the following at minimum (data shall always include design and actual measured data):
- .1 Title Page: Company Name, Address, and Telephone Number; Project Name, Location, Architect, Engineer, and Project Contractor.
- .2 Include types, serial number and dates of calibration of instruments used.
- .3 Air Handling Units: Location, Local Identification, Manufacturer, Model, Size, Arrangement, discharge and class, Supply Air Flow, Return Air Flow, Outside Air Flow, Static Pressures, Fan RPM, inlet and outlet dry bulb and wet bulb temperatures.
- .4 Duct air quantities: Mains, Branches, Outside Air and Exhausts (Maximum and Minimum), Duct sizes; Number of pressure readings; Sum of velocity measurements; Average velocity; duct air flow rate.
- .5 Exhaust Fan Data: Location, Manufacturer, Model, Specified and Actual Air Flow, Static Pressure, and Fan RPM.
- .6 Electric Motors: Manufacturer, HP/BHP, Phase, Voltage, Amperage (maximum operating and full load), RPM, Service Factor, Starter Heater Elements.
- .7 V-Belt Drive: Identification/Location, Driven Sheave Diameter and RPM belt Size and Quantity, Motor Sheave Diameter and RPM.
- .8 Air Distribution: Terminal Number, Room Number/Location, Terminal Type and Size, Area Factor, Design Velocity and Air Flow, Test Velocity and Air Flow.
- .9 Air Inlets and Outlets: Outlet identification location and Designation; Manufacturer's catalogue identification and type; Application factors; air velocities; air flow rates; Deflector vane or diffuser cone settings.
- .10 Pump Data: Location, Identification/Number, Manufacturer, Size/Model, Drive type, Motor type, Flow Rate, Head, BHP, Discharge and Suction Pressure (full flow and no flow).
- .11 Coil Data: Location, Identification/Number, Service, Manufacturer, Element type, Air Flow Rate, Entering Air and Leaving Air Temperatures (dry bulb and wet bulb), Water Flow rate and Pressure Drop, Entering and Leaving Water Temperatures, energy transfer rate.
- .12 Terminal Heating/Cooling Equipment with fans (unit heaters, force flows, unit ventilators, fan coils etc.): Location, Identification/Number, Manufacturer, Model, Heat transfer rate, Entering and Leaving Water Temperatures, Water Pressure drops, Water Flow Rates, air flow. If a steam system include steam pressure, temperature and condensate temperature. If a heating/cooling system provide data for both modes of operation.
- .13 Heat Exchangers: Location, Identification/Number, Manufacturer, Capacity, Model, Heated media, Heating media, Entering and Leaving Water Temperatures, Pressure drops, Water Flow Rates, energy transfer rate. If a steam system include steam pressure, temperature and condensate temperature

2 Products

2.1 NOT USED

3 Execution

3.1 PREPARATION

.1 Before adjusting and balancing, verify that systems are complete and operable. Ensure temperature control systems are complete and operable, thermal overload protection is in place, final filters installed, hydronic systems, flushed, filled, and vented.

.2 Provide instruments required for testing, adjusting, and balancing operations. Make instruments available to Consultant to facilitate spot checks during testing.

.3 Recorded data shall represent actually measured, or observed condition.

3.2 GENERAL PROCEDURES

.1 Balance to maximum measured flow, allowable deviation as specified.

.2 Permanently mark settings on valves, splitters, dampers, and other adjustment devices.

.3 Subsequent to correctional work, take measurements to verify balance has not been disrupted or that any such disruption has been rectified.

.4 At final inspection, re-check random selections of data recorded in report. Re-check points of areas as selected and witnessed by the Owner.

.5 Check and adjust systems approximately six (6) months after final acceptance and submit report.

.6 The Balancing Contractor shall include the cost of sheave changes necessary to achieve specified air flow within limits specified.

3.3 AIR SYSTEM PROCEDURES

.1 Adjust air handling and distribution systems to provide required or design supply, return and exhaust air quantities. Permanently mark settings of damper and other adjustment devices allowing settings to be restored.

.2 Make air quantity measurements in ducts by Pitot tube traverse of entire cross-sectional area of duct.

.3 Measure air quantities at each air inlet and outlet. Use volume control devices to regulate air quantities.

.4 Vary total system air quantities by adjustment of fan speeds. Where Variable Frequency Drives (VFDs) are installed, utilize VFDs to adjust fan speed. Provide drive changes where required.

.5 Where modulating dampers are provided, take measurements and balance at extreme conditions. Balance variable volume systems at maximum air flow rate - full cooling, and at minimum air flow rate - full heating.

.6 Provide system schematic with required and actual air quantities recorded at each outlet or inlet.

.7 Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across the fan. Make allowances for 50 percent loading of filters.

3.4 WATER SYSTEM PROCEDURE

.1 Adjust water systems to provide required or design quantities. Permanently mark settings of valves and other adjustment devices allowing settings to be restored. Set and lock memory stops.

.2 Use calibrated venturi tubes, orifices, or other metered fittings and pressure gauges in conjunction with permanent and portable type flow meters to determine flow rates for system balance. Where flow metering devices are not installed, base flow balance on temperature difference across various heat transfer elements in the system.

.3 Adjust systems to provide specified pressure drops and flows through heat transfer elements prior to thermal testing. Perform balancing by measurement of temperature differential in conjunction with air balancing.

.4 Effect system balance with automatic control valves fully open to heat transfer elements.

.5 Effect adjustment of water distribution systems by means of balancing cocks, valves and fittings. Do not use service or shut-off valves for balancing unless indexed for balance point.

.6 Where pump capacity available is less than total flow requirements or individual system parts, full flow in any part may be simulated by temporary restriction of flow to other parts.

.7 Where flow restrictors are used provide record data of air and water inlet and outlet temperatures at design conditions.

END OF SECTION

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 Sustainable requirements for construction and verification.

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 SUBMITTALS

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

.2 Test Reports: submit test reports 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 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 Departmental Representative.
- .2 Prepare report of results and submit to Departmental Representative within 7 days 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 work of this Section and on-site installations in accordance with Section 01 32 16 - Construction Progress Schedules - Bar (GANTT) Chart.
  - .1 Verify project requirements.
  - .2 Review installation 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.

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 Departmental Representative at least one month before anticipated start date.

.4 Test instruments: calibrated and certificate of calibration deposited with Departmental Representative no more than 28 days before start of tests.

.5 Re-calibrated every six months thereafter.

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 PREPARATION

.1 Do not conceal or cover ductwork or equipment until inspected by consultant and tested.

.2 Provide equipment, materials and labour for tests and pay expenses. Use test instruments by approved laboratory or manufacturer and furnish certificate showing degree of accuracy.

.3 Test instruments shall have been calibrated within one year.

.4 Install permanent gauges and thermometers just prior to tests to avoid changes in calibration.

.5 Before adjusting and balancing, verify that systems are complete and operable. Ensure temperature control systems are complete and operable, thermal overload protection is in place, final filters installed, hydronic systems, flushed, filled, and vented.

.6 Provide instruments required for testing, adjusting, and balancing operations. Make instruments available to Consultant to facilitate spot checks during testing.

.7 Recorded data shall represent actually measured, or observed condition. And shall be included in O&M Manual

3.3 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, fire dampers.

.3 Repeat tests until specified leakage at test 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.

3.4 SITE TOLERANCES

.1 Allowable system leakage tolerances are to follow SMACNA Leakage standards as specified under ductwork.

.2 Evaluation of test results to use surface area of duct and pressure in duct as basic parameters.

3.5 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 Low Pressure Ducts: Test for tightness such that leakage is inaudible and not detectable by feel. Check for audible leaks at 250 Pa above duct design operating pressure.

.5 Medium and High Pressure Ductwork: Check for audible leaks. Test for tightness as specified by the SMACNA Manuals at a duct leakage classification of 3 with a static pressure equal to 2 times the external static pressure of the associated air system.

3.6 FIELD QUALITY CONTROL

.1 Performance Verification:
- .1 Departmental Representative to witness tests and to verify reported results.
- .2 To be certified by same TAB agency approved by Departmental Representative to undertake TAB on this project.

END OF SECTION

1 General

1.1 REFERENCES

.1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
- .1 ANSI/ASHRAE/IESNA 90.1-01, SI; Energy Standard for Buildings Except Low-Rise Residential Buildings.

.2 American Society for Testing and Materials International, (ASTM)
- .1 ASTM B209M, Specification for Aluminum and Aluminum Alloy Sheet and Plate (Metric).
- .2 ASTM C335, Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.
- .3 ASTM C411, Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
- .4 ASTM C449/C449M, Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.
- .5 ASTM C547, Specification for Mineral Fiber Pipe Insulation.
- .6 ASTM C553, Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
- .7 ASTM C612, Specification for Mineral Fiber Block and Board Thermal Insulation.
- .8 ASTM C795, Specification for Thermal Insulation for Use with Austenitic Stainless Steel.
- .9 ASTM C921-(1998)e1, Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.

.3 Canadian General Standards Board (CGSB)
- .1 CGSB 51-GP-52Ma, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.

.4 Thermal Insulation Association of Canada (TIAC): National Insulation Standards (R1999).

.5 Underwriters Laboratories of Canada (ULC)
- .1 CAN/ULC-S102, Surface Burning Characteristics of Building Materials and Assemblies.
- .2 CAN/ULC-S701, Thermal Insulation Polyotrene, Boards and Pipe Covering.

1.2 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" - will mean "not concealed" as defined herein.
- .3 Insulation systems - insulation material, fasteners, jackets, and other accessories.

.2 TIAC Codes:
- .1 CRD: Code Round Ductwork,
- .2 CRF: Code Rectangular Finish.

1.3 SHOP DRAWINGS

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

.2 Submit for approval manufacturer's catalogue literature related to installation, fabrication for duct jointing recommendations.

1.4 MANUFACTURERS' INSTRUCTIONS

.1 Submit manufacturer's installation instructions in accordance with Section 01 33 00 - Submittal Procedures.

.2 Installation instructions to include procedures used, and installation standards achieved.

1.5 QUALITY ASSURANCE

.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.

.2 Materials: UL listed; flame spread/smoke developed rating of 25/50 in accordance with ASTM E84.

.3 Do work to TIAC standards.

.4 Deliver material to job site in original non-broken factory packaging, labelled with manufacturer's density and thickness.

.5 Perform work at ambient and equipment temperatures as recommended by the adhesive manufacturer. Make good separation of joints or cracking of insulation due to thermal movement or poor workmanship.

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 Mineral fibre: as specified includes glass fibre, rock wool, slag wool.

.2 Thermal conductivity ("k" factor) not to exceed specified values at 24 deg.C mean temperature when tested in accordance with ASTM C335. Maximum “K” factor to be 0.035 W/m. deg.K (0.24 BTU in/hr/sq.ft. Deg.K) to ASTM C5553.

.3 TIAC Class C-1: Rigid mineral fibre board to ASTM C612, unfaced or faced with vapour retarder jacket; ksi value of 0.035 at 24 degrees C.

.4 TIAC Code C-2: mineral fibre blanket to ASTM C553 with or without factory applied vapour retarder jacket; ksi value of 0.035 at 24 degrees C

.5 Flexible Duct Liner: Flexible non-combustible mineral fiber blanket to ASTM C 1071 Type 1; ksi value of 0.035 at 24 degrees C, 24 kg/cu m minimum density; coated air side for maximum 20.3 m/s air velocity. Minimum NRC value of 0.65 at 25mm to ASTM 423.

.6 Rigid Duct Liner: semi-rigid non-combustible mineral fiber to ASTM C 1071 Type 2; ksi value of 0.035 at 24 degrees C, 48 kg/cu m minimum density; coated air side for maximum 20.3 m/s air velocity. Minimum NRC value of 0.7 at 25mm to ASTM 423.

2.3 JACKETS

.1 Interior Applications:
- .1 Vapour Barrier Jackets: to CGSB 51-GP-52Ma.
- .2 PVC Jackets: One piece, high-gloss pre-moulded type, 0.8 mm (30mls) thick. Jackets exposed to outdoor use or flourescent lighting shall be ultra-violet ray resistant.
- .3 Canvas Jackets: ULC listed treated cotton fabric, 220 g/sq.m. to ASTM C 921
- .4 Aluminum Jackets: 0.51 mm thick; stucco embossed.

.2 Exterior Applications:
- .1 Aluminum Jackets: 0.51 mm thick; stucco embossed.
- .2 Stainless Steel Jackets: Type 304 stainless steel; 0.25 mm thick, stucco embossed
- .3 Outdoor Jacket: Coated glass fibre sheet, 16 kg/sq m.

2.4 ACCESSORIES

.1 Bands: 20 mm wide; 0.38 mm thick stainless steel.

.2 Insulating Cement: Hydraulic setting on mineral wool.

.3 Fibrous Glass Cloth: Untreated; 305 g/sq m weight.

.4 Adhesives: Compatible with insulation, waterproof, fire-retardant type.

.5 Impale Anchors: Galvanized steel, 2 mm diameter with 35mm diameter head, length as required for insulation.

.6 Joint Tape: self adhesive reinforced aluminum, minimum 50mm wide

.7 Tie Wire: stainless steel, 1.5 mm.

.8 Outdoor vapour retarder mastic:
- .1 Vinyl emulsion type acrylic, compatible with insulation
- .2 Fibrous glass cloth

3 Execution

3.1 PRE-INSTALLATION REQUIREMENTS

.1 Pressure testing of ductwork systems complete, witnessed and certified.

.2 Surfaces clean, dry, free from foreign material.

3.2 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 Fasteners: install at 300 mm on centre in horizontal and vertical directions, minimum 2 rows each side.

.6 Apply high compressive strength insulation where insulation may be compressed by weight of ductwork.

.7 Locate insulation or cover seams in least visible location.

.8 Provide recovering jackets on exposed insulation throughout, including equipment room. Insulation located in crawl spaces, shafts and suspended ceiling spaces is not considered exposed. Use pre-sized paper under recovering at uneven insulated surfaces.

.9 External Duct Insulation:
- .1 Secure insulation with vapour barrier with wires and seal jacket joints with vapour barrier adhesive or tape to match jacket.
- .2 Secure insulation without vapour barrier with staples, tape, or wires.
- .3 Install without sag on underside of duct work. Use adhesive or mechanical fasteners to prevent sagging. Seal vapour barrier penetrations with vapour barrier adhesive. Stop and point insulation around access doors and damper operators.

.10 Exposed Rectangular: Secure rigid insulation with 50% coverage of adhesive and 12 gauge galvanized impale anchor tabs on 400 mm (16") centres. Seal joints and breaks with 250 mm (10") wide strips of open mesh glass cloth or tape imbedded between 2 coats of vapour barrier sealant. Point up other joints and breaks with hydraulic setting cement.

.11 Round Duct and Concealed Rectangular Duct: Adhere flexible insulation to ductwork with adhesive applied in 150 mm (6") wide strips on 400 mm (16") centres. Provide 16 gauge annealed tie wire tied, spiral wound or half hitched at 200 mm (8") centres for securing duct insulation until adhesive sets. Butt insulation and seal joints and breaks with 50 mm (2") lap of foil adhered over joint.

.12 Acoustic lining: Apply to interior of ducts where shown.
- .1 Adhere insulation with adhesive for 100 percent coverage. Secure insulation with mechanical fasteners on 375 mm centres maximum on top and side of duct work with dimension exceeding 500 mm. Seal and smooth joints. Seal vapour barrier penetrations with vapour barrier adhesive. Cut off excess fastener length and cover with brush coat of mastic.
- .2 Use 25 mm (1") thick insulation unless otherwise noted.

.3 Provide vapour barrier located on the warm side for outside air intakes.
.4 Ducts with acoustic insulation do not require external thermal insulation
.5 Ductwork dimensions indicated on drawings include insulation thickness.

3.3 INSTALLATION - JACKETS

.1 Install in accordance with TIAC standards and manufacturers written requirements.

.2 Provide recovering jackets on exposed insulation throughout, including equipment room. Insulation located in crawl spaces, shafts and suspended ceiling spaces is not considered exposed. Use pre-sized paper under recovering at uneven insulated surfaces.

3.4 DUCTWORK INSULATION SCHEDULE

.1 Insulation types and thicknesses: conform to following table:

System	TIAC Code	Vapour Retarder	Thickness (mm)
Rectangular cold and dual temperature supply air ducts	C-1	yes	50
Round cold and dual temperature supply air ducts	C-2	yes	50
Supply, return and exhaust ducts exposed in space being served	none, unless indicated otherwise on drawings		
Mixing plenums	C-1	yes	50
Exhaust duct between fan and louvre/discharge	C-1	Yes	50
Acoustically lining	none		25

.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 TIAC codes noted in table:

	Rectangular	Round
Indoor, concealed	none	none
Indoor, exposed within mechanical room	CRF/1	CRD/2
Indoor, exposed elsewhere	CRF/2	CRD/3
Outdoor, exposed to precipitation	CRF/3	CRD/4
Outdoor, elsewhere	CRF/4	CRD/5

END OF SECTION

1. General

1.1 REFERENCES

.1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
- .1 ANSI/ASHRAE/IESNA 90.1-01-SI, Energy Standard for Buildings Except Low-Rise Residential Buildings.

.2 American Society for Testing and Materials (ASTM International)
- .1 ASTM B209M-01, Specification for Aluminum and Aluminum Alloy Sheet and Plate.
- .2 ASTM C335-95, Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.
- .3 ASTM C411-97, Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
- .4 ASTM C449/C449M-00, Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.
- .5 ASTM C533-95 (2001), Specification for Calcium Silicate Block and Pipe Thermal Insulation.
- .6 ASTM C547-00, Specification for Mineral Fiber Pipe Insulation.
- .7 ASTM C553-00, Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
- .8 ASTM C612-00a, Specification for Mineral Fiber Block and Board Thermal Insulation.
- .9 ASTM C795-92 (1998)e1, Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
- .10 ASTM C921-89 (R1996), 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 CGSB 51-GP-53M-95, Poly (Vinyl Chloride) Jacketing Sheet, for Insulated Pipes, Vessels and Round Ducts.

.4 Thermal Insulation Association of Canada (TIAC)
- .1 National Insulation Standards 1992(R1999).

.5 Underwriters Laboratories of Canada (ULC)
- .1 CAN/ULC-S102-M88 (R2000), Surface Burning Characteristics of Building Materials and Assemblies.

1.2 PRODUCT DATA

.1 Submit Product Data in accordance with Section 01 33 00 - Submittal Procedures.

1.3 SAMPLES

.1 Submit samples in accordance with Section 01 33 00 - Submittal Procedures.

.2 Submit for approval: complete assembly of each type of insulation system, insulation, coating, and adhesive proposed. Mount sample on 12 mm plywood board. Affix typewritten label beneath sample indicating service.

1.4 MANUFACTURER'S INSTRUCTIONS

.1 Submit manufacturer's installation instructions in accordance with 01 33 00 - Submittal Procedures.

.2 Installation instructions to include procedures to be used, installation standards to be achieved.

1.5 QUALITY ASSURANCE

.1 Applicator: Company specializing in mechanical insulation application with three years minimum experience.

.2 Materials: UL listed; flame spread/smoke developed rating of 25/50 in accordance with ASTM E84.

.3 Do work to TIAC standards.

.4 Deliver material to job site in original non-broken factory packaging, labelled with manufacturer's density and thickness.

.5 Perform work at ambient and equipment temperatures as recommended by the adhesive manufacturer. Make good separation of joints or cracking of insulation due to thermal movement or poor workmanship.

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 Mineral fibre: includes glass fibre and rock wool. Insulation on steam equipment to be rock wool only, glass fibre is not permitted.

.2 Rock wool shall be utilized on steam systems.
- .1 TIAC Code A-1; rigid pre-moulded mineral fibre to ASTM C 547 with or without factory applied vapour retarder jacket; ksi value of 0.035 at 24 deg.C
- .2 TIAC Code A-2: rigid moulded calcium silicate to ASTM C533 in sections and blocks, and with special shapes to suit project requirements, asbestos free; ksi value of 0.060 at 147 degrees C

.3 TIAC Code A-3: rigid pre-moulded mineral fibre to ASTM C 547 with or without factory applied vapour retarder jacket for high temperature applications; ksi value of 0.072 at 260 degrees C

.4 TIAC Code A-6: flexible unicellular tubular elastomer to ASTM C534; ksi value of 0.04 at 24 degrees C

.5 TIAC Class C-1: Rigid mineral fibre board to ASTM C612, unfaced or faced with CGSB 51-GP-52Ma vapour retarder jacket; ksi value of 0.035 at 24 deg.C.

.6 TIAC Code C-2: mineral fibre blanket to ASTM C553 with or without factory applied vapour retarder jacket. Thermal conductivity; ksi value of 0.04 at 24 degrees C.

2.3 CEMENT

.1 Thermal insulating and finish

.1 To: ASTM C449/C449M.

.2 Hydraulic setting or Air drying on mineral wool, to ASTM C449.

2.4 INSULATION SECUREMENTS

.1 Tape: Self-adhesive, aluminum, plain, 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 Fasteners: 2 mm diameter pins with 35 mm diameter clips. Length of pin to suit thickness of insulation.

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.

3. Execution

3.1 PRE- INSTALLATION REQUIREMENTS

.1 Pressure testing of equipment and adjacent piping systems complete, witnessed and certified.

.2 Surfaces clean, dry, free from foreign material.

3.2 INSTALLATION

.1 Install materials in accordance with manufacturer's instructions and TIAC National standards.

.2 In exposed equipment in finished areas, locate insulation and cover seams in least visible locations.

.3 Provide insulation with vapour barrier when medium may be below ambient temperature and as noted on schedules.

.4 Neatly finish insulation at supports, protrusions, and interruptions.

.5 Apply insulation with edges tightly butted, joints staggered and secured in place by steel bands. Where necessary weld on suitable anchors.

.6 Provide sufficient clearance around openings for normal operation of equipment.

.7 Finish hot surface insulation with 25 mm galvanized hexagonal mesh and coat with hydraulic setting insulation cement.

.8 Finish cold surface insulation joints with 100 mm wide strips of vapour barrier sealed with vapour barrier adhesive finish insulation with heavy coat of vapour barrier mastic applied over whole body. Finish with a final coat of cement containing 25% by weight of Portland Cement. Recover and provide an extra coat of lagging adhesive.

.9 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.
- .1 Hangers, supports outside vapour retarder jacket.

.10 Supports, Hangers:
- .1 Apply high compressive strength insulation, suitable for service, at oversized saddles and shoes where insulation saddles have not been provided.

3.3 INSULATION SCHEDULES

.1 Insulation for equipment to match requirements for associated piping or ductwork serving equipment unless otherwise specified.

.2 Thickness of insulation, refer to Section 23 07 15 Thermal Insulation for Piping and 23 07 13 Duct Insulation.

.3 Finishes:
- .1 Exposed indoors: Stucco embossed aluminum jacket
- .2 Exposed in mechanical rooms: Stucco embossed aluminum jacket.
- .3 Concealed, indoors: canvas on valves, fittings. No further finish.
- .4 Use vapour retarder jacket on TIAC code A-3, A-6 and C-2 insulation compatible with insulation.
- .5 Outdoors: water-proof aluminum jacket.
- .6 Finish attachments: SS screws, at 150 mm on centre. Seals: wing.
- .7 Installation: to appropriate TIAC code.

END OF SECTION

1 General

1.1 SUMMARY

.1 Section Includes:
- .1 Thermal insulation for piping and piping accessories.

1.2 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.

1.3 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.

1.4 QUALITY ASSURANCE

.1 Applicator: Company specializing in mechanical insulation application with three years minimum experience.

.2 Materials: UL listed; flame spread/smoke developed rating of 25/50 in accordance with ASTM E84.

.3 Do work to TIAC standards.

.4 Deliver material to job site in original non-broken factory packaging, labelled with manufacturer's density and thickness.

.5 Perform work at ambient and equipment temperatures as recommended by the adhesive manufacturer. Make good separation of joints or cracking of insulation due to thermal movement or poor workmanship.

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 Mineral fibre specified includes glass fibre and rock wool. Insulation on steam lines to be rock wool only, glass fibre is not permitted.
- .1 TIAC Code A-1; rigid pre-moulded mineral fibre to ASTM C 547 with or without factory applied vapour retarder jacket; ksi value of 0.035 at 24 degrees

.2 TIAC Code A-2: rigid moulded calcium silicate to ASTM C533 in sections and blocks, and with special shapes to suit project requirements, asbestos free; ksi value of 0.060 at 147 deg.C.

.3 TIAC Code A-3: rigid pre-moulded mineral fibre to ASTM C 547 with or without factory applied vapour retarder jacket for high temperature applications; ksi value of 0.072 at 260 degrees C

.4 TIAC Code A-6: flexible unicellular tubular elastomer to ASTM C534; ksi value of 0.04 at 24 degrees C

.5 TIAC Class C-1: Rigid mineral fibre board to ASTM C612, unfaced or faced with CGSB 51-GP-52Ma vapour retarder jacket; ksi value of 0.035 at 24 deg.C.

.6 TIAC Code C-2: mineral fibre blanket to ASTM C553 with or without factory applied vapour retarder jacket. Thermal conductivity; ksi value of 0.04 at 24 deg.C

2.3 REMOVABLE, PRE-FABRICATED INSULATING ENCLOSURES

.1 Use of insulating materials other than those stated in this specification requires Departmental Representative's approval. Standard of acceptance for re-usable insulation blankets shall be Reflex Re-usable flexible insulation covers.

.2 All materials shall be of flame resistant materials.

.3 Re-usable flexible insulation blanket outer jacket material shall be 0.26 kg/m2. Teflon coated fibreglass cloth.

.4 Material used to secure seams and attachments on re-usable flexible insulation blankets shall be 10 strand stainless steel thread with polyester wrap.

.5 Re-usable flexible insulation blanket liner material shall be 560 grams/m2 Teflon coated fibreglass cloth for operating temperatures up to 232 deg.C.

.6 Minimum insulation thickness shall be 25 mm insulation for operating temperatures up to 232 deg.C.

.7 Insulation materials shall be Type E needled fibreglass mat containing no organic binders and no less than 11 pound density for operating temperatures up to 538 deg.C.

.8 Fasteners shall be velcro closures incorporated with seam flaps in conjunction with sewn on straps and stainless steel D rings.

.9 Flaps shall be used to cover all closing seams and cover slots. The flaps shall be 50 mm wide plain flaps for operating temperatures up to 232 deg.C.

.10 6 mm matrix braded Nomex draw-cord closures shall be used on cover openings over 50 mm in diameter. Close the ends of covers over adjacent insulation or piping.

.11 Quilting fasteners shall be 14 gauge stainless steel quilt pins and locking washers.

.12 A stainless steel drain grommet, 11 mm in diameter, shall be installed at the low point on the cover.

.13 A permanent stainless steel or aluminum identification tag shall be attached to each blanket. Tags shall be secured to the re-usable blanket with aluminum rivets and shall be installed in the most visible location on the blanket.

2.4 ACCESSORIES

.1 Bands: 20 mm wide; 0.38 mm thick stainless steel.

.2 Insulating Cement: Hydraulic setting on mineral wool.

.3 Fibrous Glass Cloth: Untreated; 305 g/sq m weight.

.4 Adhesives: Compatible with insulation, waterproof, fire-retardant type.

.5 Impale Anchors: Galvanized steel, 2 mm diameter with 35mm diameter head, length as required for insulation.

.6 Joint Tape: self adhesive reinforced aluminum, minimum 50mm wide

.7 Tie Wire: stainless steel, 1.5 mm.

.8 Outdoor vapour retarder mastic:
- .1 Vinyl emulsion type acrylic, compatible with insulation
- .2 Fibrous glass cloth

2.5 JACKETS

.1 Interior Applications:
- .1 Vapour Barrier Jackets: to CGSB 51-GP-52Ma.
- .2 PVC Jackets: One piece, high-gloss pre-moulded type, 0.8 mm (30mls) thick. Jackets exposed to outdoor use or flourescent lighting shall be ultra-violet ray resistant.
- .3 Canvas Jackets: ULC listed treated cotton fabric, 220 g/sq.m. to ASTM C 921
- .4 Aluminum Jackets: 0.51 mm thick; stucco embossed.

.2 Exterior Applications:
- .1 Aluminum Jackets: 0.51 mm thick; stucco embossed.
- .2 Stainless Steel Jackets: Type 304 stainless steel; 0.25 mm thick, stucco embossed
- .3 Outdoor Jacket: Coated glass fibre sheet, 16 kg/sq m.

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 Surfaces clean, dry, free from foreign material.

3.3 INSTALLATION ON PIPING

.1 Install materials in accordance with manufacturer's instructions and TIAC National standards.

.2 Continue insulation with vapour barrier through penetrations. pack around pipes with fire proof self-supporting insulation material, properly sealed.

.3 In exposed piping, locate insulation and cover seams in least visible locations.

.4 Provide insulation with vapour barrier when medium conveyed may be below ambient temperature and as noted on schedules.

.5 Insulate fittings and valves on pipe systems.

.6 On insulated piping with vapour barrier, insulate fittings, valves, unions, flanges, strainers, flexible connections, and expansion joints. Cover with open mesh glass cloth sealed with vapour barrier sealant.

.7 On insulated piping without vapour barrier and piping conveying fluids 60 degrees C or less, do not insulate flanges and unions at equipment, but bevel and seal ends of insulation at such locations.

.8 Provide an insert of cork or other heavy density material not less than 150 mm long, of same thickness and contour as adjoining insulation, between support shield and piping, but under the finish jacket, on piping 50 mm diameter or larger.

.9 Neatly finish insulation at supports, protrusions, and interruptions.

.10 Handicap Plumbing Fixtures: Insulate trap and drain with 25 mm (1") fibreglass insulation complete with high gloss white PVC jacket. Refer to Plumbing specifications.

.11 Each and every chilled water pipe fitting and accessories located outside of the mechanical room shall be insulated to prevent sweating on exposed parts, this includes all unions, balancing valves, strainers, drains, air vent stems, etc. All parts utilized in maintaining the system shall be insulated with removable insulation. In mechanical rooms, insulation may be omitted on equipment where drain pans are provided including pumps and associated inlet valves.

3.4 REMOVABLE, PRE-FABRICATED, INSULATION AND ENCLOSURES

.1 Removable insulation bags must be provided for the following: control valves, unions or flanges at equipment, steam traps, flanged valves, expansion joints, PRVs, heat exchangers, and all pressure vessels that require cyclical inspection in accordance with the Provincial Boiler and Pressure Vessel Act.

.2 Design: to permit movement of expansion joint and to permit periodic removal and replacement without damage to adjacent insulation.

.3 Blankets on flanged valves and equipment shall be designed to cover adjacent mating flanges and overlap line insulation by a minimum of 50 mm. Allowance of stud length plus 25 mm from the back of the mating flange shall be used to calculate the cut back distance of line insulation. Draw-cold flaps shall not be considered as part of the overlap.

.4 Blankets on valves shall be designed to cover the valve body and the bonnet flange of the valve.

.5 Blankets for pressure gauges include block and bleed valve.

.6 Blankets for PSV's shall include the outlet flange. Blanket shall cover entire spring chamber.

.7 All blankets shall be fitted with an identification tag clearly marked with the following information:

.1	Equipment size and type	i.e. 6" 300# Control Valve
.2	Equipment location and tag number	i.e. 21-PV-129
.3	Manufacturer's Serial Number	i.e SN01010

.8 All equipment shall be field measured by blanket supplier. Measurements shall be performed after equipment is installed. All necessary allowances for the blankets shall be coordinated between the blanket supplier and the mechanical, electrical and insulation Contractors.

.9 Re-usable flexible insulation blanket construction:

.1 Blankets up to 25 mm thick shall be inside seam construction with double stitching, with the liner and jacket material sewn together to form the insulation pocket.

.1 Perimeter flaps shall be formed as an extension of the liner and jacket, and shall not be attached to blanket as separate pieces.

.2 All blankets up to 25 mm thick must be double stitched. First stitch will be performed with cloth layers sewn together inside out. Blanket will then be turned right side out and top stitched around all penetrations and around the perimeter of the insulation pocket to create a separation between the insulation pocket and the perimeter flaps.

.3 All draw-cord and closure flaps, required inside the perimeter of the blanket shall be attached inside the seam, between the liner and jacket layers of the blanket.

.2 Blankets over 25 mm thick shall be constructed using boxed corners and gussets in order to maintain consistent thickness across the entire area of the blanket.

.1 Perimeter flaps shall be formed as an extension of the outer jacket, and shall not be attached to the blanket as separate pieces.

.2 All draw-cord and closure flaps, required inside the perimeter of the blanket, shall be attached inside the seam, between the liner and jacket layers of the blanket.

3.5 INSTALLATION - JACKETS

.1 Install in accordance with TIAC standards and manufacturers written requirements.

.2 Indoor, Concealed Pipes: Apply pipe insulation with an integral all-service jacket complete with vapour barrier if specified. Secure jacketing using appropriate fastenings on approximately 100mm centres. Cover longitudinal and circumferential joints with jacket finishing tape neatly applied. Alternately secure jacketing using integral self-sealing lap and self-sealing circumferential joint strips. Fittings, (valves and strainers if specified) not finished with PVC covers shall be covered with a hard coat cement and finish with treated fitting fabric applied with fabric adhesive. Finish jackets as scheduled.

.3 Indoor, Exposed Applications: Insulate as for concealed applications. Finish jacket to be as indicated in schedule. Where indicated by Architect to be painted, finish insulation with canvas jacket; size for finish painting.

.4 Exterior Applications: Vapour barrier jacket, covered with aluminum jacket with seams located on bottom side of horizontal piping. insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe, and finish with glass mesh reinforced vapour barrier cement. Lap joints 75 mm (3") minimum and seal with compatible waterproof lap cement.

.5 Provide recovering jackets on exposed insulation throughout, including equipment room. Insulation located in crawl spaces, shafts and suspended ceiling spaces is not considered exposed. Use pre-sized paper under recovering at uneven insulated surfaces.

.6 Metal Jackets: Over the pipe insulation apply metal jacketing using necessary fastenings on approximately 150mm centres. Over insulated fittings, (valve bodies, valve bonnets, strainers and flanges etc. as specified) apply metal jacket or preformed metal fitting covers to provide a complete jacket system. Secure with necessary fastenings.

.7 PVC Jackets: Over the pipe insulation apply PVC jacketing using necessary fastenings on approximately 100mm centres. Cover longitudinal and circumferential joints with finishing tape neatly applied. Over insulated fittings, valve bodies, valve bonnets, strainers and flanges if specified) apply PVC jacket or preformed PVC fitting covers to provide a complete jacket system. Secure with appropriate fastenings and jacket finishing tape.

3.6 PIPING INSULATION SCHEDULES

.1 Includes valves, valve bonnets, strainers, flanges, fittings and all associated equipment unless otherwise specified.

.2 TIAC Code: A-1.
- .1 Seals: lap seal adhesive, lagging adhesive.
- .2 Installation: TIAC Code 1501-H.

.3 TIAC Code: A-3.
- .1 Seals: VR lap seal adhesive, VR lagging adhesive.
- .2 Installation: TIAC Code: 1501-C.

.4 TIAC Code: A-6.
- .1 Seals: lap seal adhesive, lagging adhesive.
- .2 Installation: to TIAC standards.

.5 TIAC Code: C-2 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.
- .3 Chilled water insulation thicknesses are listed such that a minimum of 25mm is maintained over all fittings, valves and accessories.
- .4 Note that in accordance with the National Energy Code of Canada for Buildings HVAC piping located outside the building envelope shall be insulated to the thickness specified for steam over 175 Deg.C. This requirement does not alter the TIAC Code defining the type of insulation to be used.

Application	Temp deg.C.	TIAC code	Pipe sizes (NPS) & insulation thickness (mm)					
		Run out	to 1	1 1/4 to 2	2 1/2 to 4	5 to 6	8 & over	
Steam (rock wool only)	up to 175	A-1	38	50	65	75	90	90
Condensate Return	60 - 94	A-1	25	38	38	38	38	
Hot Water	60 - 94	A-1	25	38	38	38	38	38
Hot Water	up to 59	A-1	25	25	25	25	38	38
Hot Water Equipment	All Temp.	A-1	38	38	38	38	38	38
Dual Temp.	4 - 94	A-3	25	38	38	38	38	38
Cold Water		A-3	25	25	25	25	25	25
Refrigerant	4 - 13	A-6	25	25	25	25	25	25
Refrigerant	below 4	A-6	25	25	38	38	38	38
RWL and RWP		C-2	25	25	25	25	25	25
(with no associated heating loop, insulate rainwater from roof to exterior discharge)								
RWL and RWP		C-2	50	50	50	50	50	50
(with associated heating loop, insulate rainwater from roof to exterior discharge)								
Chilled Water	4 - 13	A-3	38	38	38	38	38	38
Chilled Water	below 4	A-3	38	38	38	38	38	38
Cooling Coil cond. drain and pan		C-2	25	25	25	25	25	25

.8 Finishes:
- .1 Exposed indoors: Stucco embossed aluminum jacket.
- .2 Exposed in mechanical rooms: Stucco embossed aluminum jacket.
- .3 Concealed, indoors: canvas on valves, fittings. No further finish.
- .4 Use vapour retarder jacket on TIAC code A-3, A-6 and C-2 insulation compatible with insulation.
- .5 Outdoors: water-proof stucco embossed aluminum jacket.

.6 Finish attachments: SS screws, at 150 mm on centre. Seals: wing.
.7 Installation: to appropriate TIAC code CRF/1 through CPF

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

1 General

1.1 REFERENCES

.1 American Society for Testing and Materials International (ASTM)
  .1 ASTM E202-04, Standard Test Methods for Analysis of Ethylene Glycols and Propylene Glycols.

1.2 CLEANING AND START-UP OF MECHANICAL PIPING SYSTEMS

.1 In accordance with Section 23 08 02 - Cleaning and Start-up of Mechanical Piping Systems.

2 Products

2.1 NOT USED

.1 Not Used.

3 Execution

3.1 PREPARATION

.1 Do not conceal or cover piping, fixtures or equipment until inspected by consultant and tested.

.2 Provide equipment, materials and labour for tests and pay expenses. Use test instruments by approved laboratory or manufacturer and furnish certificate showing degree of accuracy.

.3 Test instruments shall have been calibrated within one year

.4 Install permanent gauges and thermometers just prior to tests to avoid changes in calibration.

.5 Carry out hydraulic tests for 8 hours and maintain pressure. Where leakage occurs, repair and re-test.

.6 Before adjusting and balancing, verify that systems are complete and operable. Ensure temperature control systems are complete and operable, thermal overload protection is in place, final filters installed, hydronic systems, flushed, filled, and vented.

.7 Provide instruments required for testing, adjusting, and balancing operations. Make instruments available to Consultant to facilitate spot checks during testing.

.8 Recorded data shall represent actually measured, or observed condition.

3.2 PRESSURE TESTS

.1 Heating Water Piping: Test to 1-1/2 times maximum working pressure or minimum 1034 kPa (150 psi) water pressure.

.2 Domestic Water Piping: Test to 1-1/2 times maximum working pressure or 1034 kPa (150 psi) water pressure measured at system low point.

.3 Drainage Systems: Test by filling with water to produce water pressure of 30 kPa (10') minimum and 75 kPa (25') maximum. Check for proper grade and obstruction by ball test.

.4 Standpipe System: Test to 2070 kPa water pressure at the valve.

.5 Sprinkler System: Test as required by authorities having jurisdiction.

.6 Control Air Piping: Test to 345 kPa air pressure. Maintain pressure 1 hour with maximum 7 kPa pressure drop.

.7 Refrigerant Piping: Test with nitrogen to 2070 kPa on high pressure side and 1035 kPa on low side and refrigerant halide torch test.

.8 Inslab piping: Test to 275 kPa (40 psi) with air for minimum of 24 hours prior to installation of concrete, and during topping pour.

.9 Gas Piping: Test as required by authority having jurisdiction.

.10 Check system during application of test pressure including visual check for leakage of water test medium, soap bubble test for air or nitrogen test medium and halide torch for refrigerant medium.

.11 During heating and cooling piping system tests, check linear expansion at elbows, U bends, expansion joints, and offsets for proper clearance.

.12 When using water as test medium for system not using water or steam, evacuate and dehydrate the piping and certify the lines are dry. Use agency specializing in this type of work.

.13 Should tests indicate defective work or variance with specified requirements, make changes immediately to correct the defects. Correct leaks by remaking joints in screwed fittings, cutting out and rewelding welded joints, remaking joints in copper lines. Do not caulk.

.14 Sprinkler system: Test as required by authorities having jurisdiction.

.15 Low pressure steam and condensate piping: Test to 700 kPa (100 psi) hydrostatic pressure.

3.3 PERFORMANCE TESTS

.1 Conduct performance tests to demonstrate equipment and systems meet specified requirements after mechanical installations are completed and pressure tested. Conduct tests as soon as conditions permit. Make changes, repairs, and adjustments required as tests may indicate prior to operating tests.

.2 Lubricate bearings, adjust and/or replace and set direct and "V" belt drives for proper alignment and tension.

.3 Calibrate and adjust thermostats, thermometers, gauges, linkage and dampers. Control valves shall operate freely.

.4 Operate and test motors and speed switches for correct wiring and sequences. Check overload heaters in motor starters.

.5 Replace disposable filters with new testing filters and remove, clean and reinstall washable filters prior to conducting testing.

.6 Clean fan wheel and coils prior to conducting tests.

.7 Remove, clean, and reinstall strainers prior to conducting tests.

.8 Fasten loose and rattling pieces of equipment. Unit heaters, pumps and other equipment shall operate quietly.

.9 Make operating tests for minimum of 5 days during heating season and cooling season of first year of operation and at times when directed, for proper setting of controls under peak load conditions.

.10 Provide services of mechanics and manufacturer's representatives, ladders, tools and associated equipment required to assist the Owner in final tests.

.11 Conduct final operating tests in presence of the Owner. Vary loads to illustrate start-up and shut-down sequence and simulate emergency Conditions for safety shut-downs, with automatic and manual reset. Repair and test defects until satisfactory. Make final adjustments to suit exact building conditions.

.12 Provide manufacturer’s start-ups and reports as specified under specific equipment. Provide copies reports in the Operation and Maintenance Manuals.

.13 Subject gas fired appliances rated in excess of 117 kW to an operational test established by the authority having jurisdiction and to pass this test before being approved for operation.

3.4 HYDRONIC SYSTEMS - PERFORMANCE VERIFICATION (PV)

.1 Perform hydronic systems performance verification after cleaning is completed and system is in full operation.

.2 When systems are operational, perform following tests:
- .1 Conduct full scale tests at maximum design flow rates, temperatures and pressures for continuous consecutive period of 48 hours to demonstrate compliance with design criteria.
- .2 Verify performance of hydronic system circulating pumps as specified, recording system pressures, temperatures, fluctuations by simulating maximum design conditions and varying.
  - .1 Pump operation.
  - .2 Heating Plant and Chilled Water Plant operation (only as pertains to supplying energy to modified systems in scope).
  - .3 Maximum heating demand.
  - .4 Maximum cooling demand.

3.5 HYDRONIC SYSTEM CAPACITY TEST

.1 Perform hydronic system capacity tests after:
- .1 TAB has been completed
- .2 Verification of operating, limit, safety controls.
- .3 Verification of primary and secondary pump flow rates.
- .4 Verification of accuracy of temperature and pressure sensors and gauges.

.2 Calculate system capacity at test conditions.

.3 Using manufacturer's published data and calculated capacity at test conditions, extrapolate system capacity at design conditions.

.4 When capacity test is completed, return controls and equipment status to normal operating conditions.

.5 Submit sample of system water to approved testing agency to determine if chemical treatment is correct. Include cost.

.6 Heating system capacity test:
- .1 Perform capacity test when ambient temperature is within 10% of design conditions. Simulate design conditions by:
  - .1 Increasing OA flow rates through heating coils (in this case, monitor heating coil discharge temperatures to ensure that coils are not subjected to freezing conditions) or
  - .2 Reducing space temperature by turning of heating system for sufficient period of time before starting testing.
- .2 Test procedures:
  - .1 Open fully heat exchanger, heating coil and radiation control valves.
  - .2 With boilers on full firing and hot water heating supply temperature stabilized, record flow rates and supply and return temperatures simultaneously.
  - .3 Conduct flue gas analysis test on boilers at full load and at low fire conditions.

.7 Chilled water system capacity test:
- .1 Perform capacity test when ambient temperature is within 10% of design conditions. Simulate design conditions by:
  - .1 Adding heat from building heating system or;
  - .2 Raising space temperature by turning off cooling and air systems for sufficient period of time before starting testing and pre-heating building to summer design space temperature (occupied) or above.
- .2 Test procedures:
  - .1 Open fully cooling coil control valves.
  - .2 Set thermostats on associated AHU's for maximum cooling.
  - .3 Set AHU's for design maximum air flow rates.
  - **.4** After system has stabilized, record chilled water flow rates and supply and return temperatures simultaneously.

3.6 STEAM SYSTEMS

.1 Performance verification:
- .1 When systems are operational, perform relevant tests of steam and condensate return piping systems as specified under hydronic systems.
- .2 Verify operation of components of steam system including:
  - .1 Steam traps by:
    - .1 Measuring temperature of condensate return and/or
    - .2 Using audio-sensing devices.
    - .3 Use of other approved methods.
  - .2 Thermostatic vents.
- .3 Verify performance of condensation units, including:
  - .1 Pump capacity at design temperature.
  - .2 Controls.
- .4 Verify performance of condensate return system to ensure return of maximum quantity of condensate return water at with minimum temperature drop.

.5 Adjust piping system as required to eliminate water hammer.

.2 Monitor system continuously until acceptance for proper operation of components including steam traps, thermostatic vents, flash tanks and condensate pumping units.

3.7 SANITARY AND STORM DRAINAGE SYSTEMS

.1 Ensure that traps are fully and permanently primed.

.2 Ensure that fixtures are properly anchored, connected to system.

.3 Operate flush valves and operate each fixture to verify drainage and no leakage.

.4 Cleanouts: refer to Section 22 42 03 - Commercial Washroom Fixtures.

.5 Roof drains:
- .1 Refer to Section 22 42 03 - Commercial Washroom Fixtures.
- .2 Remove caps as required.

3.8 REPORTS

.1 Include record of all tests in Operation and Maintenance Manuals.

3.9 TRAINING

.1 In accordance with Section 21 05 01 - Common Work Results Mechanical.

END OF SECTION

1 General

1.1 SUMMARY

.1 Section Includes:
  .1 Procedures and cleaning solutions for cleaning mechanical piping systems.

1.2 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).

1.3 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.

1.4 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.

2 Products

2.1 GENERAL REQUIREMENTS

.1 Provide on-site start-up services and support services as required during first year of operation to maintain chemical treatment program.

.2 Materials which may contact finish areas through leakage shall be colourless.

.3 It is the Contractor’s full responsibility for providing suitable working systems especially and in accordance with the requirements of the boiler/chiller manufacturer and equipment construction (copper, aluminum, cast iron, etc.).

2.2 CLOSED HYDRONIC SYSTEM

.1 Cleaning:
  .1 Buffered liquid alkaline compound with emulsifying agents and detergents to remove grease and petroleum products; sodium tripoly phosphate and sodium molybdate.
  .2 Biocide, chlorine release agents such as sodium hypochlorite or calcium hypochlorite, or microbiocides such as quarternary ammonia compounds, tributyl tin oxide, methylene bis (thiocyanate), or isothiazolones.

.2 Glycol:
.1 Refer to equipment schedule for type of glycol and percentage of solution. Contractor shall ensure glycol utilized meets Manufacturers requirements for the installed equipment.

2.3 STEAM SYSTEM

.1 Cleaning:
.1 Alkaline compound with emulsifying agents and detergents to remove grease and petroleum products; sodium tripoly phosphate and sodium molybdate.
.2 Biocide, chlorine release agents such as sodium hypochlorite or calcium hypochlorite, or microbiocides such as quarternary ammonia compounds, tributyl tin oxide, methylene bis (thiocyanate), or isothiazolones

.2 Treatment:
.1 Sequestering agent to reduce hardness and prevent feedline congestion; phosphate.
.2 Base to provide alkalinity; hydroxide.
.3 Oxygen scavenger; sodium sulphite or hydrazine.
.4 Carbon dioxide neutralizer; volatile amines such as morpholine or cyclohexylamine.
.5 Filming amines; octadecylamine.

.3 Application:
.1 Boilers: Sequestering agents to reduce and inhibit scaling, corrosion, foaming, sludge and acid attack, contingent on local water supply.
.2 Piping: injection of amines to reduce scaling and corrosion of piping system.
.3 Condensate Receiver: sequestering agents to reduce and inhibit scaling, corrosion, foaming, sludge and acid attack, contingent on local water supply

2.4 POT FEEDER

.1 1.9L (2 quart) capacity cast iron or welded steel with quick opening cap for working pressure of 1200 kPa.

2.5 SIDESTREAM FILTER

.1 Refer to Section 23 21 14 Hydronic Specialties.

2.6 WATER METER

.1 Displacement type cold water meter with sealed, tamper-proof magnetic drive, impulse contact register, single pole, double throw dry contact switch.

2.7 SOLENOID VALVES

.1 Forged brass body globe pattern, normally open or closed as required, general purpose solenoid enclosure, and continuous duty coil.

2.8 GLYCOL SYSTEM

.1 Refer to equipment schedule.

.2 Packaged glycol mixing and fill system complete with following standard components:
.1 Storage/mixing tank with cover
.2 Power supply: cord and plug for standard 115 VAC plug.

.3 Pressure pump capable of running dry without damage.
.4 Low level pump cut-out.
.5 Pump suction hose with inlet strainer and check valve.
.6 Feeder system shall be compatible with glycol solutions up to 50%.
.7 Manual diverter valve for purging air and agitating contents of storage tank.
.8 Unit to be complete with Low Level Alarm Panel c/w Remote Monitoring Dry Contacts and Selectable Audible Alarm

2.9 HEAT TRANSFER FLUID

.1 Refer to equipment schedule for percentage by volume solution of inhibited glycol based heat transfer fluid and type of glycol.

.2 Heating Water Systems: Heat transfer fluid shall be in accordance with the type/construction of the boiler being installed (copper, aluminum, cast iron, stainless steel, etc.) and in accordance with the boiler manufacturer's requirements. The contractor shall ensure that the chemical treatment Agency has all necessary information regarding the boiler system. All chemicals used and system maintenance information shall be provided and included in the maintenance manuals. For boilers with aluminium heat exchangers, glycol with multi-metal additives such as produced by Rhogard, Brenntag, Ashland or Furnox shall be used according to the boiler manufacturer.

.3 Chilled Water Systems: Heat transfer fluid shall be in accordance with the type/construction of the chiller being installed and in accordance with the chiller manufacturer's requirements. The contractor shall ensure that the chemical treatment Agency has all necessary information regarding the chiller. All chemicals used and system maintenance information shall be provided and included in the maintenance manuals.

.4 Dilution Water: Glycol supplier shall identify the optimum dilution water quality required to complement the glycol solution. If different than specified below, this shall be submitted to the Consultant for review. In general, water used to dilute the concentration of glycol must be either distilled, de-ionized, and contain less than 25 ppm of chloride and sulfite, and less than 50ppm each of hard water ions (calcium and magnesium as calcium carbonate) with a total hardness not to exceed 100ppm. If good quality water is not available, the glycol supplier shall provide the heat transfer fluid and water to meet the specifications of the system.

2.10 TEST EQUIPMENT

.1 Provide test kits as required to determine proper systems treatment and not limited to the following:
.1 System Test Kit: P & M Alkalinity, scale inhibitor, nitrite, sulphite, molybdate, Ph and hardness.
.2 Refractormeter to measure freezing protection of glycol mixture.
.3 Alkalinity titration test kit.
.4 Chloride titration test kit.
.5 Sulphite titration test kit.
.6 Total hardness titration test kit.
.7 Low phosphate test kit.
.8 Conductivity bridge, range 0 - 10,000 microhms.
.9 Creosol red pH slide complete with reagent.
.10 High nitrite test kit.

.2 Refractormeter to measure freezing protection of glycol mixture.

3 Execution

3.1 PREPARATION

.1 Ensure reasonable care is exercised in preventing debris, dirt and other foreign material from entering piping system during construction.

.2 Cleaning procedures:
- .1 Provide detailed report outlining proposed cleaning procedures at least 2 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

.3 Systems to be operational, filled, started, and vented prior to cleaning.

.4 Place terminal control valves in open position during cleaning.

.5 Verify that electric power is available and of the correct characteristics.

.6 Provide adequate drain connections to completely drain systems in one hour. Use water meter to record gallonage (litres) in each system.

.7 Remove strainer screens from system during cleaning. Protect or remove control devices from systems being cleaned. Terminal control valves shall be in open position during cleaning.

.8 System pumps may be used for cleaning provided that new set of seals are provided and installed, and pumps are dismantled and inspected. Replace worn parts, install new gaskets and turnover used seals.

3.2 INSTALLATION

.1 Install equipment to manufacturer's written instructions and as per schematics and drawings.

3.3 CLEANING SEQUENCE

.1 Concentration: As recommended by manufacturer.

.2 Flush velocity in system mains and branches shall be sufficient to ensure removal of debris.

.3 Hot Water Heating Systems:
- .1 Apply heat while circulating, slowly raising temperature to 71 degrees C and maintain for 12 hours minimum.
- .2 Remove heat and circulate to 37.8 degrees C or less; drain systems as quickly as possible and refill with clean water.
- .3 Circulate for 6 hours at design temperatures, then drain.
- .4 Refill with clean water and test. Repeat flush and test until traces of system cleaner is removed to satisfaction of the Departmental Representative.
- .5 Refill system with water or water/glycol solution as specified.

.4 Chilled Water Systems:
- .1 Circulate for 48 hours, then drain systems as quickly as possible.
- .2 Refill with clean water, circulate for 24 hours, then drain.
- .3 Refill with clean water and test. Repeat flush and test until traces of system cleaner is removed to satisfaction of the Engineer.
- .4 Refill system with water or water/glycol solution as specified.

.5 Steam Systems:
- .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 Apply heat, slowly raising temperature to 71 degrees C and maintain for 12 hours minimum.
- .4 Cool, then drain as quickly as possible.
- .5 Refill with clean water, drain, refill, test, and check for sludge.
- .6 Repeat until system is free of sludge.
- .7 Apply heat to produce steam for piping system and maintain for 8 hours minimum.
- .8 Bypass traps and waste condensate.
- .9 Starting at drip point closest to source, verify removal of condensate, then re-install steam trap internal parts. Repeat sequence down the line.
- .10 Water hammer: determine source and eliminate cause.
- .11 Flush system until clear or for a minimum of 4 days.
- .12 For condensate return systems, put condensate to drain for a minimum of 7 days to remove oil before returning back to feed system. Prior to connecting, contractor shall take water sample to Central Heating Plant for testing to prove condensate is clean. System shall be flushed until sample passes test.

.6 Use neutralizer agents on recommendation of system cleaner supplier and approval of Consultant.

.7 Inspect, remove sludge, and flush low points with clean water after cleaning process is completed. Include disassembly of components as required.

.8 When cleaning is completed, submit report, complete with certificate of compliance with specifications of cleaning component supplier.

3.4 CLOSED SYSTEM TREATMENT

.1 Provide one bypass feeder in conjunction with sidestream filters on each system. Install isolating and drain valves and necessary piping. Install around balancing valve downstream of circulating pumps unless indicated otherwise.

.2 Introduce closed system treatment through bypass feeder when required or indicated by test.

.3 An analysis of the closed system water shall be taken and recorded by the contractor after completion of work clearly indicating the following: tests proving glycol concentration, tests showing inhibitor strength, tests indicating Ph levels and water quality, Test reports shall identify specified requirements of system and manufacturers requirements for installed equipment and clearly show that water quality, pH, and inhibitor strength all meet identified requirements. This report shall be recorded in the maintenance manual. Refer to ASTM E202.
- .1 Perform tests before system is turned over to the Owner.
- .2 Provide test prior to end of guarantee and replenish as required.

.3 Provide written test results for review for all tests.

.4 Provide antifreeze solution lost from the systems from any cause other than neglect by the Owner during the first year of operation.

.5 Provide two extra 204 litre (45 gallon) drums of specified glycol following

3.5 STEAM SYSTEM TREATMENT

.1 Provide bypass feeder on feed water line to each boiler.

.2 Provide solution pumps to feed sequestering agent and base from solution tank into boiler. Provide minimum of one pump per boiler if treatment materials can be mixed. Provide agitator as required.

.3 Provide solution pump to feed oxygen scavenger from solution tank into condensate receiver/boiler feedwater tank. Provide pumps required to treat feed water. Provide agitator as required. Interlock pump to make-up water meter.

.4 Provide solution pump to feed carbon dioxide neutralizer or filming amine from solution tank into steam header. Provide minimum of one pump.per boiler. Provide agitator as required.

.5 Activate solution pumps when feed water pumps are running.

.6 Provide conductivity controller to sample boiler water and operate solenoid blowdown valve. Provide timer activated sampling with solenoid valve, balancing valve, and conductivity probe. Pipe to blowdown tank.

.7 Provide liquid level switch in each solution tank to de- activate solution pump and agitator, and sound local alarm bell.

3.6 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.
- .7 Check water level / pressure 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.
- .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, 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

3.7 MANUFACTURER'S INSTRUCTIONS

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

END OF SECTION

1 General

1.1 SUMMARY

.1 Section Includes:
  .1 Copper piping valves and fittings for hydronic systems.
.2 Sustainable requirements for construction and verification.

1.2 REFERENCES

.1 American National Standards Institute (ANSI)/American Welding Society (AWS)
  .1 ANSI/AWS A5.8/A5.8M-04, Specification Filler Metals for Brazing and Bronze Welding.

.2 American Society of Mechanical Engineers (ASME)
  .1 ANSI/ASME B16.4-98, Gray-Iron Threaded Fittings.
  .2 ANSI/ASME B16.15-1985 (2004), Cast Bronze Threaded Fittings.
  .3 ANSI B16.18-2001, Cast Copper Alloy, Solder Joint Pressure Fittings.
  .4 ANSI/ASME B16.22-2001, Wrought Copper and Copper-Alloy Solder Joint Pressure Fittings.

.3 American Society for Testing and Materials International (ASTM)
  .1 ASTM B32-04, Standard Specification for Solder Metal.
  .2 ASTM B61-02, Standard Specification for Steam or Valve Bronze Castings.
  .3 ASTM B62-02, Standard Specification for Composition Bronze or Ounce Metal Castings.
  .4 ASTM B88M-03, Standard Specification for Seamless Copper Water Tube Metric.
  .5 ASTM E202-04, 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 SP67-2002a, Butterfly Valves.
  .2 MSS SP70-1998, Cast Iron Gate Valves, Flanged and Threaded Ends.
  .3 MSS SP71-1997, Grey Iron Swing Check Valves, Flanged and Threaded Ends.
  .4 MSS SP80-2003, Bronze Gate, Globe, Angle and Check Valves.
  .5 MSS SP85-2002, Cast Iron Globe and Angle Valves, Flanged and Threaded Ends.

1.3 QUALITY ASSURANCE

.1 Regulatory Requirements: ensure Work is performed in compliance with applicable Provincial /Territorial regulations.

.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 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 Products

2.1 TUBING

.1 Type A 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 or grooved 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.

.3 Butterfly valves: application: isolating each section of multiple component equipment (eg. multi-section coils):
- .1 NPS 2 1/2 and over: lug type, grooved ends: 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: with PFTE disc, as specified Section 23 05 23.01 - Valves - Bronze.
  - .2 Elsewhere: with composition disc, as specified Section 23 05 23.01 - Valves - Bronze.

.5 Balancing, for TAB:
- .1 Sizes: calibrated balancing valves, as specified.
- .2 NPS 2 and under:
  - .1 Automatic flow control device.

.6 Drain valves: gate, Class 125, non-rising stem, solid wedge disc, as specified Section 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, Grooved 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.

.9 Ball valves:
- .1 NPS 2 and under: as specified Section 23 05 23.01 - Valves - Bronze.

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 PIPING INSTALLATION

.1 Refer to Section 23 05 05 Installation of Pipework

.2 Connect to equipment in accordance with manufacturer's instruction unless otherwise indicated.

.3 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.

.4 Slope piping in direction of drainage and for positive venting.

.5 Use eccentric reducers at pipe size change installed to provide positive drainage or positive venting.

.6 Provide clearance for installation of insulation and access for maintenance of equipment, valves and fittings.

.7 Assemble piping using fittings manufactured to ANSI standards.

3.3 VALVE INSTALLATION

.1 Refer to Section 23 05 05 - Installation of Pipework.

.2 Install rising stem valves in upright position with stem above horizontal.

.3 Install butterfly valves on chilled water and condenser water lines only.

.4 Install gate, ball or butterfly valves at branch take-offs and to isolate each piece of equipment, and as indicated.

.5 Install globe valves for balancing and in by-pass around control valves 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 Boiler Rooms and Mechanical Equipment Rooms.

.8 Install ball valves for glycol service.

3.4 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.

3.5 AUTOMATIC CONTROL VALVES

.1 Install where indicated.

.2 Record flow or valve identification tag.

.3 Flow to be within 10% of specified value.

3.6 FLUSHING AND CLEANING

.1 Flush and clean in presence of Departmental Representative.

.2 Flush after pressure test for a minimum of 4h.

.3 Fill with solution of water and non-foaming, phosphate-free detergent 3% solution by weight. Circulate for minimum of 8h.

.4 Refill system with clean water. Circulate for at least 4h. Clean out strainer screens/baskets regularly. Then drain.

.5 Refill system with clean water. Circulate for at least 2h. 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 Departmental Representative's approval.

3.7 FILLING OF SYSTEM

.1 Refill system with clean water/glycol solution, adding water treatment as specified.

3.8 FIELD QUALITY CONTROL

.1 Testing:
- .1 Test system in accordance with Section 230801 Performance Verification Mechanical Piping Systems.

.2 Balancing:
- .1 Balance water systems to within plus or minus 5% of design output.

.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 Departmental Representative.

END OF SECTION

1 General

1.1 SUMMARY

.1 Section Includes.
- .1 Materials and installation for steel piping, valves and fittings for hydronic systems in building services piping.
- .2 Sustainable requirements for construction and verification.

1.2 REFERENCES

.1 American Society of Mechanical Engineers (ASME).
- .1 ASME B16.1-98, Cast Iron Pipe Flanges and Flanged Fittings.
- .2 ASME B16.3-98, Malleable Iron Threaded Fittings.
- .3 ASME B16.5-03, Pipe Flanges and Flanged Fittings.
- .4 ASME B16.9-01, Factory-Made Wrought Buttwelding Fittings.
- .5 ASME B18.2.1-03, Square and Hex Bolts and Screws (Inch Series).
- .6 ASME B18.2.2-87 (R1999), Square and Hex Nuts (Inch Series).

.2 American Society for Testing and Materials International, (ASTM).
- .1 ASTM A47/A47M-99, Standard Specification for Ferritic Malleable Iron Castings.
- .2 ASTM A53/A53M-02, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless.
- .3 ASTM A536-84 (1999)e1, Standard Specification for Ductile Iron Castings.
- .4 ASTM B61-02, Standard Specification for Steam or Valve Bronze Castings.
- .5 ASTM B62-02, Standard Specification for Composition Bronze or Ounce Metal Castings.
- .6 ASTM E202-00, Standard Test Method for Analysis of Ethylene Glycols and Propylene Glycols.

.3 American Water Works Association (AWWA).
- .1 AWWA C111-00, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.

.4 Canadian Standards Association (CSA International).
- .1 CSA B242-M1980 (R1998), Groove and Shoulder Type Mechanical Pipe Couplings.
- .2 CAN/CSA W48-01, Filler Metals and Allied Materials for Metal Arc Welding (Developed in cooperation with the Canadian Welding Bureau).

.5 Manufacturer's Standardization of the Valve and Fittings Industry (MSS).
- .1 MSS-SP-67-025, Butterfly Valves.
- .2 MSS-SP-70-98, Cast Iron Gate Valves, Flanged and Threaded Ends.
- .3 MSS-SP-71-97, Cast Iron Swing Check Valves Flanged and Threaded Ends.
- .4 MSS-SP-80-03, Bronze Gate, Globe, Angle and Check Valves.
- .5 MSS-SP-85-02, Cast Iron Globe and Angle Valves, Flanged and Threaded Ends.

1.3 SUBMITTALS

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

.2 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.

1.4 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.

1.5 MAINTENANCE

.1 Extra Materials.
.1 Provide 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.

2 Products

2.1 PIPE

.1 Steel pipe: to ASTM A53/A53M, Grade B, as follows:
.1 To NPS6.

2.2 PIPE JOINTS

.1 NPS2 and under: screwed fittings with PTFE tape.

.2 NPS2-1/2 and over: flanges to CAN/CSA W48.

.3 Roll grooved: standard coupling to CSA B242.

.4 Flanges: plain or raised face, slip-on weld neck to AWWA C111.

.5 Orifice flanges: slip-on raised face, 2100 kPa.

.6 Flange gaskets: to AWWA C111.

.7 Pipe thread: taper.

.8 Bolts and nuts: to ASME B18.2.1 and ASME B18.2.2.

.9 Roll grooved coupling gaskets: type EPDM.

2.3 FITTINGS

.1 Screwed fittings: malleable iron, to ASME B16.3, Class 150.

.2 Pipe flanges and flanged fittings:
.1 Cast iron: to ASME B16.1, Class 125.
.2 Steel: to ASME B16.5.

.3 Butt-welding fittings: steel, to ASME B16.9.

.4 Unions: malleable iron, to ASTM A47/A47M and ASME B16.3.

.5 Fittings for roll grooved piping: malleable iron to ASTM A47/A47M, ductile iron to ASTM A536.

2.4 VALVES

.1 Connections:
- .1 NPS2 and smaller: screwed ends.
- .2 NPS2.1/2 and larger: Flanged or grooved ends.

.2 Gate valves: to MSS-SP-70. Application: Isolating equipment, control valves, pipelines:
- .1 NPS2 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 NPS21/2 and over:
  - .1 Mechanical Rooms: non-rising stem, solid wedge disc, lead free bronze trim, as specified Section 23 05 23.02 - Valves - Cast Iron.
    - .1 Operators: handwheel.
  - .2 Elsewhere: Non-rising stem, solid wedge disc, lead free bronze trim, as specified Section 23 05 23.02 - Valves - Cast Iron.
    - .1 Operators: handwheel.

.3 Butterfly valves: to MSS-SP-67 Application: Isolating cells or section of multiple component equipment (eg. multi section coils, multi-cell cooling towers):
- .1 NPS21/2 and over: Lug type, Grooved ends: as specified Section 23 05 17 - Pipe Welding.

.4 Globe valves: to MSS-SP-80, 85 Application: Throttling, flow control, emergency bypass:
- .1 NPS2 and under:
  - .1 Mechanical Rooms: with PTFE 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 NPS21/2 and over:
  - .1 With composition lead free, bronze disc, lead free, bronze trim, as specified Section 23 05 23.02 - Valves - Cast Iron.
  - .2 Operators: handwheel.

.5 Balancing, for TAB:
- .1 Sizes: Calibrated balancing valves, as specified this section.
- .2 NPS2 and under:
  - .1 Automatic flow control device where specified.
  - .2 Circuit setter where specified.

.6 Drain valves: Gate, Class 125, non-rising stem, solid wedge disc, as specified Section 23 05 23.01 - Valves - Bronze.

.7 Swing check valves: to MSS-SP-71.

.1 NPS2 and under:
.1 Class 125, swing, with composition disc, as specified Section 23 05 23.01 - Valves - Bronze.
.2 NPS21/2 and over:
.1 Flanged or Grooved ends: as specified Section 23 05 23.02 - Valves - Cast Iron.

.8 Silent check valves:
.1 NPS2 and under:
.1 As specified Section 23 05 23.01 - Valves - Bronze.
.2 NPS21/2 and over:
.1 Flanged or Grooved ends: as specified Section 23 05 23.02 - Valves - Cast Iron.

.9 Ball valves:
.1 NPS2 and under: as specified Section 23 05 23.01 - Valves - Bronze.

.10 Lubricated Plug Valves
.1 NPS21/2 and over:
.1 As specified Section 23 05 23.02 - Valves - Cast Iron.

3 Execution

3.1 PIPING INSTALLATION

.1 Install pipework in accordance with Section 23 05 05 - Installation of Pipe Work.

3.2 BALANCING VALVES

.1 Install flow measuring stations and flow balancing valves as indicated.

.2 Remove handwheel after installation and when TAB is complete.

.3 Tape joints in prefabricated insulation on valves installed in chilled water mains.

3.3 CLEANING, FLUSHING AND START-UP

.1 In accordance with Section 23 08 02 - Cleaning and Start-Up of Mechanical Piping Systems.

3.4 TESTING

.1 Test system in accordance with Section 23 05 00 Common Work Results for Mechanical.

.2 For glycol systems, retest with propylene glycol to ASTM E202, inhibited, for use in building system after cleaning. Repair leaking joints, fittings or valves.

3.5 BALANCING

.1 Balance water systems to within plus or minus 5% of design output.

.2 Refer to Section 23 05 93 - Testing, Adjusting and Balancing for HVAC for applicable procedures.

3.6 GLYCOL CHARGING

.1 Provide mixing tank and positive displacement pump for glycol charging.

.2 Retest for concentration to ASTM E202 after cleaning.

3.7 PERFORMANCE VERIFICATION

.1 In accordance with Section 23 08 01 - Performance Verification of Mechanical Piping.

END OF SECTION

1 General

1.1 SECTION INCLUDES

.1 Expansion tanks.
.2 Air vents.
.3 Air separators.
.4 Strainers.
.5 Pump suction fittings.
.6 Combination fittings.
.7 Flow indicators, controls, meters.
.8 Radiator valves.
.9 Relief valves.
.10 Glycol specialties.

1.2 QUALITY ASSURANCE

.1 Comply with Provincial Regulations and have CSA approval.

.2 Grooved joint piping specialties shall be of the same manufacturer as the adjoining couplings.

.3 Construct pressure tanks to ASME Code for unfired pressure vessels.

1.3 REFERENCES

.1 ASME - SEC 8D - Boilers and Pressure Vessels Code - Rules for Construction of Pressure Vessels.

1.4 SUBMITTALS

.1 Section 01 33 00: Procedures for submittals.

.2 Product Data: Provide product data for manufactured products and assemblies required for this project. Include component sizes, rough-in requirements, service sizes, and finishes. Include product description, model and dimensions.

.3 Manufacturer's Installation Instructions: Indicate hanging and support methods, joining procedures.

.4 Provide operating and service procedures for expansion tank, including setting tank pressure, replacing bladder etc.

1.5 PROJECT RECORD DOCUMENTS

.1 Section 01 78 00: Submittals for project closeout.

.2 Record actual locations of flow controls.

1.6 OPERATION AND MAINTENANCE DATA

.1 Section 01 78 00: Submittals for project closeout.

.2 Maintenance Data: Include installation instructions, assembly views, lubrication instructions, and replacement parts list.

2 Products

2.1 EXPANSION TANKS

.1 Construction: Welded steel with heavy duty butyl air/water interface, tank style to match equipment schedule. Tank shall be cleaned, prime coated, and supplied with steel support saddles; with tappings for installation of accessories.
- .1 Pressure rating: 860 kPa.
- .2 Size: As noted on equipment schedule.

.2 Tank shall be tested and stamped to ASME SEC 8-D.

.3 Quick Connect Air Inlet:
- .1 Expansion Tank: Inlet tire check valve, manual air vent, tank drain, and pressure relief valve.

.4 Automatic Cold Water Fill Assembly: Pressure reducing valve, reduced pressure double check back flow preventer, test cocks, strainer, vacuum breaker, and valved bypass.

.5 Hot Water Heating System:
- .1 Select expansion tank pressure relief valve to match boiler..
- .2 Set pressure reducing valve at select 35 kPa.

.6 Precharge air side to 84 kPa (12 PSI) initial fill pressure of system.

2.2 AIR VENTS

.1 Manual Type: Short vertical sections of 50 mm diameter pipe to form air chamber, with 12mm (1/2") full port ball valve at top of chamber. Discharge to u-bend copper, PEX or plastic tubing of sufficient length to permit discharge to 5 gallon pail. Where pipe sizes are less than 64mm (2-1/2") air chamber shall be line size.

.2 Float Type:
- .1 Cast iron body and cover, with stainless steel, brass and EPDM internal components, and NPS 19 mm inlet connection, 9.5 mm discharge and rated at 1034 kPa working pressure.
- .2 Float: solid material suitable for system operating temperature and pressure. Minimum temperature to be 121 Deg.C.
- .3 Provide isolating valve before inlet.

2.3 SEPARATORS

.1 Combination Air Separators/Strainers:
- .1 Centrifugal air separator, steel, tested and stamped to ANSI/ASME SEC 8-D; for 860 kPa operating pressure, with integral galvanized steel strainer with 5mm perforations, tangential inlet and outlet flanged or grooved connections, and internal stainless steel air collector tube.

2.4 SUCTION DIFFUSER

.1 Fitting: Angle pattern, cast-iron body, threaded for 50 mm and smaller, flanged for 65 mm and larger, rated for 1200 kPa working pressure, with full length straightening vanes, cylinder strainer with 5 mm diameter openings, disposable fine mesh stainless steel strainer to fit over cylinder strainer, and permanent magnet located in flow stream and removable for cleaning.

.2 Accessories: Adjustable foot support, 25mm (1") blowdown tapping in bottom, pressure gauge tappings.

2.5 COMBINATION PUMP INLET AND STRAINER FITTING

.1 Provide angle type suction guide fitting with flanged cast iron or grooved (inlet) ductile iron body, stainless steel, steel or cast iron guide vanes and removable stainless steel strainer. Design based on Victaulic Series 731-I

.2 Accessories: drain tapping in bottom, pressure gauge tappings

2.6 COMBINATION PUMP DISCHARGE VALVES

.1 Triple-Duty Valve Assembly: Shall not be permitted.

2.7 CIRCUIT SETTER (STATIC BALANCING)

.1 Provide bronze (copper alloy), ductile iron or cast iron with bronze or copper alloy disc, complete with pressure tappings, memory lock and insulation blocks.

2.8 AUTOMATIC FLOW RESTRICTOR

.1 Automatic flow control valve complete with isolation and strainer, sized for design flow rate

.2 Construction: Forged or cast brass or bronze body with union on inlet, temperature and pressure test ports on inlet and outlet.

.3 Control flow within 5 percent of selected rating, over operating pressure range of 10 times minimum pressure required for control, maximum minimum pressure 13.7 kPa.

.4 Control Mechanism: Stainless steel or nickel plated brass piston or regulator cup, operating against stainless steel helical or wave formed spring.

.5 In-line strainer with 20 mesh stainless steel filter screen and drain valve.

.6 Isolation Valve: Ball valve with Teflon seats, refer to valve specifications.

2.9 RELIEF VALVES

.1 Bronze body, teflon seat, stainless steel stem and springs, automatic, direct pressure actuated, capacities ASME certified and labelled.

2.10 SIDE-STREAM FILTRATION SYSTEM

.1 System: Flow indicator, filter housing with cartridge filter, shut-off valves, and flow control valve.

.2 Performance: Design flow 0.25 L/sec with maximum pressure drop of 20.7 kPa.

.3 Hot Water and Glycol Filter Housing: Glass reinforced nylon plastic suitable for 105 degrees C and 1380 kPa operating conditions.

.4 Chilled Water Filter Housing: Reinforced polypropylene plastic housing suitable for 52 degrees C and 860 kPa operating conditions.

.5 Cartridges: 0.03 mm for start-up and 0.005 mm for system operation.

.6 Provide one case of thirty 20-micron cartridges and one case of thirty 5-micron cartridges.

3 Execution

3.1 INSTALLATION

.1 Install specialties to manufacturer's written instructions.

.2 Clean and flush glycol system before adding glycol solution. Refer to Section 23 25 00.

3.2 EXPANSION TANKS

.1 Support tanks inside building from building structure.

.2 Refer to equipment schedule and drawings for size and configuration.

.3 Adjust expansion tank pressure to suit actual site conditions.

.4 Install lockshield type valve at inlet to tank.

3.3 AIR VENTS

.1 Provide manual air vents at system high points and as indicated.

.2 Install automatic air vents at system air separator, heating units and system high points not readily accessible for servicing.

.3 Install gate valve on automatic air vent inlet. Run discharge to nearest drain or service sink.

.4 For automatic air vents in ceiling spaces or other concealed locations, provide vent tubing to nearest drain.

.5 Where large air quantities can accumulate, provide enlarged air collection standpipes.

3.4 SEPARATOR

.1 Provide in line air separator on suction side of system circulation pump.

3.5 RELIEF VALVES

.1 Provide relief valves on pressure tanks, low pressure side of reducing valves, heat exchangers, expansion tanks and where indicated.

.2 Select system relief valve capacity so that it is greater than make-up pressure reducing valve capacity. Select equipment relief valve capacity to exceed rating of connected equipment.

.3 Pipe relief valve outlet to nearest floor drain.

.4 Where one line vents several relief valves, make cross sectional area equal to sum of individual vent areas.

3.6 PUMP FITTINGS

.1 Provide pump suction fitting and strainer on suction side of centrifugal pumps. Remove temporary strainers after cleaning systems.

.2 Combination strainer and suction fitting may be utilized in lieu of individual suction diffuser and strainer.

.3 Provide balancing device on discharge of pump, refer to details for style.

.4 A combination balance, check, and isolation valve may be used on pump discharge where indicated or required to conserve space.

.5 Support pump fittings with floor mounted pipe and flange supports to eliminate undue stress on pump connection

3.7 HYDRONIC BALANCING VALVES

.1 Provide balancing valves on all heating and cooling equipment and all hydronic terminal devices to facilitate system balancing.

.2 Provide balancing valves on branch lines, as indicated, to facilitate system balancing.

.3 Provide circuit setters on heating and cooling equipment as indicated on details and schematics.

.4 Provide automatic flow restrictors on heating and cooling equipment as indicated on details and schematics.

3.8 SIDE STREAM FILTER

.1 Provide side-stream filtration system for each and every separate closed loop hydronic system. Install across main circulating pumps with flow from pump discharge to pump suction.

END OF SECTION

1 General

1.1 SECTION INCLUDES

.1 In-line circulators.
.2 Vertical in-line pumps.
.3 Close coupled pumps.
.4 Base mounted pumps.

1.2 REFERENCES

.1 UL 778 - Motor-Operated Water Pumps.

1.3 PERFORMANCE REQUIREMENTS

.1 Ensure pumps operate at specified system fluid temperatures without vapour binding and cavitation, are non-overloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.

1.4 SUBMITTALS

.1 Section 01 33 00: Procedures for submittals.

.2 Product Data: Provide certified pump curves showing performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable. Include electrical characteristics and connection requirements.

.3 Manufacturer's Installation Instructions: Indicate hanging and support requirements and recommendations.

.4 Millwright's Certificate: Certify that base mounted pumps have been aligned.

1.5 OPERATION AND MAINTENANCE DATA

.1 Section 01 78 00: Submittals for project closeout.

.2 Operation and Maintenance Data: Include installation instructions, assembly views, lubrication instructions, and replacement parts list.

1.6 QUALITY ASSURANCE

.1 Manufacturer: Company specializing in manufacture, assembly, and field performance of pumps with minimum three years experience.

.2 Alignment: Align base mounted pumps by qualified millwright.

1.7 REGULATORY REQUIREMENTS

.1 Products Requiring Electrical Connection: Listed and classified by ULC as suitable for the purpose specified and indicated.

2 Products

2.1 GENERAL REQUIREMENTS

.1 Statically and dynamically balance rotating parts.

.2 Construction shall permit complete servicing without breaking piping or motor connections.

.3 Pumps shall operate at 1750 RPM unless specified otherwise.

.4 Pump connections shall be flanged.

.5 Heating pumps shall be suitable for handling water at 110 deg.C (230 deg.F).

.6 Refer to equipment schedules for pump size, capacity, and minimum efficiency.

.7 Pumps to be complete with suction and discharge gauge ports.

.8 Pumps shall be rated for greater of 862 kPa (125 psi) or 1.5 times maximum working pressure.

2.2 SYSTEM LUBRICATED CIRCULATORS

.1 Type: Horizontal shaft, single stage, direct connected with multiple speed wet rotor motor for in-line mounting, 110 degrees C maximum water temperature.

.2 Casing: Cast iron with flanged pump connections.

.3 Impeller, Shaft, Rotor: Stainless Steel.

.4 Bearings: Metal Impregnated carbon (graphite) and ceramic.

.5 Starter housing and terminal box to be aluminum.

.6 Motor: Impedance protected single speed or multiple speed with external speed selector as indicated on equipment schedule.

2.3 IN-LINE CIRCULATORS

.1 Type: Horizontal shaft, single stage, direct connected, with resiliently mounted motor for in-line mounting, oil lubricated.

.2 Casing: Cast iron, with flanged pump connections.

.3 Impeller: Cadmium plated steel or bronze, keyed to shaft.

.4 Bearings: Two, oil lubricated bronze sleeves.

.5 Shaft: Alloy or stainless steel with copper or bronze sleeve, integral thrust collar.

.6 Seal: Carbon rotating against a stationary ceramic seat, viton fitted, 135 degrees C maximum continuous operating temperature.

.7 Drive: Flexible coupling.

2.4 VERTICAL IN-LINE PUMPS

.1 Type: Vertical, single stage, close coupled, radially or horizontally split casing, for in-line mounting, suitable for horizontal or vertical operation.

.2 Casing: Cast iron, with suction and discharge gauge port, casing wear ring, seal flush connection, drain plug, flanged suction and discharge.

.3 Impeller: Bronze, fully enclosed, keyed directly to motor shaft or extension and secured with locknut.

.4 Shaft: Stainless steel or carbon steel with bronze or stainless steel sleeve through seal chamber.

.5 Seal Options:

- .1 Carbon rotating against a stationary ceramic seat, viton fitted, 107 degrees C maximum continuous operating temperature.
- .2 Packing gland with minimum four rings graphite impregnated packing and bronze lantern rings, 110 degrees C maximum continuous operating temperature.

2.5 CLOSE COUPLED PUMPS

.1 Type: Horizontal shaft, single stage, close coupled, radially split casing, for 860 kPa maximum working pressure.

.2 Casing: Cast iron, with suction and discharge gauge ports, renewable bronze casing wearing rings, seal flush connection, drain plug, flanged suction and discharge.

.3 Impeller: Bronze, fully enclosed, keyed to motor shaft extension.

.4 Shaft: Stainless steel.

.5 Seal options:

- .1 Carbon rotating against a stationary ceramic seat, 107 degrees C] maximum continuous operating temperature.
- .2 Carbon rotating against a stationary ceramic seat, viton fitted, 135 degrees C maximum continuous operating temperature.
- .3 Packing gland with minimum four rings graphite impregnated packing and bronze lantern rings, 110 degrees C maximum continuous operating temperature.

2.6 BASE MOUNTED PUMPS

.1 Type: Horizontal shaft, single stage, direct connected, radially or horizontally split casing.

.2 Casing: Cast iron, split volute, with suction and discharge gauge ports, renewable bronze casing wearing rings, seal flush connection, drain plug, flanged suction and discharge.

.3 Impeller: Bronze, fully enclosed, keyed to shaft.

.4 Bearings: Oil lubricated roller or ball bearings.

.5 Shaft: Alloy steel with copper, bronze, or stainless steel shaft sleeve.

.6 Seal options:
- .1 Carbon rotating against a stationary ceramic seat, 107 degrees C] maximum continuous operating temperature.
- .2 Carbon rotating against a stationary ceramic seat, Viton fitted, 135 degrees C maximum continuous operating temperature.
- .3 Packing gland with minimum four rings graphite impregnated packing and bronze lantern rings, 110 degrees C maximum continuous operating temperature.

.7 Drive: Flexible coupling with coupling guard.

.8 Baseplate: High grade heat treated cast iron or reinforced heavy steel with integral drain rim.

2.7 INTEGRAL VARIABLE SPEED PUMPS

.1 The self-sensing product shall consist of a factory prepackaged and preprogrammed pump, drive, motor, and integral controls package. Note that controller shall be mounted remotely from pump.

.2 The drive shall be mounted on wall and wired to the motor. It shall be mounted with rubber vibration mounts. The mounting and packing of the drive shall be done in a manner that transmitted acceleration levels will be three times below the allowable limits published by the drive manufacturer. These limits will apply to a frequency range of 0-10,000 HZ.

.3 The performance speed of this package shall 1750 RPM nominal as standard. Exceptions for 3600 RPM will be noted in the schedules. 3600 RPM shall NOT be an allowable substitution for a specified 1750 PRM package. 3600 RPM products might be considered as a substitution for 1750 RPM only if that manufacturer provides a spare motor, drive, and seal for each pumping unit.

.4 Pump logic controller, variable frequency drives, sensor/transmitters and related equipment shall be installed by the mechanical contractor as shown on the plans. Electrical shall wire power to controller and from controller to pump motor.

.5 Pump Logic Controller:
- .1 The controller operation shall operate the system using a tested and proven program that safeguards against undesirable or damaging conditions including:
  - .1 Motor overload
  - .2 Pump flow surges
  - .3 Hydraulic cycling (hunting).
  - .4 End of curve unstable operation: The pump logic controller, through a factory pre-programmed algorithm, shall be capable of protecting the pumps from hydraulic damage due to operation beyond their published end-of-curve. This feature requires a flow meter for activation. The operator interface shall include an owner adjustable flow set point to set the parameters for this routine.
- .2 The pump logic controller shall be capable of starting, unloading, and stopping pumps based on a system performance program that will minimize energy consumption, provide reliable performance and bumpless transitions.
- .3 The integrated logic controller shall be capable of running four different hydronic optimization sub-routines
  - .1 Setup one: This subroutine shall allow the pump package to track a quadratic system curve and will optimize a secondary distribution loop.

It shall use a technology that allows the pump, drive, and motor package to translate the hydronic data from both a pump and system curve and translate it to electrical data. This allows the drive to know exactly where it is in the hydronic world.

.2 Setup two: This subroutine shall allow two pumps to run as backup for each other and shall alternate the pumps based on a real time clock.

.3 Setup three: This subroutine shall allow the package to run in a customer defined flow rate. The package will always seek to run at the user defined flow even with fouling causing system changes. It shall use a technology that allows the pump, drive, and motor package to translate the hydronic data from both a pump and system curve and translate it to electrical data. This allows the drive to know exactly where it is in the hydronic world.

.4 Setup four: This subroutine shall incorporate a traditional external sensing and control platform. It shall allow the option of controlling the pumps with three zones of differential pressure or central plant differential temperature. This optional setup shall allow the owner the option of external sensing without adding an external controller.

.4 The control platform shall include a subroutine equal to allow for the automatic balancing of secondary system distribution pumps. The package shall automatically run system distribution pumps to a user defined duty point and will recognize that duty point and hold the pumps at a speed that matches the actual installed system quadratic system curve. The package will then use this data to set up a new duty point as the max point for the quadratic control curve. Use of external balancing devices will not be needed.

.5 The package shall serve as a flow metering device and will display pump flow at the user interface.

.6 Variable Frequency Drives:

.1 The VFD shall convert incoming fixed frequency three-phase ac power into an adjustable frequency and voltage for controlling the speed of three-phase ac motors. The motor current shall closely approximate a sine wave. Motor voltage shall be varied with frequency to maintain desired motor magnetization current suitable for the driven load and to eliminate the need for motor derating. When properly sized, the VFD shall allow the motor to produce full rated power at rated motor voltage, current, and speed without using the motor's service factor. VFDs utilizing sine weighted/coded modulation (with or without 3rd harmonic injection) must provide data verifying that the motors will not draw more than full load current during full load and full speed operation.

.1 The VFD shall include an input full-wave bridge rectifier and maintain a fundamental (displacement) power factor near unity regardless of speed or load.

.2 The VFD shall have a dual 5% impedance DC link reactor on the positive and negative rails of the dc bus to minimize power line harmonics and protect the VFD from power line transients. The chokes shall be non-saturating. Swinging chokes that do not provide full harmonic filtering throughout the entire load range are not acceptable. VFDs with saturating (non-linear) dc link reactors shall require an additional 3% AC line reactor to provide acceptable harmonic performance at full load, where harmonic performance is most critical.

.3 The VFD’s full load output current 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 120% of rated torque for up to 0.5 second while starting.

.4 The VFD shall provide full motor torque at any selected frequency from 20 hz to base speed while providing a variable torque v/hz output at reduced speed. This is to allow driving direct drive fans without high speed derating or low speed excessive magnetization, as would occur if a constant torque v/hz curve was used at reduced speeds. Breakaway current of 160% shall be available.

.5 A programmable automatic energy optimization selection feature shall be provided standard in the VFD. This feature shall automatically and continuously monitor the motor's speed and load to adjust the applied voltage to maximize energy savings.

.6 The VFD must be able to produce full torque at low speed to operate direct drive fans.

.7 Output power circuit switching shall be able to be accomplished without interlocks or damage to the VFD.

.8 An automatic motor adaptation 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 perform the test.

.9 Galvanic isolation shall be provided between the VFD's power circuitry and control circuitry to ensure operator safety and to protect connected electronic control equipment from damage caused by voltage spikes, current surges, and ground loop currents. VFDs not including either galvanic or optical isolation on both analog i/o and discrete digital i/o shall include additional isolation modules.

.10 VFD shall minimize the audible motor noise through the used of an adjustable carrier frequency. The carrier frequency shall be automatically adjusted to optimize motor and VFD operation while reducing motor noise. VFDs with fixed carrier frequency are not acceptable.

.11 All VFDs shall contain integral emi filters to attenuate radio frequency interference conducted to the ac power line.

.12 The drive enclosure shall be standard as NEMA 12 (ip 55) and optional shall be NEMA 4X (ip 66). See schedules for project requirements.

.13 Protective Features:

.1 A minimum of class 20 i2t electronic motor overload protection for single motor applications shall be provided. Overload protection shall automatically compensate for changes in motor speed.

.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 language. Codes are not acceptable.

.3 Protect VFD from input phase loss. The VFD should be able to protect itself from damage and indicate the phase loss condition. During an input phase loss condition, the VFD shall be able to be programmed to either trip off while displaying an alarm, issue a warning while running at reduced output capacity, or issue a warning while running at full commanded speed. This function is independent of which input power phase is lost.

.4 Protect from under voltage. The VFD shall provide full rated output with an input voltage as low as 90% of the nominal. The VFD will continue to operate with reduced output, without faulting, with an input voltage as low as 70% of the nominal voltage.

.5 Protect from over voltage. The VFD shall continue to operate without faulting with a momentary input voltage as high as 130% of the nominal voltage.

.6 The VFD shall incorporate a programmable motor preheat feature to keep the motor warm and prevent condensation build up in the motor when it is stopped in a damp environment by providing the motor stator with a controlled level of current.

.7 VFD shall include a "signal loss detection" algorithm with adjustable time delay to sense the loss of an analog input signal. It shall also include a programmable time delay to eliminate nuisance signal loss indications. The functions after detection shall be programmable.

.8 VFD shall function normally when the keypad is removed while the VFD is running. No warnings or alarms shall be issued as a result of removing the keypad.

.9 VFD shall catch a rotating motor operating forward or reverse up to full speed without VFD fault or component damage.

.10 Selectable over-voltage control shall be provided to protect the drive from power regenerated by the motor while maintaining control of the driven load.

.11 VFD shall include current sensors on all three output phases to accurately measure motor current, protect the VFD from output short circuits, output ground faults, and act as a motor overload. If an output phase loss is detected, the VFD will trip off and identify which of the output phases is low or lost.

.12 If the temperature of the VFD's heat sink rises to 80?c, the VFD shall automatically reduce its carrier frequency to reduce the heat sink temperature. It shall also be possible to program the VFD so that it reduces its output current limit value if the VFD's temperature becomes too high.

.13 In order to ensure operation during periods of overload, it must be possible to program the VFD to automatically reduce its output current to a programmed value during periods of excessive load. This allows the VFD to continue to run the load without tripping.

.14 The VFD shall have temperature controlled cooling fan(s) for quiet operation, minimized losses, and increased fan life. At low loads or low ambient temperatures, the fan(s) may be off even when the VFD is running.

.15 The VFD shall store in memory the last 10 alarms. A description of the alarm, and the date and time of the alarm shall be recorded.

.16 When used with a pumping system, the VFD shall be able to detect no-flow situations, dry pump conditions, and operation off the end of the pump curve. It shall be programmable to take appropriate protective action when one of the above situations is detected.

.2 Internal Control Algorithm

.1 This is a standard HVAC drive that has been upgraded and modified by pump experts for hydronic applications. It is set up with a closed loop internal control sequence that will optimize life cycle, system comfort, and minimize energy consumption.

.3 Interface Features

.1 Hand, off and auto keys shall be provided to start and stop the VFD and determine the source of the speed reference. It shall be possible to either disable these keys or password protect them from undesired operation.

.2 There shall be an "info" key on the keypad. The info key shall include "on-line" context sensitive assistance for programming and troubleshooting.

.3 The VFD shall be programmable to provide a digital output signal to indicate whether the VFD is in hand or auto mode. This is to alert the building automation system whether the VFD is being controlled locally or by the building automation system.

.4 Password protected keypad with alphanumeric, graphical, backlit display can be remotely mounted. Two levels of password protection shall be provided to guard against unauthorized parameter changes.

.5 All VFDs shall have the same customer interface. The keypad and display shall be identical and interchangeable for all sizes of VFDs.

.6 To set up multiple VFDs, it shall be possible to upload all setup parameters to the VFD's keypad, place that keypad on all other VFDs in turn and download the setup parameters to each VFD. To facilitate setting up VFDs of various sizes, it shall be possible to download from the keypad only size independent parameters. Keypad shall provide visual indication of copy status.

.7 Display shall be programmable to communicate in multiple languages including english, spanish and french.

.8 A red fault light, a yellow warning light and a green power-on light shall be provided. These indications shall be visible both on the keypad and on the VFD when the keypad is removed.

.9 A quick setup menu with factory preset typical HVAC parameters shall be provided on the VFD. The VFD shall also have individual fan, pump, and compressor menus specifically designed to facilitate start-up of these applications.

.10 A four-feedback PID controller to control the speed of the VFD shall be standard. This controller shall accept up to four feedback signals. It shall be programmable to compare the feedback signals to a common setpoint or to individual setpoints and to automatically select either the maximum or the feedback signal as the controlling signal. It shall also be possible to calculate the controlling feedback signal as the average of all feedback signals or the difference between a pair of feedback signals.

.1 The VFD shall be able to apply individual scaling to each feedback signal.

.2 The VFD's PID controller shall be able to actively adjust its setpoint based on flow. This allows the VFD to compensate for a pressure feedback sensor which is located near the output of the pump rather than out in the controlled system.

.11 The VFD shall have three additional PID controllers which can be used to control damper and valve positioners in the system and to provide setpoint reset.

.12 Floating point control interface shall be provided to increase/decrease speed in response to contact closures.

.13 Five simultaneous meter displays shall be available. They shall include at a minimum, frequency, motor current, motor voltage, VFD output power, VFD output energy, VFD temperature in degrees, among others.

.14 Programmable sleep mode shall be able to stop the VFD. When its output frequency drops below set "sleep" level for a specified time, when

an external contact commands that the VFD go into sleep mode, or when the VFD detects a no-flow situation, the VFD may be programmed to stop. When the VFD's speed is being controlled by its PID controller, it shall be possible to program a "wake-up" feedback value that will cause the VFD to start. To avoid excessive starting and stopping of the driven equipment, it shall be possible to program a minimum run time before sleep mode can be initiated and a minimum sleep time for the VFD.

.15 A 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 initiating an output "run request" signal to indicate to the external equipment that the VFD has received a request to run.

.16 VFD shall be programmable to display feedback signals in appropriate units, such as inches of water column (in-wg), pressure per square inch (psi) or temperature (deg.F).

.17 VFD shall be programmable to sense the loss of load and signal this condition via a keypad warning, relay output and/or over the serial communications bus. To ensure against nuisance indications, this feature must be based on motor torque, not current, and must include a proof timer to keep brief periods of no load from falsely triggering this indication.

.4 Standard Control And Monitoring Inputs And Outputs

.1 Six dedicated, programmable digital inputs shall be provided for interfacing with the systems control and safety interlock circuitry.

.1 Two terminals shall be programmable to act as either as digital outputs or additional digital inputs.

.2 Two programmable relay outputs, Form C 240 V AC, 2 A, shall be provided for remote indication of VFD status.

.1 Each relay shall have an adjustable on delay / off delay time.

.3 Two programmable analog inputs shall be provided that can be either direct-or-reverse acting. Each shall be independently selectable to be used with either an analog voltage or current signal.

.1 The maximum and minimum range of each shall be able to be independently scalable from 0 to 10 V dc and 0 to 20 mA.

.2 A programmable low-pass filter for either or both of the analog inputs must be included to compensate for noise.

.3 The VFD shall provide front panel meter displays programmable to show the value of each analog input signal for system set-up and troubleshooting,

.4 One programmable analog current output (0/4 to 20 mA) shall be provided for indication of VFD status. This output shall be programmable to show the reference or feedback signal supplied to the VFD and for VFD output frequency, current and power. It shall be possible to scale the minimum and maximum values of this output.

.5 It shall be possible through serial bus communications to read the status of all analog and digital inputs of the VFD.

.6 It shall be possible to command all digital and analog output through the serial communication bus.

.5 Optional Control And Monitoring Inputs And Outputs

.1 It shall be possible to add optional modules to the VFD in the field to expand its analog and digital inputs and outputs.

.1 These modules shall use rigid connectors to plug into the VFD's control card.

.2 The VFD shall automatically recognize the option module after it is powered up. There shall be no need to manually configure the module.

.3 Modules may include such items as:

a) Additional digital outputs, including relay outputs
b) Additional digital inputs
c) Additional analog outputs
d) Additional analog inputs, including Ni or Pt temperature sensor inputs

.4 It shall be possible through serial bus communications to control the status of all optional analog and digital outputs of the VFD.

.6 Standard programmable firefighter's override mode allows a digital input to control the VFD and override all other local or remote commands. It shall be possible to program the VFD so that it will ignore most normal VFD safety circuits including motor overload. The VFD shall display firemode whenever in firefighter's override mode. Firemode shall allow selection of forward or reverse operation and the selection of a speed source or preset speed, as required to accommodate local fire codes, standards and conditions.

.7 A real-time clock shall be an integral part of the VFD.

.1 It shall be possible to use this to display the current date and time on the VFD's display.

.1 Ten programmable time periods, with individually selectable ON and OFF functions shall be available. The clock shall also be programmable to control start/stop functions, constant speeds, PID parameter setpoints and output relays. Is shall be possible to program unique events that occur only during normal work days, others that occur only on non-work days, and others that occur on specific days or dates. The manufacturer shall provide free PC-based software to set up the calendar for this schedule.

.2 All VFD faults shall be time stamped to aid troubleshooting.

.3 It shall be possible to program maintenance reminders based on date and time, VFD running hours, or VFD operating hours.

.4 The real-time clock shall be able to time and date stamp all faults recorded in the VFD fault log.

.8 The VFD shall be able to store load profile data to assist in analyzing the system demand and energy consumption over time.

.9 The VFD shall include a sequential logic controller to provide advanced control interface capabilities. This shall include:

.1 Comparators for comparing VFD analog values to programmed trigger values

.1 Logic operators to combine up to three logic expressions using Boolean algebra
.2 Delay timers
.3 A 20-step programmable structure

10. The VFD shall include a cascade controller which allows the VFD to operate in closed loop set point (PID) control mode one motor at a controlled speed and control the operation of 3 additional constant speed motor starters.

.11 Serial communications
.1 The VFD shall include a standard eia-485 communications port and capabilities to be connected to the following serial communication protocols at no additional cost and without a need to install any additional hardware or software in the VFD:
.1 Modbus RTU
.2 BACnet MS/TP
.3 LonWorks Free Topology (FTP)
.4 VFD shall have standard rs-485 port for direct connection of personal computer (pc) to the VFD. The manufacturer shall provide no-charge pc software to allow complete setup and access of the VFD and logs of VFD operation through the rs-485 port. It shall be possible to communicate to the VFD through this usb port without interrupting VFD communications to the building management system.
.5 The VFD shall have provisions for an optional 24 v DC back-up power interface to power the VFD's control card. This is to allow the VFD to continue to communicate to the building automation system even if power to the VFD is lost.

12. Adjustments
.1 The VFD shall have a manually adjustable carrier frequency that can be adjusted in 0.5 khz increments to allow the user to select the desired operating characteristics. The VFD shall also be programmable to automatically reduce its carrier frequency to avoid tripping due to thermal loading.
.1 Four independent setups shall be provided.
.2 Four preset speeds per setup shall be provided for a total of 16.
.3 Each setup shall have two programmable ramp up and ramp down times. Acceleration and deceleration ramp times shall be adjustable over the range from 1 to 3,600 seconds.
.4 Each setup shall be programmable for a unique current limit value. If the output current from the VFD reaches this value, any further attempt to increase the current produced by the VFD will cause the VFD to reduce its output frequency to reduce the load on the VFD. If desired, it shall be possible to program a timer which will cause the VFD to trip off after a programmed time period.
.5 If the VFD trips on one of the following conditions, the VFD shall be programmable for automatic or manual reset: external interlock, under-voltage, over-voltage, current limit, over temperature, and VFD overload.

.6 The number of restart attempts shall be selectable from 0 through 20 or infinitely and the time between attempts shall be adjustable from 0 through 600 seconds.

.7 An automatic "start delay" may be selected from 0 to 120 seconds. During this delay time, the VFD shall be programmable to either apply no voltage to the motor or apply a DC braking current if desired.

.8 Four programmable critical frequency lockout ranges to prevent the VFD from operating the load at a speed that causes vibration in the driven equipment shall be provided. Semi-automatic setting of lockout ranges shall simplify the set-up.

.13 Optional features

.1 All optional features shall be built and mounted by VFD manufacturer. All optional features shall be UL listed by the VFD manufacturer as a complete assembly and carry a UL label.

.1 All panels shall be marked for their short circuit current rating in compliance with UL.

.14 Service conditions

.1 Ambient temperature, continuous, full speed, full load operation:

.1 -10 to 45°C (14 to 113°F) through 125 hp @ 460 and 600 volt, through 60 hp @ 208 volt

.2 -10 to 40°C (14 to 104°F) 150 hp and larger

.1 0 to 95% relative humidity, non-condensing.

.2 Elevation to 3,300 feet without derating.

.3 AC line voltage variation, -10 to +10% of nominal with full output.

.4 No side clearance shall be required for cooling.

.5 All power and control wiring shall be done from the bottom.

.6 All VFDs shall be plenum rated.

.7 Pumps

.1 Inline pump matched to VFD and factory tested.

3 Execution

3.1 PREPARATION

.1 Verify that electric power is available and of the correct characteristics (voltage and phase) prior to ordering pump.

3.2 INSTALLATION

.1 Install to manufacturer's written instructions.

.2 Provide access space around pumps for service. Provide no less than minimum as recommended by manufacturer.

.3 Decrease from line size with long radius reducing elbows or reducers. Support piping adjacent to pump such that no weight is carried on pump casings. For close coupled or base mounted pumps, provide supports under elbows on pump suction and discharge line sizes 102 mm and over. Refer to Section 23 05 48.

.4 Provide line sized shut-off isolation valve and strainer on pump suction, and line sized soft seated check valve, balancing device, and shut-off isolation valve on pump discharge.

.5 Provide air cock and drain connection on horizontal pump casings.

.6 Provide drains for bases and stuffing boxes piped to and discharging into floor drains.

.7 Provide common pressure gauge, piped complete with isolation valves to suction and discharge side of pump.

.8 Check, align, and certify alignment of base mounted pumps prior to start-up.

.9 Install close coupled and base mounted pumps on concrete housekeeping base, with anchor bolts, set and level, and grout in place. Refer to Section 03 30 00.

.10 Lubricate pumps before start-up.

3.3 INTEGRAL VARIABLE SPEED PUMPS

.1 Install equipment in accordance with manufacturer's instructions and all applicable codes.

.2 Ensure that pump is pipe-mounted and free to float with any movement, expansion and contraction of piping system.

.1 Support pump using floor mounted saddle or wall bracket as required.

.2 For vertical in-line pumps supported from structure, ensure no pipe strain is imposed on pump flanges.

.3 Power wiring, as required, shall be the responsibility of the electrical contractor. All wiring shall be performed per manufacturer's instructions and all applicable codes.

.4 Control wiring for remote mounted switches and sensor/transmitters shall be the responsibility of the controls contractor. All wiring shall be performed per manufacturer's instructions and all applicable codes.

.5 Demonstration:

.1 The control package manufacturer's factory trained representative shall provide start-up of the packaged pumping system. This start-up shall include verification of proper installation, system initiation, adjustment and fine tuning. Start-up shall not be considered complete until the sequence of operation, including all alarms, has been sufficiently demonstrated to the Owner or Owner's designated representative. This jobsite visit shall occur only after all hook-ups, tie-ins, and terminations have been completed and signed-off on the manufacturer's start-up request form.

.2 The pump control package manufacturer's factory trained representative shall provide on-site training for owner's personnel. This training shall fully cover maintenance and operation of all system components.

3.4 PERFORMANCE VERIFICATION

.1 General
- .1 In accordance with manufacturer's recommendations and as specified herein.

.2 Exclusions:
- .1 This paragraph does not apply to small fractional horse-power (lower than 1/2 hp) circulators.

.3 Assumptions: these PV procedures assume that:
- .1 Manufacturer's performance curves are accurate.
- .2 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 the Standard.
- .3 Where procedures do not exist, discontinue PV, report to and await instructions.

.5 Multiple Pump Installations - Series and Parallel:
- .1 Repeat PV procedures specified above for pump performance and pump BHP for combinations of pump operations.

.6 Mark points of design and actual performance at design conditions as finally set upon completion of TAB.

.7 Include reports in Operation and Maintenance Manuals:
- .1 Record of point(s) 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 Pump performance curves (family of curves) to be provided with report.

END OF SECTION

1 General

1.1 SECTION INCLUDES

.1 Materials and installation of steel piping valves, fittings for low pressure steam and condensate building services piping. Refer to 23 20 13 for High Pressure (above 15 psi) steam and condensate.

.2 Sustainable requirements for construction, verification and operation.

1.2 REFERENCES

.1 American National Standards Institute (ANSI).

- .1 ANSI/ASME B16.1-98, Cast Iron Pipe Flanges and Flanged Fittings.
- .2 ANSI/ASME B16.25-97, Buttwelding Ends.
- .3 ANSI/ASME B16.3-98, Malleable Iron Threaded Fittings.
- .4 ANSI/ASME B16.5-03, Pipe Flanges and Flanged Fittings.
- .5 ANSI/ASME B16.9-01, Factory-Made Wrought Steel Buttwelding Fittings.
- .6 ANSI B18.2.1-03, Square and Hex Bolts and Screws (Inch Series).
- .7 ANSI/ASME B18.2.2-87(R1999), Square and Hex Nuts (Inch Series).

.2 American Water Works Association (AWWA).

- .1 AWWA C111-2000, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.

.3 American Society for Testing and Materials International, (ASTM).

- .1 ASTM A47/A47M-99, Standard Specification for Ferritic Malleable Iron Castings.
- .2 ASTM A53/A53M-02, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated, Welded and Seamless.
- .3 ASTM A126-95(2001), Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.

.4 Canadian Standards Association (CSA International).

- .1 CSA W48-01, Filler Metals and Allied Materials for Metal Arc Welding (Developed in cooperation with the Canadian Welding Bureau).

.5 Manufacturers Standardization Society of the Valve and Fittings Industry, Inc.

- .1 MSS-SP-70-98, Cast Iron Gate Valves, Flanged and Threaded Ends.
- .2 MSS-SP-71-97, Gray Iron Swing Check Valves, Flanged and Threaded Ends.
- .3 MSS-SP-80-97, Bronze Gate, Globe, Angle and Check Valves.
- .4 MSS-SP-85-94, Gray Iron Globe and Angle Valves, Flanged and Threaded Ends.

1.3 SUBMITTALS

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

.2 Submit product data and include manufacturer's literature data sheets for following: valves.

.3 Submit shop drawings.

.4 Submit 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 HEALTH AND SAFETY

.1 Do construction occupational health and safety in accordance with Section 01 35 30 - Health and Safety Requirements.

2 Products

2.1 PIPE

.1 Steel pipe: to ASTM A53/A53M, Grade B, to be Schedule 80, refer to 23 05 05.

2.2 PIPE JOINTS

.1 NPS 2 and under: screwed fittings with PTFE tape or 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 AWWA C111.

.4 Pipe thread: taper.

.5 Bolts and nuts: carbon steel, to ANSI/ASME B18.2.1 and ANSI/ASME B18.2.2.

.6 Buttwelding ends: to ANSI/ASME B16.25 as indicated.

2.3 FITTINGS

.1 Pipe flanges: cast-iron to ANSI/ASME B16.1, Class 250.

.2 Screwed fittings: malleable iron to ANSI/ASME B16.3, Class 300.

.3 Steel pipe gaskets, flanges and flanged fittings: to ANSI/ASME B16.5.

.4 Buttwelding fittings: steel to ANSI/ASME B16.9.

.5 Unions: malleable iron, to ASTM A47/A47M and ANSI/ASME B16.3.

2.4 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 Mechanical Rooms: Class 300, rising stem, split wedge disc, as specified Section 23 05 22- Valves-Bronze.

.2 Elsewhere: Class 300, non-rising stem, solid wedge disc, as specified Section 23 05 22- Valves-Bronze.

.2 NPS 2 1/2 -8:

.1 Mechanical Rooms: Class 300, rising stem, split wedge disc, cast iron, lead- free bronze trim, as specified Section 23 05 23 - Valves - Cast Iron: Gate, Globe, Check.

.1 Operators.

.2 Elsewhere: Class 300, Non-rising stem, solid wedge disc, cast iron with lead- free bronze trim, as specified Section 23 05 23 - Valves - Cast Iron: Gate, Globe, Check.

.1 Operators.

.3 Globe valves: Application: Steam service, throttling, flow control, emergency bypass.

.1 NPS 2 and under:

.1 Mechanical Rooms: with PFTE disc as specified Section 23 05 22 - Valves - Bronze.

.2 Elsewhere: with composition disc as specified Section 23 05 22 - Valves - Bronze.

.2 NPS 2 1/2 and over:

.1 With composition lead-free bronze disc, cast iron with bronze trim, to Section 23 05 23 - Valves - Cast Iron: Gate, Globe, Check.

.1 Operators.

.4 Gate valves: Application: Pumped and gravity condensate return service, steam drip point assemblies.

.1 NPS 2 and under:

.1 Mechanical Rooms: Class 300, rising stem, split wedge disc, as specified Section 23 05 22 - Valves-Bronze.

.2 Elsewhere: Class 300, non-rising stem, solid wedge disc, as specified Section 23 05 22 - Valves - Bronze.

.2 NPS 2 1/2 and over:

.1 Mechanical Rooms: Class 300, rising stem, split wedge disc, cast iron, lead-free bronze trim, as specified Section 23 05 23 - Valves - Cast Iron: Gate, Globe, Check.

.1 Operators.

.2 Elsewhere: Class 300, non-rising stem, solid wedge disc, cast iron with lead-free bronze trim, as specified Section 23 05 23 - Valves - Cast Iron: Gate, Globe, Check.

.5 Drain valves: Gate, Class 125, non-rising stem, solid wedge disc, as specified Section 23 05 22 - Valves - Bronze.

.6 Bypass valves around large size gate and globe valves: as specified Section 23 05 24- Valves - Cast Steel.

.7 Lift check valves:

.1 NPS 2 and under: Class 300, lift, with composition disc, as specified Section 23 05 22 - Valves - Bronze.

.2 NPS 2 1/2 and over: as specified Section 23 05 23 - Valves - Cast Iron: Gate, Globe, Check.

2.5 VALVE OPERATORS

.1 Handwheel: on valves except as specified.

.2 Handwheel with chain operators: on valves installed more than 2400 mm above floor in Boiler Rooms and Mechanical Equipment Rooms.

3 Execution

3.1 PIPING

.1 Install pipework in accordance with Section 23 05 01 - Installation of Pipework, supplemented as specified herein.

.2 Connect branch lines into top of mains.

.3 Install piping in direction of flow with slopes as follows, unless otherwise indicated:
- .1 Steam: 1:240.
- .2 Condensate return: 1:70.

.4 Make provision for thermal expansion as indicated.

.5 Drip pocket: line size.

3.2 VALVES

.1 Install globe valves around, NPS 8 and over, gate valves.

3.3 TESTING

.1 Test system in accordance with Section 23 05 00 - Common Work Results - Mechanical.

.2 Test pressure: 1-1/2 times maximum system operating pressure or 860 kPa whichever is greater.

3.4 CLEANING, FLUSHING, START-UP

.1 In accordance with Section 23 08 02 - Cleaning and Start-up of Mechanical Piping Systems.

.2 In order to activate steam system after completing all work, contractor must fill out the site specific steam activation sheet and submit it to the Departmental Representative complete with copies of the following:
- .1 Install permits for each piece of equipment complete with data reports governed by the Technical Safety Authority of Saskatchewan (boiler branch), have been submitted.
- .2 Hydrostatic test complete with witness’s signature. If applicable
- .3 All non destructive tests
- .4 All ultrasonic testing completed (if applicable)
- .5 Design registration. (if applicable)
- .6 All MTR’s.
- .7 The acceptance inspection report completed by the Technical safety authority.
- .8 Contractors QC manual (must be registered with TSASK)
- .9 Registered welding procedures. (must be registered with TSASK)

3.5 PERFORMANCE VERIFICATION (PV)

.1 General:
- .1 In accordance with Section 23 08 01 - Performance Verification of Mechanical Piping 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.
- .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, re-align, repeat start-up procedures.

END OF SECTION

1 General

1.1 SECTION INCLUDES

.1 Materials and installation of steel piping valves, fittings for steam and condensate building services piping.

.2 Sustainable requirements for construction, verification and operation.

1.2 REFERENCES

.1 American Society for Mechanical Engineers (ASME International).

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

.1 ASTM A126-95(2001), Standard Specification for Gray Iron Castings for Valves, Flanges and Pipe Fittings.

.2 ASTM A167-99, Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet and Strip.

.3 ASTM A216/A216M-2003, Standard Specification for Steel Castings, Carbon, Suitable for Fusion Welding for High-Temperature Service.

.4 ASTM A240/A240M-04, Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.

.5 ASTM A276-03, Standard Specification for Stainless Steel Bars and Shapes.

.6 ASTM A278/A278M-01, Standard Specification for Gray Iron Castings for Pressure - Containing Parts for Temperatures up to 650 Degrees F (350 deg.C).

.7 ASTM A351/A351M-03, Standard Specification for Steel Castings, Austenitic, Austenitic- Ferritic (Duplex) for Pressure-Containing Parts.

.8 ASTM A564/A564M-02a, Standard Specification for Hot-Rolled and Cold-Finished Age-Hardening Stainless Steel Bars and Shapes.

.9 ASTM B62-02, Standard Specification for Composition Bronze or Ounce Metal Castings.

1.3 SUBMITTALS

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

.2 Submit shop drawings and product data and include manufacturer's literature indicating Canadian Registration Number (CRN): Steam traps, vacuum breakers, pressure reducing valves, air vents and safety relief valves.

.3 Provide maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals and include following:

.1 Special servicing requirements.

1.4 HEALTH AND SAFETY

.1 Do construction occupational health and safety in accordance with Section 01 35 30 - Health and Safety Requirements.

1.5 QUALITY ASSURANCE

.1 Low pressure steam is steam at 103 kPa or less.

.2 Comply with Provincial regulations.

.3 Equipment to have CSA approval.

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 0-110 KPA

.1 Application: for modulating steam service on convertors as indicated.

.2 Materials: body - cast-steel; valve - stainless steel with stainless steel seat; float and mechanisms - stainless steel; air vent - stainless steel thermostatic type.

.3 Capacity: as indicated.

2.3 FLOAT AND THERMOSTATIC STEAM TRAPS 111-1000 KPA

.1 Application: for modulating steam service on convertors as indicated.

.2 Materials: body - cast-steel; valve - stainless steel with stainless steel seat; air vent - stainless steel thermostatic type.

.3 Capacity: as indicated.

2.4 INVERTED BUCKET STEAM TRAP 0-1000 KPA

.1 Not permitted.

2.5 VACUUM BREAKERS 0.85-68 KPA

.1 Application: on inlets to heat exchangers as indicated.

.2 Materials: body and cap - lead-free stainless steel; spring - stainless steel; stem and seat - lead-free stainless steel.

.3 Capacity: as indicated.

2.6 PRESSURE REDUCING VALVE -EXTERNAL PILOT OPERATED

.1 Location: as indicated.

.2 Self operating, external pilot, single seat, diaphragm operated, dead end shutoff, enclosed spring chamber main and pilot valve.

.3 Connections:
- .1 Under NPS 2: screwed ends.
- .2 NPS 2-1/2 and over: flanged ends.

.4 Main valve:
- .1 Body: cast iron to ASTM A126, Class B.
- .2 Diaphragm: stainless steel to ASTM A167, ASTM A240/A240M.
- .3 Seat rings: stainless steel to ASTM A276.
- .4 Disc: stainless steel to ASTM A564/A564M, ASTM A276.
- .5 Stem: stainless steel to ASTM A276.
- .6 Spring: carbon steel.
- .7 Bolting: carbon steel.

.5 Pilot valve:
- .1 Body: cast iron to ASTM A126, Class B.
- .2 Diaphragm: stainless steel to ASTM A167, ASTM A240/A240M.

.6 Capacity: As indicated.

.7 To be Spence Model “E” valve with “D” pilot - no exception.

2.7 SAFETY AND RELIEF VALVES

.1 Spring loaded type of bronze with high capacity and full nozzle and to ASME code.

.2 Material: body - forged copper alloy; valve - housing lead-free cast bronze; spring - steel, cadmium plated; lead-free bronze/brass trim.

2.8 DRIP PAN ELBOWS

.1 Application: on discharge of steam safety relief valves 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: lead-free bronze.

.4 Connections: screwed.

.5 Screen: stainless steel with 0.8 mm perforations.

2.10 PIPE LINE STRAINERS NPS 2-1/2 AND OVER

.1 Application: ahead of condensate pumps, steam traps, control valves as indicated.

.2 Working pressure: 860 kPa.

.3 Body: cast iron.

.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.

2.11 FLASH TANKS

.1 Locations: as indicated.

.2 Construction: to ASME code.

.3 Maximum working pressure: 860 kPa.

.4 Connections: NPS 2 and under, screwed; NPS 2-1/2 and over, flanged; as indicated.

.5 Finish: prime coated.

.6 Supports: vertical legs for vertical tank; saddles for horizontal tank.

3 Execution

3.1 GENERAL

.1 Install in accordance with manufacturers' recommendations.

.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.

.2 Install float and thermostatic steam traps to drain condensate from convertors, flash tanks, steam jacketed equipment and direct steam injected equipment.

.3 Install inverted bucket steam traps to drain condensate from steam main headers and branch lines.

.4 Size steam traps to handle a minimum of two times the maximum condensate load of the apparatus served.

.5 Traps used for dripping steam mains and branches shall be minimum 20 mm size.

3.5 LOW PRESSURE TRAP ASSEMBLIES

.1 Install trap with union or flanged connection at both ends.

.2 Provide gate valve and strainer at inlet, gate valve and check valve at discharge.

.3 Provide minimum 250 mm long dirt pocket of same pipe size as apparatus return connection.

.4 Do not use thermostatic elements in traps until system has been operated and dirt pockets cleared of sediment and scale. Provide temporary covers for use prior to this time.

3.6 PRESSURE REDUCING VALVES

.1 Install on 3-valve bypass with strainer on inlet.

.2 Pipe as indicated. Follow manufacturer's installation instructions.

3.7 FLASH TANKS

.1 Pipe arrangement as indicated.

3.8 PERFORMANCE VERIFICATION

.1 In accordance with Section 23 08 01 - Performance Verification of Mechanical Piping Systems.

END OF SECTION

1 General

1.1 SECTION INCLUDES

.1 Metal duct work.
.2 Nonmetal duct work.
.3 Casing and plenums.
.4 Buried duct work.
.5 Kitchen hood duct work.
.6 Duct cleaning.

1.2 REFERENCES

.1 ASTM A36/A36M - Carbon Structural Steel.
.2 ASTM A90/A90M - Weight (Mass) of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings.
.3 ASTM A167 - Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
.4 ASTM A480/A480M - General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip.
.5 ASTM A568/A568M - General Requirements for Steel Sheet, Carbon, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled.
.6 ASTM A653/A653M - Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
.7 ASTM A1008/A1008M - Steel, Sheet, Cold-Rolled Carbon, Structural, High-Strength Low-Alloy and High Strength Low-Alloy with Improved Formability.
.8 ASTM A1011/A1011M - Standard Specification for Steel, Sheet, and Strip Hot-Rolled, Carbon, Structural, High-Strength, Low-Alloy with Improved Formability.
.9 ASTM B209 - Aluminum and Aluminum-Alloy Sheet and Plate.
.10 ASTM C14/C14M - Concrete Sewer, Storm Drain, and Culvert Pipe.
.11 ASTM C443 - Joints for Concrete Pipe and Manholes, Using Rubber Gaskets.
.12 AWS D9.1 - Sheet Metal Welding Code.
.13 NBS PS 15 - Voluntary Product Standard for Custom Contact-Moulded Reinforced-Polyestor Chemical Resistant Process Equipment.
.14 NFPA 90A - Installation of Air Conditioning and Ventilating Systems.
.15 NFPA 90B - Installation of Warm Air Heating and Air-Conditioning Systems.
.16 NFPA 91 - Exhaust Systems for Air Conveying of Vapours, Gases, Mists, and Noncombustible Particulate Solids.
.17 NFPA 96 - Ventilation Control and Fire Protection of Commercial Cooking Operations.
.18 SMACNA - HVAC Air Duct Leakage Test Manual.
.19 SMACNA - HVAC Duct Construction Standards - Metal and Flexible.
.20 SMACNA - Fibrous Glass Duct Construction Standards.
.21 UL 181 - Factory-Made Air Ducts and Connectors.

1.3 DEFINITIONS

.1 Low pressure/low velocity: Static pressure in duct less than 498 Pa (2" w.g.) and velocities less than 10 meters/second (2000 fpm).

.2 Medium pressure/high velocity: Static pressure in duct less than 996 Pa (4" w.g.) and velocities between 10 meters/second (2000 fpm) and 20 meters/second (4000 fpm).

.3 High pressure/high velocity: Static pressure in ducts more than 996 Pa (4" w.g.) And velocities greater than 4000 fpm.

.4 Duct sizes: as shown on drawings are outside dimensions. For acoustically lined or internally insulated ducts, sizes shown are actual duct sizes and the insulation thickness has been accounted for.

1.4 PERFORMANCE REQUIREMENTS

.1 No variation of duct configuration or sizes permitted except by written permission. Size round ducts installed in place of rectangular ducts to ASHRAE table of equivalent rectangular and round ducts.

1.5 SUBMITTALS

.1 Section 01 33 00: Procedures for submittals.

.2 Shop Drawings: Indicate duct fittings, particulars such as gauges, sizes, welds, and configuration prior to start of work for 1000 kPa pressure class and higher systems.

.3 Product Data: Provide data for duct materials.

.4 Test Reports: Indicate pressure tests performed. Include date, section tested, test pressure, and leakage rate, following SMACNA HVAC Air Duct Leakage Test Manual.

1.6 QUALITY ASSURANCE

.1 Perform Work to SMACNA - HVAC Duct Construction Standards - Metal and Flexible.

.2 Ductwork shall meet the requirements of NFPA 90A, Air Conditioning and Ventilating Systems, and NFPA No. 96, Standard for the Installation of Equipment for the Removal of Smoke and Grease-Laden Vapours from Commercial Cooking Equipment

1.7 QUALIFICATIONS

.1 Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

.2 Installer: Company specializing in performing the work of this section with minimum 3 years documented experience.

1.8 ENVIRONMENTAL REQUIREMENTS

.1 Do not install duct sealants when temperatures are less than those recommended by sealant manufacturers.

.2 Maintain temperatures during and after installation of duct sealants.

2 Products

2.1 DUCT MATERIALS

.1 Galvanized Steel Ducts: ASTM A653 galvanized steel sheet, lock-forming quality, having G60 zinc coating to ASTM A90 on both sides.

.2 Steel Ducts: ASTM A1008.

.3 Aluminum Ducts: ASTM B209; aluminum sheet, alloy 3003-H14. Aluminum Connectors and Bar Stock: Alloy 6061- T6 or of equivalent strength.

.4 Stainless Steel Ducts: ASTM A167, Type 304.

.5 Concrete Ducts: ASTM C14; hub and spigot concrete sewer pipe with ASTM C443 joints, rubber gaskets.

.6 Fasteners: use rivets and bolts throughout; sheet metal screws accepted on low pressure ducts.

2.2 SEALANT

.1 Oil resistant, water based or solvent based, anti-microbial, anti-bacterial, ultra violet resistant, polymer type, flame resistant duct sealant.

.2 VOC content to be less than VOC limits of the State of California's South Coast Air Quality District Rule #1168. VOC content less than 30 g/L (less water and less exempt compounds) for sealing metal to metal contact.

.3 Sealant shall be cured for a minimum of 48 hours.

.4 Flame Spread Rating: 0 (zero).

.5 Smoke Spread Raring: 0 (zero).

2.3 TAPE

.1 Polyvinyl treated, open weave fibre glass, 50 mm wide.

2.4 SEAL CLASSIFICATION

.1 Classification as follows:

Maximum Pressure Pa	SMACNA Seal Class
up to 500	B
Over 500	A

.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. Longitudinal seams unsealed.

.4 Unsealed seams and joints.

2.5 DUCT WORK FABRICATION

.1 Fabricate and support to SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated. Provide duct material, gauges, reinforcing, and sealing for operating pressures indicated.

.2 Construct T's, bends, and elbows with radius of not less than 1-1/2 times width of duct on centreline. Where not possible and where rectangular elbows are used, provide air foil turning vanes.

.3 Complete metal ducts within themselves with no single partition between ducts. Where width of duct exceeds 450 mm, cross break for rigidity. Open corners are not acceptable.

.4 Lap metal ducts in direction of air flow. Hammer down edges and slips to leave smooth duct interior.

.5 Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.

.6 Fabricate continuously welded round and oval duct fittings two gauges heavier than duct gauges indicated in SMACNA Standard. Joints: minimum 100 mm cemented slip joint, brazed or electric welded. Prime coat welded joints.

.7 Provide standard 45 degree lateral wye takeoffs unless duct manufacturer can show 90 degree and tap has less static pressure loss.

.8 Rigidly construct metal ducts with joints mechanically tight, substantially airtight, braced and stiffened so as not to breath, rattle, vibrate or sag. Caulk duct joints and connections with sealant as ducts are being assembled.

.9 Provide easements where low pressure ductwork conflicts with piping and structure where easements exceed 10% duct area, split into two ducts maintaining original duct area.

.10 Exposed ductwork to be fabricated from Aluminum for aesthetics.

2.6 FITTINGS

.1 Fabrication: to SMACNA.

.2 Radiused elbows.
- .1 Rectangular: standard radius with single thickness turning vanes. Centreline radius: 1.5 times width of duct.
- .2 Round: smooth radius. Centreline radius: 1.5 times diameter.
- .3 Oval: 7 gore 90’s, 5 gore 45’s.

.3 Mitred elbows, rectangular:
- .1 To 400 mm: with single thickness Airfoil turning vanes.
- .2 Over 400 mm: with double thickness Airfoil 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: 15 degrees maximum included angle when increasing duct sizes.
- .2 Converging: 45 degrees maximum included angle downstream of equipment.
- .3 Diverging: 30 degrees maximum included angle upstream of equipment.

.6 Offsets:
.1 Full radiused elbows, as indicated.

.7 Obstruction deflectors: maintain full cross-sectional area.
.1 Maximum included angles: as for transitions.

2.7 MANUFACTURED DUCT WORK AND FITTINGS

.1 Manufacture to SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated. Provide duct material, gauges, reinforcing, and sealing for operating pressures indicated.

.2 Flat Oval Ducts:
.1 Machine made from round spiral lockseam duct with light reinforcing corrugations; fittings manufactured of at least two gauges heavier metal than duct.

.3 Double Wall Insulated Flat Oval Ducts:
.1 Machine made from round spiral lockseam duct with light reinforcing corrugations, galvanized steel outer wall, 25 mm thick fibreglass insulation, perforated galvanized steel inner wall; fittings manufactured with solid inner wall.

.4 PVC Coated Steel Ducts:
.1 UL 181, Class 1, galvanized steel duct coated with polyvinyl chloride plastic, 0.1 mm thick on outside and 0.05 mm thick on inside.

.5 Transverse Duct Connection System:
.1 SMACNA "E" rated rigidly class connection, interlocking angle and duct edge connection system with sealant, gasket, cleats, and corner clips.

2.8 CASINGS

.1 Fabricate casings to SMACNA HVAC Duct Construction Standards - Metal and Flexible and construct for operating pressures indicated.

.2 Mount floor mounted casings on 100 mm high concrete curbs. At floor, rivet panels on 200 mm centres to angles. Where floors are acoustically insulated, provide liner of 1.20 mm galvanized expanded metal mesh supported at 300 mm centres, turned up 300 mm at sides with sheet metal shields.

.3 Reinforce door frames with steel angles tied to horizontal and vertical plenum supporting angles. Install hinged access doors where indicated or required for access to equipment for cleaning and inspection. Provide clear wire glass observation ports, minimum 150 X 150 mm size.

.4 Fabricate acoustic casings with reinforcing turned inward. Provide 1.50 mm back facing and 0.80 mm perforated front facing with 2.4 mm diameter holes on 4 mm centres. Construct panels 75 mm thick packed with 72 kg/cu m minimum glass fibre media, on inverted channels of 1.50 mm.

2.9 FIRESTOPPING

.1 Retaining angles around duct, on both sides of fire separation

.2 Fire stopping material and installation must not distort duct.

2.10 HANGERS AND SUPPORTS

.1 Hangers and Supports: in accordance with Section 23 05 29 - Hangers and Supports for HVAC Piping Equipment.

.1 Band hangers: use on round and oval ducts up to 500 mm diameter, of same material as duct but next sheet metal thickness heavier than duct.

.2 Trapeze hangers: ducts over 500 mm diameter or longest side, to SMACNA.

.3 Hangers: steel angle with black steel rods to 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 or steel plate washer.

.1 Mount to top cord.

.3 For steel beams: manufactured beam clamps:

2.11 WIRE ROPE SUSPENSION SYSTEMS

.1 Wire rope suspension systems shall be ULC, CSA and SMACNA approved and tested.

.2 Wire suspensions systems consist of a pre-formed wire rope sling with either a ferruled loop, permanently fixed threaded 1/4ins (or 3/8ins) stud, or permanently fixed nipple end with toggle, at one end or hook or eyelet. The end fixings and the wire must be of the same manufacturer. The system is secured and tensioned with a hanger self-locking grip at the other end.

.3 Only wire and or supports supplied and or approved, shall be used with the system.

.4 The contractor shall select the correct specification of wire hanger to use for supporting each particular service from table 1 below. Each size is designated with a maximum Safe Working Load Limit (which incorporates a 5:1 safety factor). The correct specification of wire hanger required is determined using the following formula:

Weight per metre of object suspended (kg) x Distance between suspension points (m) = Weight loading per hanger suspension point (kg).

Table 1 Wire Hanger Safe Working Loads

Size	**Working Load Limit (kg)** **Working Load Limit (lbs)**
No. 1	0 - 10 kg (0 - 22 lbs)
No. 2	10.5 - 45.5 kg (23 - 100 lbs)
No. 3	46 - 91 kg (101 - 200 lbs)
No. 4	95.5 - 225 kg (210 - 495 lbs)
No. 5	225.5 - 325 kg (496 - 715 lbs)

(i) Where the installed wire rope is not vertical then the working load limit shall be reduced in accordance with the recommendations given in the manufacturer's handbook.

.5 The contractor shall select and use the correct length of wire rope required to support the service.

.6 No in-line joins shall be permitted in the rope.

3 Execution

3.1 GENERAL REQUIREMENTS

.1 Do work in accordance with SMACNA.

.2 Do not break continuity of insulation vapour barrier with hangers or rods.
.1 Ensure diffuser is fully seated.

.3 Support risers in accordance with SMACNA.

.4 Install breakaway joints in ductwork on sides of fire separation.

.5 Install proprietary manufactured flanged duct joints and manufactured equipment in accordance with manufacturer's instructions.

.6 Manufacture duct in lengths and diameter to accommodate installation of acoustic duct lining.

.7 At each point where ducts pass through partitions, the joints around the duct shall be sealed with non-combustible material.

3.2 INSTALLATION

.1 Install and seal ducts to SMACNA HVAC Duct Construction Standards - Metal and Flexible according to seal classification specified.

.2 Provide openings in duct work where required to accommodate thermometers and controllers. Provide pilot tube openings where required for testing of systems, complete with metal can with spring device or screw to ensure against air leakage. Where openings are provided in insulated duct work, install insulation material inside a metal ring.

.3 Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.

.4 Use double nuts and lock washers on threaded rod supports.

.5 Provide access doors for inspection.

.6 Tape joints of PVC coated metal duct work with PVC tape.

.7 Connect terminal units to supply ducts directly or with 300 mm maximum length of flexible duct. Do not use flexible duct to change direction.

.8 Connect diffusers to low pressure ducts directly. To decouple diffuser from duct system, use 1.5 m maximum length of flexible duct held in place with caulking compound and strap or clamp. Do not use flexible duct to change direction.

.9 Connect flexible ducts to metal ducts with adhesive and strap or clamp.

.10 Set plenum doors 150 to 300 mm above floor. Arrange door swings so that fan static pressure holds door in closed position.

.11 During construction provide temporary closures of metal or taped polyethylene on open duct work to prevent construction dust from entering duct work system.

.12 Provide floor drains in fresh air coil, and humidifier sections with deep seal traps.

3.3 CLEANING

.1 Clean work to requirements of Division 1 and as detailed herein.

.2 Clean duct system and force air at high velocity through duct to remove accumulated dust. To obtain sufficient air, clean half the system at a time. Protect equipment which may be harmed by excessive dirt with temporary filters, or bypass during cleaning.

.3 Provide adequate access into duct work for cleaning purposes.

.4 Prior to occupancy and during initial occupancy, building shall be flushed at maximum outdoor air volume. Supply a total of 4,300 cu.m of outdoor air per sq.m of floor area or approximately 30,564,400cu.m of outdoor air or approximately 54 days of flushing. Note that a minimum of 3 weeks of flushing will be required prior to occupancy.

3.4 WATER TIGHT DUCTS

.1 Provide watertight duct for:
- .1 Fresh air intake.
- .2 As indicated.

.2 Form bottom of horizontal duct without longitudinal seams.
- .1 Solder or weld joints of bottom and side sheets.
- .2 Seal other joints with duct sealer.

.3 Slope horizontal branch ductwork down towards hoods served.
- .1 Slope header ducts down toward risers.

.4 Fit base of riser with 150 mm deep drain sump and 32 mm drain connected, with deep seal trap and discharging to open funnel drain.

3.5 WIRE ROPE SUSPENSION SYSTEMS

.1 The wire hangers shall be fixed to the building structure in accordance with the standard practice and structural limitations.

.2 Loop end can be wrapped around purlins, beams, roof trusses and other accessible building features.

.3 Stud end can be fixed with suitable anchors into concrete ceilings and structures, metal decking and pressed metal brackets (using nuts).

.4 Toggle end can be fixed into profile roof cladding, light fittings and luminaries.

.5 Other wire rope systems can be fixed to an approved structure, as determined by the Departmental Representative.

.6 The wire hangers shall not be fixed to any other services, without the approval of the Departmental Representative.

.7 The free end of the wire rope should be threaded through one channel of the self-locking grip before being either passed around the object being suspended or connected to it, using a suitable fixing. The wire rope is then threaded back through the second channel in the grip until the required level is achieved.

.8 Adjust duct elevations as required to remain level and plumb, the weight of the suspended object must be independently supported while making adjustments.

.9 The wire rope must not be damaged, twisted or deformed in any way prior to, or during, installation. Any such ropes must be discarded and replaced.

.10 When installing wire hangers the angle between the ropes when exiting the grip must never exceed the manufacturer's recommendations and/or 60 degrees.

.11 Lubricants, paint or any other coating shall not be applied to the wire hanger as it may impair its performance.

.12 Wire hangers must be installed in accordance with the manufacturer's loading and installation instructions and all the manufacturer's recommendations.

3.6 LEAKAGE TESTS

.1 Refer to Section 23 05 94.

.2 In accordance with SMACNA HVAC Duct Leakage Test Manual.

.3 Do leakage tests in sections.

.4 Make trial leakage tests as instructed to demonstrate workmanship.

.5 Do not install additional ductwork until trial test has been passed.

.6 Test section minimum of 30 m long with not less than three branch takeoffs and two 90 degrees elbows.

.7 Complete tests before performance insulation or concealment Work.

3.7 SEALANT APPLICATION

.1 Contractor shall apply sealant on exposed ductwork in a 50mm band centered on joint.

.2 Sealant shall be applied evenly with a clean edge finish perpendicular to duct and plumb.

.3 Tape shall be utilized to provide clean edge finish to sealant application.

3.8 SOUND ATTENUATING TRANSFER DUCTS

.1 Sound attenuating transfer air ducts shall be installed where indicated on drawings complete with internal acoustic insulation in accordance with Section 23 07 13.

.2 Elbows on sound attenuating transfer air ducts shall not utilize turning vanes.

.3 Geometry of all sound attenuating transfer air ducts shall ensure that sound contacts a minimum of two duct surfaces.

.4 Provide single elbow configurations or double elbow configurations as indicated on drawings. It is permissible to utilize double elbow configurations in lieu of single elbow but not vice versa.

END OF SECTION

1 General

1.1 SUMMARY

.1 Section Includes:
  .1 Materials and installation of high-pressure metallic ductwork, joints and accessories.
.2 Sustainable requirements for construction and verification.

1.2 REFERENCES

.1 American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE).
.2 American Society for Testing and Materials (ASTM).
  .1 ASTM A653/A653M-04a, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process. (Metric).
.3 Department of Justice Canada (Jus).
  .1 Canadian Environmental Protection Act (CEPA), 1999, c. 33.
  .2 Transportation of Dangerous Goods Act (TDGA), 1992, c. 34.
.4 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
  .1 Material Safety Data Sheets (MSDS).
.5 Sheet Metal Air Conditioning Contractors' National Association (SMACNA).
  .1 SMACNA HVAC Duct Construction Standards, Metal and Flexible, 95 (Addendum No. 1, (1997).
  .2 SMACNA HVAC Air Duct Leakage Test Manual, 1st Edition 1985.
  .3 SMACNA IAQ Guideline for Occupied Buildings under Construction, 1st Edition 1995.

1.3 SUBMITTALS

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

.2 Product Data: submit WHMIS MSDS - Section 02 61 33 - Hazardous Materials for the following:
  .1 Sealants.
  .2 Tape.
  .3 Proprietary joints.
  .4 Fittings.

1.4 QUALITY ASSURANCE

.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.

.2 Health and Safety:
  .1 Do construction occupational health and safety in accordance with Section 01 35 30 - 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.

.3 Store and manage hazardous materials in accordance with cepa, tdga AND Regional and Municipal Regulations.

.2 Waste Management and Disposal: Remove from site and dispose of packaging materials at appropriate recycling facilities.

.1 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.

.2 Divert unused metal materials from landfill to metal recycling facility as approved by Departmental Representative.

.3 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.

.4 Fold up metal and plastic banding, flatten and place in designated area for recycling.

.5 Handle and dispose of hazardous materials in accordance with CEPA, TDGA, Regional and Municipal regulations.

.6 Disposal of asbestos waste generated by removal activities must comply with Federal, Provincial, Territorial and Municipal regulations. Dispose of asbestos waste in sealed double thickness 6 ml bags or leak proof drums. Label containers with appropriate warning labels.

.7 Provide manifests describing and listing waste created. Transport containers by approved means to licenced landfill for burial**.**

1.6 DEFINITIONS

.1 Low pressure/low velocity: static pressure in duct less than 498 Pa and velocities less than 10 meters/second.

.2 Medium pressure/high velocity: Static pressure in duct less than 996 Pa and velocities between 10 meters/second and 20 meters/second.

.3 High pressure/high velocity: Static pressure in ducts more than 996 Pa and velocities greater than 4000 fpm.

.4 Duct sizes: as shown on drawings are outside dimensions. For acoustically lined or internally insulated ducts, sizes shown are actual duct sizes and the insulation thickness has been accounted for

1.7 QUALITY ASSURANCE

.1 Ductwork shall meet the requirements of NFPA 90A, Air Conditioning and Ventilating Systems, and NFPA No. 96, Standard for the Installation of Equipment for the Removal of Smoke and Grease-Laden Vapours from Commercial Cooking Equipment.

.2 Fabricate in accordance with SMACNA duct manuals and ASHRAE handbooks.

1.8 INDOOR AIR QUALITY (IAQ) MANAGEMENT PLAN

.1 During construction meet or exceed the requirements of SMACNA IAQ Guideline for Occupied Buildings under Construction.

2 Products

2.1 GENERAL

.1 Fasteners: Use rivets and bolts throughout; sheet metal screws accepted on low pressure ducts.

.2 Complete metal ducts within themselves with no single partition between ducts. Where width of duct exceeds 450 mm, cross break for rigidity. Open corners are not acceptable.

.3 Lop metal ducts in direction of air flow. Hammer down edges and slips to leave smooth duct interior.

.4 Where 1.5 time radius elbows are not possible and where rectangular elbows possible, use rectangular elbows and provide approved type air foil turning vanes. Where acoustical lining is provided, provide turning vanes of perforated metal type with fibre glass inside.

.5 Rigidly constructed metal ducts with joints mechanically tight, substantially airtight, braced and stiffened so as not to breath, rattle, vibrate or sag. Caulk duct joints and connections with sealant as ducts are being assembled.

2.2 DUCTWORK

.1 Material:
- .1 Galvanized steel with Z90 designation zinc coating lock forming quality: to ASTM A653/A653M.
- .2 Thickness: to SMACNA.

.2 Construction - round and oval.
- .1 Ducts: factory fabricated, spiral wound, with matching fittings and specials to SMACNA.
- .2 Transverse joints up to 900 mm: slip type with tape and sealants.
- .3 Transverse joints over 900 mm: Vanstone.
- .4 Fittings:
  - .1 Elbows: smooth radius or seven-piece (for 90 degrees), five-piece (for 45 degrees). Centreline radius: 1.5 x diameter.
  - .2 Branches: conical transition with conical branch at 45 degrees and 45 degrees elbow.

.3 Construction - rectangular:
- .1 Ducts: to SMACNA.
- .2 Transverse joints: welded or proprietary duct joints to SMACNA seal Class A.
- .3 Fittings:
  - .1 Elbows: smooth radius; centreline radius 1.5 x width of duct. No vanes.
  - .2 Branches: with conical branch at 45 degrees and 45 degrees elbow except where duct manufacturer can show 90 degree and tap has less static pressure loss.

.4 Firestopping:
- .1 50 x 50 x 3 mm retaining angles around duct, on both sides of fire separation.
- .2 Firestopping material must not distort duct.

2.3 SEAL CLASSIFICATION

.1 Classification as follows:

Maximum Pressure Pa	SMACNA Seal Class
2500	A
1500	A
1000	A
750	A

.2 Seal classification:

.1 Class A: longitudinal seams, transverse joints, duct wall penetrations and connections made airtight with sealant, gaskets, tape or combination thereof.

.2 Class B: longitudinal seams, transverse joints and connections made airtight with gaskets, sealant, tape or combination thereof.

2.4 SEALANT

.1 Oil resistant, water based, anti-microbial, anti-bacterial, ultra violet resistant, polymer type, flame resistant duct sealant.

.2 VOC content to be less than VOC limits of the State of California's South Coast Air Quality District Rule #1168. VOC content less than 30 g/L (less water and less exempt compounds) for sealing metal to metal contact.

.3 Sealant shall be cured for at minimum of 48 hours.

.4 Flame and Smoke Spread Rating: 0 (zero).

2.5 TAPE

.1 Polyvinyl treated, open weave fibre glass, 50 mm wide.

2.6 DUCT LEAKAGE

.1 In accordance with SMACNA HVAC air duct leakage test manual.

2.7 HANGERS AND SUPPORTS

.1 Hangers and Supports: in accordance with Section 23 05 29 - Hangers and Supports for HVAC Piping Equipment.

.1 Band hangers: use on round and oval ducts up to 500 mm diameter, of same material as duct but next sheet metal thickness heavier than duct.

.2 Trapeze hangers: ducts over 500 mm diameter or longest side, to SMACNA.

.3 Hangers: steel angle with black steel rods to 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 or steel plate washer.
  - .1 Mount to top cord.
- .3 For steel beams: manufactured beam clamps:

2.8 WIRE ROPE SUSPENSION SYSTEMS

.1 Wire rope suspension systems shall be ULC, CSA and SMACNA approved and tested.

.2 Wire suspensions systems consist of a pre-formed wire rope sling with either a ferruled loop, permanently fixed threaded 1/4ins (or 3/8ins) stud, or permanently fixed nipple end with toggle, at one end or hook or eyelet. The end fixings and the wire must be of the same manufacturer. The system is secured and tensioned with a hanger self-locking grip at the other end.

.3 Only wire and or supports supplied and or approved, shall be used with the system.

.4 The contractor shall select the correct specification of wire hanger to use for supporting each particular service from table 1 below. Each size is designated with a maximum Safe Working Load Limit (which incorporates a 5:1 safety factor). The correct specification of wire hanger required is determined using the following formula:

Weight per metre of object suspended (kg) x Distance between suspension points (m) = Weight loading per hanger suspension point (kg).

Table 1 Wire Hanger Safe Working Loads

Size	**Working Load Limit (kg)** **Working Load Limit (lbs)**
No. 1	0 - 10 kg (0 - 22 lbs)
No. 2	10.5 - 45.5 kg (23 - 100 lbs)
No. 3	46 - 91 kg (101 - 200 lbs)
No. 4	95.5 - 225 kg (210 - 495 lbs)
No. 5	225.5 - 325 kg (496 - 715 lbs)

(i) Where the installed wire rope is not vertical then the working load limit shall be reduced in accordance with the recommendations given in the manufacturer's handbook.

.5 The contractor shall select and use the correct length of wire rope required to support the service.

.6 No in-line joins shall be permitted in the rope.

3 Execution

3.1 GENERAL

.1 Do work in accordance with SMACNA.

.2 Do not break continuity of insulation vapour barrier with hangers or rods.
- .1 Insulate band hangers 100 mm beyond insulated duct.
- .2 Ensure diffuser is fully seated.

.3 Support risers in accordance with SMACNA.

.4 Install breakaway joints in ductwork on sides of fire separation.

.5 Ensure installation of firestopping does not distort duct.

.6 Provide openings in ductwork where required to accommodate thermometers and controllers. Provide pitot tube openings where required for testing of systems, complete with metal cam with spring device or screw to ensure against air leakage. Where openings are provided in insulated ductwork, install insulation material inside a metal ring.

.7 Clean duct systems and force air at high velocity through duct to remove accumulated dust. To obtain sufficient air, clean half the system at a time. Protect equipment which may be harmed by excessive dirt with filters, or bypass during cleaning.

.8 Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.

.9 Connect terminal units to medium pressure ducts with 300 mm maximum length of flexible duct. Do not use flexible duct to change directions.

.10 At each point where ducts pass through partitions, the joints around the duct shall be sealed with non-combustible material.

3.2 HANGERS

.1 Band hangers: install in accordance with SMACNA.

.2 Angle hangers: complete with locking nuts and washers.

.3 Hanger spacing: as follows:

Duct Size (mm)	Spacing (mm)
to 1500	3000
1501 and over	2500

3.3 SEALING AND TAPING

.1 Apply sealant in accordance with SMACNA and to manufacturer's recommendations.

.2 Bed tape in sealant and recoat with minimum of one coat of sealant to manufacturer's recommendations.

3.4 WIRE ROPE SUSPENSION SYSTEMS

.1 The wire hangers shall be fixed to the building structure in accordance with the standard practice and structural limitations.

.2 Loop end can be wrapped around purlins, beams, roof trusses and other accessible building features.

.3 Stud end can be fixed with suitable anchors into concrete ceilings and structures, metal decking and pressed metal brackets (using nuts).

.4 Toggle end can be fixed into profile roof cladding, light fittings and luminaries.

.5 Other wire rope systems can be fixed to an approved structure, as determined by the Departmental Representative.

.6 The wire hangers shall not be fixed to any other services, without the approval of the Departmental Representative.

.7 The free end of the wire rope should be threaded through one channel of the self-locking grip before being either passed around the object being suspended or connected to it, using a suitable fixing. The wire rope is then threaded back through the second channel in the grip until the required level is achieved.

.8 Adjust duct elevations as required to remain level and plumb, the weight of the suspended object must be independently supported while making adjustments.

.9 The wire rope must not be damaged, twisted or deformed in any way prior to, or during, installation. Any such ropes must be discarded and replaced.

.10 When installing wire hangers the angle between the ropes when exiting the grip must never exceed the manufacturer's recommendations and/or 60 degrees.

.11 Lubricants, paint or any other coating shall not be applied to the wire hanger as it may impair its performance.

.12 Wire hangers must be installed in accordance with the manufacturer's loading and installation instructions and all the manufacturer's recommendations.

3.5 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 Perform leakage tests in sections.

.4 Perform trial leakage tests, as instructed to demonstrate workmanship.

.5 Do not install additional ductwork until trial tests have been achieved.

.6 Test section minimum of 30 m long with not less than three branch takeoffs and two 90 degrees elbows.

.7 Complete tests before performing insulation or concealment Work.

END OF SECTION

1 General

1.1 SECTION INCLUDES

.1 Air turning devices/extractors.
.2 Backdraft dampers.
.3 Combination fire and smoke dampers.
.4 Duct access doors.
.5 Duct test holes.
.6 Fire dampers.
.7 Flexible duct connections.
.8 Volume control dampers.

1.2 REFERENCES

.1 NFPA 90A - Installation of Air Conditioning and Ventilating Systems.
.2 NFPA 92A - Smoke-Control Systems.
.3 SMACNA - HVAC Duct Construction Standards - Metal and Flexible.
.4 UL 33 - Heat Responsive Links for Fire-Protection Service.
.5 UL 555 - Fire Dampers.
.6 UL 555S - Smoke Dampers.

1.3 SUBMITTALS

.1 Section 01 33 00: Procedures for submittals.

.2 Shop Drawings: Provide for shop fabricated assemblies including volume control dampers.

.3 Product Data: Provide for shop fabricated assemblies including volume control dampers. Include electrical characteristics and connection requirements.

.4 Manufacturer's Installation Instructions: Indicate for dampers including fire and fire/ smoke dampers.

1.4 PROJECT RECORD DOCUMENTS

.1 Section 01 78 00: Submittals for project closeout.

.2 Record actual locations of access doors.

1.5 QUALITY ASSURANCE

.1 Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

.2 Accessories shall meet the requirements of NFPA 90A, Air Conditioning and Ventilating Systems.

.3 Fabricate in accordance with ASHRAE handbooks and SMACNA duct manuals.

1.6 REGULATORY REQUIREMENTS

.1 Products Requiring Electrical Connection: Listed and classified by Underwriters' Laboratories Inc., as suitable for the purpose specified and indicated.

1.7 DELIVERY, STORAGE, AND HANDLING

.1 Section 01 61 00: Transport, handle, store, and protect products.

.2 Protect dampers from damage to operating linkages and blades.

1.8 EXTRA MATERIALS

.1 Section 01 78 00: Submittals for project closeout.

.2 Provide two of each size and type of fusible link.

2 Products

2.1 TURNING VANES

.1 Factory or shop fabricated single thickness or double thickness, to recommendations of SMACNA and as indicated.

.2 Shall be airfoil type.

.3 Where acoustical lining is provided, provide turning vanes of perforated metal type with fibre glass inside.

2.2 BACKDRAFT DAMPERS.

.1 Gravity Backdraft Dampers, Size 450 x 450 mm or Smaller Provided with Air Moving Equipment: Air moving equipment manufacturers standard construction.

.2 Extruded aluminum 6063T5 backdraft damper frame shall not be less than 1.52 mm in thickness. Frame shall be 63.5 mm deep.

.3 Blades shall be extruded aluminum (6063T5) profiles and shall be less than 1.52 mm in thickness.

.4 Blade and side seals shall be extruded silicone. Seals are to be secured in integral slots within the aluminum extrusions.

.5 Bearing system shall be composed of Celcon bearings rotating on zinc-plated 12.7 mm steel pivot points.

.6 Linkage system shall consist of hard alloy aluminum (6005T6) crank arms fastened to zinc-plated steel pivot rods and shall be doubly secured within channel running along top of blade. Large diameter 8.73 mm hard alloy aluminum (6065-T6C) linkage rod shall connect the crank arms by means of a zinc-plated steel trunnion.

.7 Cup point trunnion set screw shall create a compression hard spot where it secures to the linkage rod for a slip-proof grip.

.8 Trunnions shall be zinc-plated to provide a hard, smooth and long-lasting rotating surface.
- .1 Performance:
- .2 Temperature range: -40 deg.C to 100 deg.C.
- .3 Leakage: 101.2 l/s per square meter at 0.25 kPa.
- .4 Pressure Drop: less than 24.9 Pa.

.9 Backdraft dampers shall be made to size required. Minimum section size shall be 152 mm wide x 152 mm high. Maximum section size shall be 914 mm wide by 3658 mm high. Mullion breaks shall be used when damper height exceeds 1220 mm.

.10 Backdraft dampers with dimensions greater than maximum section size shall be manufactured in multiple sections. Multiple sections are not interlinked or connected. To install, each section must be individually fastened to a structural frame prepared on site.

.11 Fully adjustable device to permit setting for varying differential static pressures less than 2.49 Pa.

2.3 DUCT ACCESS DOORS

.1 Fabricate to SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated.

.2 Access doors to be ULC labelled.

.3 Fabrication for un-insulated ducts: Rigid and close-fitting of galvanized steel with sealing gaskets and quick fastening locking devices.

.4 Fabrication for 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 with sealing gaskets and quick fastening locking devices.

.5 Gaskets: neoprene.

.6 Hardware:
- .1 Less Than 300 mm Square: Secure with sash locks complete with safety chain.
- .2 Up to 450 mm Square: Provide two hinges and two sash locks.
- .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.
- .5 300 x 300 mm glass viewing panels where indicated.
- .6 Hold open devices.

.7 Access doors with sheet metal screw fasteners are not acceptable.

2.4 DUCT TEST HOLES

.1 Temporary Test Holes: Cut or drill in ducts as required. Cap with neat patches, neoprene plugs, threaded plugs, or threaded or twist-on metal caps.

.2 Permanent Test Holes: Factory fabricated, air tight flanged fittings with screw cap. Provide extended neck fittings to clear insulation.

2.5 FLEXIBLE DUCT CONNECTIONS

.1 Fabricate to SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated.

.2 Connector:
- .1 Fabric: cUL listed fire-retardant self extinguishing neoprene coated woven glass fibre fabric to NFPA 90A, minimum density 1.0 kg/sq m. Approximately 50mm of fabric clenched by means of double locked seams.

.2 Frame: 75 mm wide, 0.6 mm thick galvanized sheet metal.
.3 Attach edging strip to ducting and equipment by screws or bolts at 150 mm (6") intervals

.3 Leaded Vinyl Sheet: Minimum 14 mm0.55 inch thick, 4.2 kg/sq m0.87 lbs per sq ft, 10 dB attenuation in 10 to 10,000 Hz range.

3 Execution

3.1 INSTALLATION

.1 Install accessories to manufacturer's written instructions, NFPA 90A, and follow SMACNA HVAC Duct Construction Standards - Metal and Flexible. Refer to Section 23 31 00 for duct construction and pressure class.

.2 Provide backdraft dampers on exhaust fans or exhaust ducts nearest to outside and where indicated.

3.2 ACCESS DOORS

.1 Provide adequately sized duct access doors for inspection and cleaning.

.2 Sizes:
.1 600 x 600 mm for person size entry.
.2 900 x 900 mm for servicing entry.
.3 300 x 300 mm for viewing.
.4 As indicated.

.3 Locations (before and after):
.1 Fire and smoke dampers (install at fire dampers).
.2 Control dampers.
.3 Devices requiring maintenance.
.4 Required by code.
.5 Reheat coils.
.6 Filters.
.7 To facilitate cleaning of ductwork (minimum
.8 Elsewhere as indicated.

.4 Provide 100 mm x 100 mm (4" x 4") quick opening access doors for inspection at balancing dampers, before and after filters, coils, fans, automatic dampers, at fire dampers, combination fire and smoke dampers, and elsewhere as indicated. Provide for cleaning kitchen exhaust duct work to NFPA 96. Provide minimum 200 x 200 mm size for hand access, 450 x 450 mm size for shoulder access, and as indicated. Provide 100 x 100 mm for balancing dampers only. Review locations prior to fabrication.

3.3 TEST PORTS

.1 Install in accordance with recommendations of SMACNA and in accordance with manufacturer's instructions.

.2 Provide duct test ports where indicated and required for testing and balancing purposes.

.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 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.

3.4 FLEXIBLE CONNECTORS

.1 Provide flexible connections immediately adjacent to equipment in ducts associated with fans and motorized equipment, and supported by vibration isolators, including but not limited to the following:
- .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.

.6 For fans developing static pressures of 1250 Pa and over, cover connections with leaded vinyl sheet, held in place with metal straps.

END OF SECTION

1 General

1.1 SUMMARY

.1 Section Includes:
- .1 Balancing dampers for mechanical forced air ventilation and air conditioning systems.
- .2 Sustainable requirements for construction and verification.

1.2 REFERENCES

.1 Sheet Metal and Air Conditioning National Association (SMACNA).
- .1 SMACNA HVAC Duct Construction Standards, Metal and Flexible-1985.

.2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
- .1 Material Safety Data Sheets (MSDS).

1.3 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.
  - .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.

.2 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.

1.4 QUALITY ASSURANCE

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

2 Products

2.1 GENERAL

.1 Manufacture to SMACNA standards.

2.2 MANUAL VOLUME CONTROL DAMPERS.

.1 Fabricate to SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated.

.2 Splitter Dampers:
- .1 Fabricate from same material as duct but one sheet metal thickness heavier (minimum 16 gauge), with appropriate stiffening to avoid vibration.
- .2 Blade: Fabricate of double thickness sheet metal to streamline shape, secured with continuous piano hinge.
- .3 Operator: Minimum 6 mm diameter rod in self aligning, universal joint action, flanged bushing with set screw and position indicator.
- .4 Rod configuration to prevent end from entering duct.
- .5 Folded leading edge.
- .6 Size on basis of straight air volume proportioning.

.3 Single Blade Dampers:
- .1 Fabricate for duct sizes up to 150 (in depth) x 760 mm.
- .2 Fabricate from same material as duct, but one sheet metal thickness heavier (minimum 16 gauge). V-groove stiffened.
- .3 Size and configuration to recommendations of SMACNA
- .4 Locking quadrant with shaft extension to accommodate insulation thickness.
- .5 Inside and outside nylon end bearings.
- .6 Channel frame of same material as adjacent duct, complete with angle stop.

.4 Multi-Blade Damper:
- .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 oil impregnated nylon.
- .5 Linkage: shaft extension with locking quadrant.
- .6 Channel frame of same material as adjacent duct, complete with angle stop.

.5 End Bearings: Except in round duct work 300 mm and smaller, provide end bearings.

.6 Quadrants:
- .1 Provide locking, indicating quadrant regulators on single and multi-blade dampers.
- .2 On insulated ducts mount quadrant regulators on stand-off mounting brackets, bases, or adapters.
- .3 Where rod lengths exceed 750 mm provide regulator at both ends.

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 where specified, where required for balancing and where indicated on drawings.

.2 Install in accordance with recommendations of SMACNA and in accordance with manufacturer's instructions.

.3 Use splitter dampers only where indicated.

.4 Provide commercial balancing dampers on all low velocity duct take-offs to diffusers, grilles, and registers, regardless of whether dampers are specified as part of the diffuser, grille, or register assembly unless specifically noted otherwise.

.5 Runouts to registers and diffusers: install single blade damper located as close as possible to main ducts. Where indicated on the drawings, a balancing damper is not required for runouts in non-accessible ceiling spaces provided a damper is specified on the register and diffuser.

.6 Dampers: shall be installed vibration free.

.7 Ensure damper operators are observable and accessible. Provide access doors in ceilings/ walls where required.

END OF SECTION

1 General

1.1 SUMMARY

.1 Section Includes:
- .1 Operating dampers for mechanical forced air ventilation and air conditioning systems.
- .2 Sustainable requirements for construction and verification.

1.2 REFERENCES

.1 American Society for Testing and Materials International (ASTM)
- .1 ASTM A653/A653M-04a, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by Hot-Dip Process.

.2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
- .1 Material Safety Data Sheets (MSDS).

1.3 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.
  - .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.

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

1.4 QUALITY ASSURANCE

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

.2 Certificates:
- .1 Catalogue or published ratings those obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency.

2 Products

2.1 MULTI-LEAF DAMPERS

.1 Opposed airfoil blade type as indicated.

.2 Extruded aluminum (6063T5) damper frame shall not be less than 2.03 mm thickness. Damper frame to be 100 mm deep.

.3 Blades to be extruded aluminum (6063T5) profiles. Aluminum end caps are to be press fitted to blade ends, in order to seal hollow interior and reduce air leakage rate.

.4 Blade and frame seals shall be of extruded silicone. Seals are to be secured in an integral slot within the aluminum extrusions.

.5 Bearings are to be composed of a Celcon inner bearing fixed to a 11.11 mm aluminum hexagon blade pin, rotating within a polycarbonate outer bearing inserted in the frame, resulting in no metal-to-metal or metal-to-plastic contact.

.6 Linkage hardware shall be installed in the frame side and constructed of aluminum and corrosion-resistant, zinc-plated steel, complete with cup-point trunnion screws for a slip-proof grip.

.7 Standard air leakage data to be certified under the AMCA Certified Ratings Program.

.8 Dampers shall be made to size required without blanking off free area.

.9 Intermediate or tubular steel structural support is required to resist applied pressure loads for dampers that consist of two or more sections in both height and width.

.10 Operator: to Division 25.

.11 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.

.12 Performance:
- .1 Temperature Range: -40 deg.C to 100 deg.C.
- .2 Leakage: 15.2 l/s per sq.meter at 0.25 kPa, 40.5 l/s per sq.meter at 1.0 kPa. Shall meet Class 1A at 0.25 kPa.
- .3 Pressure Drop: less than 4 Pa at 5.08 m/s.

2.2 DISC TYPE DAMPERS

.1 Frame: insulated brake formed, welded, 1.6 mm thick, galvanized steel to ASTM A653/A653M.

.2 Disc: insulated 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, spring loaded actuator, zinc-aluminum foundry alloy casting cam follower.

.6 Performance:
- .1 Leakage: in closed position less than 0.001 % of rated air flow at .25 kPa pressure differential across damper.
- .2 Pressure drop: at full open position less than 5 Pa differential across damper at 5.08 m/s.

2.3 BACKDRAFT DAMPERS

.1 Extruded aluminum 6063T5 backdraft damper frame shall not be less than 1.52 mm in thickness. Frame shall be 63.5 mm deep.

.2 Blades shall be extruded aluminum (6063T5) profiles and shall be less than 1.52 mm in thickness.

.3 Blade and side seals shall be extruded silicone. Seals are to be secured in integral slots within the aluminum extrusions.

.4 Bearing system shall be composed of Celcon bearings rotating on zinc-plated 12.7 mm steel pivot points.

.5 Linkage system shall consist of hard alloy aluminum (6005T6) crank arms fastened to zinc-plated steel pivot rods and shall be doubly secured within channel running along top of blade. Large diameter 8.73 mm hard alloy aluminum (6065-T6C) linkage rod shall connect the crank arms by means of a zinc-plated steel trunnion.

.6 Cup point trunnion set screw shall create a compression hard spot where it secures to the linkage rod for a slip–proof grip.

.7 Trunnions shall be zinc-plated to provide a hard, smooth and long-lasting rotating surface.

.8 Performance:
- .1 Temperature range: -40 deg.C to 100 deg.C.
- .2 Leakage: 101.2 l/s per square meter at 0.25 kPa.
- .3 Pressure Drop: less than 24.9 Pa.

.9 Backdraft dampers shall be made to size required. Minimum section size shall be 152 mm wide x 152 mm high. Maximum section size shall be 914 mm wide by 3658 mm high. Mullion breaks shall be used when damper height exceeds 1220 mm.

.10 Backdraft dampers with dimensions greater than maximum section size shall be manufactured in multiple sections. Multiple sections are not interlinked or connected. To install, each section must be individually fastened to a structural frame prepared on site.

.11 Fully adjustable device to permit setting for varying differential static pressures less than 2.49 Pa.

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 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 Install insulated dampers at interface with outdoors including outdoor air intakes, exhaust ducts, and relief ducts.

END OF SECTION

1 General

1.1 SUMMARY

.1 Section Includes:
- .1 Fire and smoke dampers, and fire stop flaps.
- .2 Sustainable requirements for construction and verification.

1.2 REFERENCES

.1 American National Standards Institute/National Fire Protection Association (ANSI/NFPA)
- .1 ANSI/NFPA 90A-2002, Standard for the Installation of Air Conditioning and Ventilating Systems.

.2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
- .1 Material Safety Data Sheets (MSDS).

.3 Underwriters Laboratories of Canada (ULC)
- .1 CAN4-S112-M1990, Fire Test of Fire Damper Assemblies.
- .2 CAN4-S112.2-M84, Standard Method of Fire Test of Ceiling Firestop Flap Assemblies.
- .3 ULC-S505-1974, Fusible Links for Fire Protection Service.

1.3 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.
  - .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.
- .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.

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

.2 Provide a Fire Damper Schedule identifying the following: damper tag, duct size, location, access door size, location.

1.4 QUALITY ASSURANCE

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

.2 Certificates:
- .1 Catalogue or published ratings those obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency signifying adherence to codes and standards.

1.5 MAINTENANCE

.1 Extra Materials:
- .1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Provide following:
  - .1 Six (6) fusible links of each type.

2 Products

2.1 FIRE DAMPERS

.1 Fabricate to NFPA 90A and as indicated.

.2 Fire dampers: arrangement Type A, B and C, listed and bear label of ULC, UL, Warnock Hersey, meet requirements of authorities having jurisdiction. Fire damper assemblies fire tested in accordance with CAN4-S112. Fusible links on fire dampers shall be constructed to ULC Standard S505.

.3 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 or required.
- .2 Fire dampers: automatic operating type and have dynamic rating suitable for maximum air velocity and pressure differential to which it will be subjected.

.4 Design and construct dampers to not reduce duct or air transfer opening cross-sectional area.

.5 Ceiling Dampers: Galvanized steel, 0.76 mm frame and 1.5 mm flap, two layers 3.2 mm ceramic fibre on top side, and one layer on bottom side for round flaps, with locking clip

.6 Horizontal Dampers: Galvanized steel, 0.76 mm frame, stainless steel closure spring, and lightweight, heat retardant non-asbestos fabric blanket.

.7 Curtain Type Dampers: Galvanized steel with interlocking blades. Provide stainless steel closure springs and latches for horizontal installations. Configure with blades out of air stream except for 250 Pa pressure class ducts up to 300 mm in height.

.8 Multiple Blade Dampers: 1.5 mm galvanized steel frame and blades, oil-impregnated bronze or stainless steel sleeve bearings and plated steel axles, 3.2 x 12.7 mm plated steel concealed linkage, stainless steel closure spring, blade stops, and lock.

.9 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.

.10 Fusible Links: separate at 71 degrees C (161 Deg.F.) with adjustable link straps for combination fire/balancing dampers.

.11 Fire dampers in low pressure ductwork may be multi-blade, offset butterfly of curtain type.

.12 Fabricate combination fire and balancing dampers with linkage readily adjustable in open position.

.13 50 x 50 x 3 mm retaining angle iron frame, on full perimeter of fire damper, on both sides of fire separation being pierced.

.14 Equip fire dampers with steel sleeve and frame installed disruption ductwork (breakaway ductwork) to ensure damper operation is not impaired. Equip sleeves or frames with perimeter mounting angles attached on both sides of wall or floor opening, except where noted otherwise. Construct ductwork in fire-rated floor-ceiling or roof-ceiling assembly systems with air ducts that pierce ceiling to conform with ULC.

.15 Fire dampers mounted on through the ceiling/floor security grilles shall utilize the security grille frame as the sleeve through the rated structure. Fire damper to be mounted on the service side to the security grille frame.

2.2 COMBINATION FIRE AND SMOKE DAMPERS

.1 Fabricate to NFPA 90A, UL 555, UL 555S, and as indicated.

.2 Provide factory sleeve and collar for each damper.

.3 Multiple Blade Dampers: Fabricate with 1.5 mm galvanized steel frame and blades, oil-impregnated bronze or stainless steel sleeve bearings and plated steel axles, stainless steel jamb seals, 3.2 x 12.7 mm plated steel concealed linkage, stainless steel closure spring, blade stops, and lock, and 12.7 mm actuator shaft.

.4 Smoke Rating: Leakage Class III Smoke Damper in accordance with UL555S. A Class lll smoke damper leaks no more than 80 cubic feet per minute (2.27 m^3/min) at 4 in. wg. (1 kPa.) differential pressure

.5 Operators: UL listed and labelled Electric 24V, 60 Hz, two-position, fail close, externally mounted.

.6 Duct Smoke Detector: Factory mounted duct smoke detector with no minimum velocity requirement and complete with single point low voltage electrical connection. Sensor to be photoelectronic type.

.7 Normally Open Smoke Responsive Fire Dampers: opposed blades complete with factory mounted actuator, flexible stainless steel blade edge seals to provide constant sealing pressure.

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 Provide fire dampers at locations indicated, where ducts and outlets pass through fire rated components, and where required by authorities having jurisdiction. Install with required perimeter mounting angles, sleeves, breakaway duct connections, corrosion resistant springs, bearings, bushings and hinges.

.2 Install fire dampers and combination smoke and fire dampers to ANSI/NFPA 90A and in accordance with conditions of ULC listing.

.3 Maintain integrity of fire separation.

.4 After completion and prior to concealment obtain approvals of complete installation from authority having jurisdiction.

.5 Install access door adjacent to each damper.

.6 Co-ordinate with installer of firestopping.

.7 Ensure access doors/panels, fusible links, damper operators are easily observed and accessible.

.8 Install break-away joints of approved design on each side of fire separation.

.9 Contractor to individually tag each and every fire damper and provide a fire damper schedule in the Operation and Maintenance manual showing tag, size, type and location.

.10 Contractor shall tag fire damper and access door with fire damper tag.

.11 Demonstrate re-setting of fire dampers to Owner's representative.

.12 Where required by authority, seal dampers against smoke with non-intumescent (non-expanding) fire rated sealant.

END OF SECTION

1 General

1.1 SUMMARY

.1 Section Includes:
  .1 Materials and installation of flexible ductwork, joints and accessories.
.2 Sustainable requirements for construction and verification.

1.2 REFERENCES

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

.2 Department of Justice Canada (Jus).
  .1 Canadian Environmental Protection Act (CEPA), 1999, c. 33.
  .2 Transportation of Dangerous Goods Act, 1992 (TDGA), c. 34.

.3 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
  .1 Material Safety Data Sheets (MSDS).

.4 National Fire Protection Association (NFPA).
  .1 NFPA 90A-02, Standard for the Installation of Air-Conditioning and Ventilating Systems.
  .2 NFPA 90B-02, Standard for Installation of Warm Air Heating and Air-Conditioning Systems.

.5 Sheet Metal and Air-Conditioning Contractors' National Association (SMACNA).
  .1 SMACNA HVAC Duct Construction Standards - Metal and Flexible, 95 (Addendum No.1, November 1997).
  .2 SMACNA IAQ Guideline for Occupied Buildings under Construction, 1st Edition 1995.

.6 Underwriters' Laboratories Inc. (UL).
  .1 UL 181-96, Standard for Factory-Made Air Ducts and Air Connectors.

.7 Underwriters' Laboratories of Canada (ULC).
  .1 CAN/ULC-S110-1986 (R2001), Fire Tests for Air Ducts.

1.3 SUBMITTALS

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

.2 Product Data: submit WHMIS MSDS in accordance with Section 02 81 01 - Hazardous Materials for the following:
  .1 Thermal properties.
  .2 Friction loss.
  .3 Acoustical loss.
  .4 Leakage.
  .5 Fire rating.

.3 Samples: submit samples with product data of different types of flexible duct being used in accordance with Section 01 33 00 - Submittal Procedures.

1.4 QUALITY ASSURANCE

.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.

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

2 Products

2.1 GENERAL

.1 Factory fabricated to CAN/ULC-S110.

.2 Pressure drop coefficients listed below are based on relative sheet metal duct pressure drop coefficient of 1.00.

.3 Flame spread rating not to exceed 25. Smoke developed rating not to exceed 50.

2.2 FLEXIBLE DUCT MATERIALS

.1 Two ply vinyl film supported by helically wound spring steel wire.
- .1 Pressure Rating: 2.50 kPa positive and 250 Pa negative.
- .2 Maximum Velocity: 20.3 m/sec.
- .3 Temperature Range: -23 to 71 degrees C.

.2 ULC Labeled, black polymer film supported by helically wound spring steel wire.
- .1 Pressure Rating: 1000 Pa positive and 175 Pa negative.
- .2 Maximum Velocity: 20.3 m/sec.
- .3 Temperature Range: -28 to 79 degrees C.

.3 ULC labeled, multiple layers of aluminum laminate supported by helically wound spring steel wire.
- .1 Pressure Rating: 2.50 kPa positive and 250 Pa negative.
- .2 Maximum Velocity: 20.3 m/sec.
- .3 Temperature Range: -28 to 99 degrees C.

2.3 INSULATED FLEXIBLE DUCT MATERIALS

.1 Two ply vinyl film supported by helically wound spring steel wire; fibreglass insulation; polyethylene vapour barrier film.
- .1 Pressure Rating: 2.50 kPa positive and 250 Pa negative.
- .2 Maximum Velocity: 20.3 m/sec.
- .3 Temperature Range: -23 to 71 degrees C.

.2 Black polymer film supported by helically wound spring steel wire; fibreglass insulation; polyethylene vapour barrier film.
- .1 Pressure Rating: 1000 Pa positive and 175 Pa negative.

.2 Maximum Velocity: 20.3 m/sec.
.3 Temperature Range: -28 to 79 degrees C.

.3 Multiple layers of aluminum laminate supported by helically wound spring steel wire; fibreglass insulation; polyethylene vapour barrier film.
.1 Pressure Rating: 2.50 kPa positive and 250 Pa negative.
.2 Maximum Velocity: 20.3 m/sec.
.3 Temperature Range: -28 to 99 degrees C.

Part 3 Execution

3.1 DUCT INSTALLATION

.1 Install in accordance with: SMACNA.

END OF SECTION

1 General

1.1 SECTION INCLUDES

.1 Centrifugal fans.
.2 Roof and Wall Exhausters.
.3 Axial fans.
.4 Propeller fans.
.5 Fan accessories.
.6 Roof curbs.
.7 Motors and Drives.
.8 Cabinet Exhaust Fans

1.2 SUBMITTALS

.1 Section 01 33 00: Procedures for submittals.

.2 Shop Drawings: Indicate assembly, unit dimensions, weight loading, required clearances, construction details, field connection details, and electrical characteristics and connection requirements.

.3 Product Data:
- .1 Provide literature which indicates dimensions, weights, capacities, ratings, fan performance, gauges and finishes of materials, and electrical characteristics and connection requirements.
- .2 Provide data of filter media, filter performance data, filter assembly, and filter frames.
- .3 Provide fan curves with specified operating point clearly plotted.
- .4 Submit sound power level data for both fan outlet and casing radiation at rated capacity.
- .5 Submit electrical requirements for power supply wiring including wiring diagrams for interlock and control wiring, clearly indicating factory-installed and field-installed wiring.

1.3 SOURCE QUALITY CONTROL

.1 Fans used shall not decrease motor size, increase noise level, increase tip speed by more than 10 percent or increase inlet air velocity by more than 20 percent, from specified criteria; and capable of accommodating static pressure variations of plus or minus 10 percent.

1.4 OPERATION AND MAINTENANCE

.1 Submit operation and maintenance data to requirements of Section 01 78 00.

.2 Include instructions for lubrication, filter replacement, motor and drive replacement, spare parts lists, and wiring diagrams.

2 Products

2.1 CENTRIFUGAL FANS

.1 Wheel and Inlet
- .1 Backward Inclined: Steel construction with smooth curved inlet flange, heavy back plate, backwardly curved blades welded or riveted to flange and back plate, cast hub riveted to back plate and keyed to shaft with set screws.
- .2 Forward Curved: Steel construction with inlet flange, back plate, shallow blades with inlet and tip curved forward in direction of air flow, mechanically secured to flange and back plate, steel hub swaged to back plate and keyed to shaft with set screw.
- .3 Airfoil Wheel: Steel construction with smooth curved inlet flange, heavy back plate, die formed hollow airfoil shaped blades continuously welded at tip, flanged and back plate, cast hub riveted to back plate and keyed to shaft with set screws.

.2 Housing
- .1 Heavy gage steel, spot welded, designed to minimize turbulence with spun inlet bell and shaped cut-off.
- .2 Factory finish before assembly in prime coated. For fans handling air downstream of humidifiers, provide two additional coats of paint. Prime coating on aluminum parts is not required.
- .3 Provide bolted construction with horizontal flanged split housing.
- .4 Fabricate plug fans without volute housing, with steel cabinet, lined.
- .5 Shafts: Hot rolled steel, ground and polished, with key-away and protectively coated with lubricating oil.
- .6 V-Belt Drive: Cast iron or steel sheaves, dynamically balanced, keyed, variable and adjustable pitch sheaves for motors 11.2 kW and under, fixed sheaves for 15 kW and over, matched belts, drive rated minimum 1.5 times nameplate rating of the motor.
- .7 Belt Guards: Fabricate to SMACNA Low Pressure Duct Construction Standards.

.3 Accessories
- .1 Inlet/Outlet Screens: Galvanized steel welded grid.
- .2 Access Doors: Shaped to conform to scroll with quick opening latches and gaskets.
- .3 Scroll Drain: 15 mm steel pipe coupling welded to low point of fan scroll.

2.2 INLINE MIXED FLOW FANS (Based on COOK QMX)

.1 Certifications**:** Fan shall be manufactured at an ISO 9001 certified facility. Fan shall be listed by Underwriters Laboratories (UL/cUL 705) for US and Canada. Fan shall bear the AMCA Certified Ratings Seal for Sound and Air Performance. Performance shall be licensed for both inlet and outlet sound.

.2 Construction**:**
- .1 The fan shall be of welded and bolted construction utilizing corrosion resistant fasteners.
- .2 Housing shall be minimum 14 gauge steel with integral inlet and outlet collars for slip fit duct connections.
- .3 Steel shall be complete with electrostatically applied baked polyester power coating or equivalent.
- .4 Straightening vanes shall be included to assure maximum efficiency and low noise levels.

.5 Adjustable motor plate shall utilize threaded studs for positive belt tensioning. Copper extended lube lines shall be furnished for lubrication of fan bearings.
.6 Lifting lugs shall be provided for ease of installation.
.7 Adjustable mounting feet shall allow field adjustment of motor position. Unit shall bear an engraved aluminum nameplate.
.8 Nameplate shall indicate design CFM, static pressure, and maximum fan RPM.
.9 Unit shall be shipped in Certified Transit Tested Packaging to protect from damage.

.3 Coating**:**
.1 Steel fan components shall be complete with an electrostatically applied, baked polyester powder coating. Each component shall be subject to a five stage environmentally friendly wash system, followed by a minimum 2 mil thick baked powder finish. Paint must exceed 1,000 hour salt spray under ASTM B117 test method.

.4 Wheel**:**
.1 Wheel shall be steel, non-overloading, high efficiency mixed-flow type.
.2 Contoured single thickness blades shall incorporate 3-D curvature for maximum efficiency across the entire surface of the blade.
.3 Blades shall be continuously welded to the backplate and inlet shroud.
.4 Hubs shall be keyed and securely attached to the fan shaft.
.5 Wheel shall overlap an aerodynamic aluminum inlet cone to provide maximum performance and efficiency.
.6 Wheel shall be balanced in accordance with AMCA Standard 204-05, Balance Quality and Vibration Levels for Fans.

.5 Motor: Motor shall be Nema design B with class B insulation rated for continuous duty and furnished at the specified voltage, phase and enclosure.

.6 Blower Shaft: Blower shaft shall be AISI C-1045 hot rolled and accurately turned, ground and polished. Shafting shall be sized for a critical speed of at least 125% of maximum RPM.

.7 Bearings:
.1 Bearings shall be designed and tested specifically for use in air handling applications.
.2 Construction shall be heavy duty regreasable ball or roller type in a cast iron pillow block housing selected for a minimum L50 life in excess of 200,000 hours at maximum cataloged operating speed.

.8 Belts and Drives:
.1 Belts shall be oil and heat resistant, static conducting.
.2 Drives shall be precision machined cast iron type, keyed and securely attached to the wheel and motor shafts.
.3 Drives shall be sized for 150% of the installed motor horsepower.

2.3 ROOF EXHAUSTERS (based on COOK ACE-D)

.1 Fan shall be a spun aluminum, roof mounted, direct driven, downblast centrifugal exhaust ventilator.

.2 Certifications:
.1 Fan shall be manufactured at an ISO 9001 certified facility.

.2 Fan shall be listed by Underwriters Laboratories (UL 705) and UL listed for Canada (cUL 705).
.3 Fan shall bear the AMCA Certified Ratings Seal for Sound and Air Performance.

.3 Construction:
.1 Fan shall be of bolted and welded construction utilizing corrosion resistant fasteners.
.2 The spun aluminum structural components shall be constructed of minimum 16 gauge marine alloy aluminum, bolted to a rigid aluminum support structure.
.3 The aluminum base shall have continuously welded curb cap corners for maximum leak protection.
.4 The discharge baffle shall have a rolled bead for added strength.
.5 An integral conduit chase shall be provided through the curb cap and into the motor compartment to facilitate wiring connections.
.6 The motor shall be enclosed in a weather-tight compartment, separated from the exhaust airstream.
.7 Unit shall bear an engraved aluminum nameplate. Nameplate shall indicate design CFM and static pressure. Unit shall be shipped in ISTA Certified Transit Tested Packaging.
.8 Fans hall have sealed bearings that do not require maintenance lubrication.

.4 Wheel:
.1 Wheel shall be centrifugal backward inclined, constructed of 100% aluminum, including a precision machined cast aluminum hub.
.2 An aerodynamic aluminum inlet cone shall be provided for maximum performance and efficiency.
.3 Wheel shall be balanced in accordance with AMCA Standard 204-05, Balance Quality and Vibration Levels for Fans.

.5 Motor shall be an electronically commutated motor rated for continuous duty and furnished either with internally mounted potentiometer speed controller for balancing.

.6 Accessories.
.1 Roof Curb: 350 mm high self-flashing matched insulated curb with continuously welded seams, built in cant strip, factory installed door nailer strip.
.2 Disconnect Switch: Factory wired non-fusible in housing for thermal overload protected motor and wall mounted.
.3 Back Draft Damper: Gravity activated, aluminum multiple blade construction, felt edged with nylon bearings.

2.4 CABINET EXHAUST FANS

.1 Cabinet and Ceiling Exhaust Fans
.1 Centrifugal Fan: V-belt or direct driven, with galvanized steel housing lined with 15 mm acoustic insulation, resilient mounted motor, gravity back draft damper in discharge.
.2 Disconnect Switch: Factory wired non-fusible in housing for thermal overload protected motor and wall mounted.
.3 Grille for Ceiling Fan: Moulded white plastic grille or aluminum grille with baked white enamel finish.
.4 V-belt Drive: Cast iron or steel sheaves, dynamically balanced, bored to fit shafts and keyed, variable and adjustable pitch motor sheave selected so required rpm is obtained with sheaves set at mid-position, fan shaft with self aligning pre-lubricated ball bearings.

.5 To be complete with factory mounted solid state speed control for air balancing only. The speed control shall not be utilized as the disconnect switch.

3 Execution

3.1 PREPARATION

.1 Verify that electric power is available and of the correct characteristics (voltage and phase) prior to ordering pump.

3.2 INSTALLATION

.1 Install in accordance with manufacturer's instructions.

.2 Assemble high pressure packaged air units by bolting sections together. Isolate fan section with flexible duct connections.

.3 Install flexible connections between fan inlet and discharge ductwork. Ensure metal bands of connectors are parallel with minimum 25 mm flex between ductwork and fan while running.

.4 Install fan restraining snubbers as indicated. Flexible connectors shall not be in tension while running.

.5 Pipe scroll drains to nearest floor drain.

.6 Provide access to adjustable blade axial fan wheels for varying blade angle setting. Adjust blades for varying range of volume and pressure.

.7 Provide floor mounted axial fans with reinforced legs and ceiling suspended units with support brackets bolted to casing flange.

.8 When fan inlet or outlet is exposed, provide safety screen.

.9 Install unit on vibration isolators with static deflection of 50 mm. For smaller fans, vibration isolators to be as recommended by manufacturer.

.10 Set roof mounted fans on metal, self flashing curbs 200 mm minimum above roof. Provide acoustic insulation on duct to below roof line and one fan inlet plenum and drip pan for collecting condensation.

.11 Provide exhaust fans with multi-blade, rattle free, back draft damper with felt lines blades edges, bird screen, disconnect switch and curb caps.

.12 Supply and install sheaves as necessary for final air balancing.

.13 Do not operate fans for any purpose until ductwork is clean, filters in place, bearings lubricated, and fan has been test run under observation.

END OF SECTION

1 General

1.1 SUMMARY

.1 Section Includes:
- .1 Supply, return and exhaust grilles and registers, diffusers and linear grilles, for commercial and residential use.
- .2 Sustainable requirements for construction and verification.

1.2 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.

1.3 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.
  - .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.
- .2 Indicate following:
  - .1 Capacity.
  - .2 Throw and terminal velocity.
  - .3 Noise criteria.
  - .4 Pressure drop.
  - .5 Neck velocity.

.2 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.

1.4 QUALITY ASSURANCE

.1 Air flow tests and sound level measurement shall be made in accordance with ANSI/ ASHRAE Standard 70.

.2 Manufacturer shall have published performance data.

.3 Manufacturer shall certify catalogued performance and ensure correct application of air outlet types.

1.5 JOB CONDITIONS

.1 Review requirements of outlets as to size, finish and type of mounting prior to submitting shop drawings and schedules of outlet.

.2 Positions indicated are approximate only. Check location of outlets and make necessary adjustment in position to conform with Architectural features, symmetry, performance, and lighting arrangement.

2 Products

2.1 GENERAL

.1 To meet capacity, pressure drop, terminal velocity, throw, noise level, neck velocity as indicated.

.2 Base air outlet application on space noise level, either by Noise Criteria (NC) curves or Room Criteria (RC) curves, as listed below:

.1 Change Rooms NC 30

.3 Frames:

.1 Full perimeter gaskets.
.2 Plaster frames for diffusers, located in plaster surface.
.3 Concealed fasteners.

.4 Concealed manual volume control damper operators.

.5 Provide baffles to direct air away from walls, columns or other obstructions within the radius of diffuser operation.

.6 Provide anti-smudge frames or plaques on diffusers located in rough textured surfaces such as acoustical plaster.

.7 Refer to equipment schedule for specification of air outlets.

.8 Colour: as directed by Departmental Representative.

2.2 MANUFACTURED UNITS

.1 Grilles, registers and diffusers of same generic type, products of one manufacturer.

2.3 HEAVY DUTY RETURN AND EXHAUST GRILLES AND REGISTERS

.1 Description:

.1 Furnish and install steel heavy duty gym grilles and registers of sizes and mounting types designated by the plans and air distribution schedule.

.2 Construction

.1 The grille blades and border shall be steel construction.
.2 The 14 gauge steel border shall have smooth contours to reduce the possibility of injury to occupants when installed in a gymnasium.
.3 Grilles shall be fixed louver type, and shall have Zero (0) degree deflection, 3/4 inch on center blade spacing.
.4 The grille blade orientation shall be front blades parallel to the long dimension.
.5 The grille shall be suitable for surface mounting with 1-1/4inch flat border.
.6 The grille shall be supplied with a frame that will accept a standard two inch filter.

.3 Finish

.1 Paint finish shall be baked-on powder coat finish with custom colour selected by architect. The paint finish must demonstrate no degradation when tested in accordance with ASTM D1308 (covered and spot immersion) and ASTM D4752 (MEK double rub) paint durability tests.
.2 The paint film thickness shall be a minimum of 2.0 mils.
.3 The finish shall have a hardness of 2H.

.4 The finish shall withstand a minimum salt spray exposure of 1000 hours with no measurable creep in accordance with ASTM D1654, and 1000 hours of exposure with no rusting or blisteringas per ASTM D610 and ASTM D714.
.5 The finish shall have an impact resistance of 80 inch-pounds.
.6 Colour as indicated in the equipment schedule.

.4 Fastening
.1 The grille shall be supplied with aluminum hinge on one side per factory standard and quarter turn quick fasteners.

.5 Filter
.1 Filter media shall be supplied by contractor not manufacturer of grille and shall match the filters supplied by the air handling unit.
.2 Filter media shall be Merv 8.

.6 Opposed Blade Damper:
.1 The register shall be supplied with a coated steel (D) opposed blade damper.
.2 The damper shall be operable from the register face.

2.4 GRID CORE RETURN AND EXHAUST GRILLES

.1 Furnish and install egg crate grilles and registers of sizes and mounting types designated by the plans and air distribution schedule.

.2 Construction:
.1 Grilles shall be aluminum construction, consisting of an extruded aluminum border
.2 An aluminum 13 x 13 x 13 mm grid egg crate core.

.3 Border:
.1 The grille shall be suitable for sidewall, exposed duct, or T-bar lay-in mounting, complete with a border, coordinate style with ceiling/wall type.
.2 Channel border (no flange) for 15/16 inch T-bar applications to maximize free area.
.3 Exposed duct border for mounting directly to exposed ducts.
.4 32mm flat face border or 25mm narrow face border for surface mount applications. Refer to schedule for border size.

.4 Mounting Frames (solid ceiling):
.1 Provide mounting frame matched to ceiling for all solid ceiling installations.

.5 Fastening:
.1 The grille shall be supplied with the fastening method indicated in the schedule and coordinated with installation.

.6 Finish:
.1 All components shall have a baked-on powder coat finish.
.2 The paint finish must demonstrate no degradation when tested in accordance with ASTM D1308 (covered and spot immersion) and ASTM D4752 (MEK double rub) paint durability tests.
.3 The paint film thickness shall be a minimum of 2.0 mils.
.4 The finish shall have a hardness of 2H.
.5 The finish shall withstand a minimum salt spray exposure of 500 hours with no measurable creep in accordance with ASTM D1654, and 1000 hours of exposure with no rusting or blisteringas per ASTM D610 and ASTM D714.
.6 The finish shall have an impact resistance of 80 inch-pounds.

.7 Colour as indicated in the equipment schedule.

.7 Balancing

.1 Unless indicated on the drawings, balancing shall be achieved with duct mounted dampers located at the branch take-off to reduce noise at the grille.

.2 When indicated on the schedule, the grille shall be supplied with an aluminum with mill finish opposed blade damper for balancing.

.3 The contractor may request to use damper mounted grilles in lieu of duct mounted grilles for solid ceiling areas but must receive confirmation in writing.

2.5 OUTSIDE LOUVRES

.1 Refer to Section 23 37 20 - Louvres, Intakes and Vents.

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 manufacturer’s instructions.

.2 Install with oval head, stainless steel screws in countersunk holes where fastenings are visible.

.3 Bolt grilles, registers and diffusers, in place, where indicated.

.4 With security grilles, contractor shall use high yield grout to fill any space between back of the face plate and the mounting surface.

3.3 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

1 General

1.1 SUMMARY

.1 Section Includes:
- .1 Mechanical louvers; intakes; vents; and reinforcement and bracing for air vents, intakes and gooseneck hoods.
- .2 Sustainable requirements for construction and verification.

1.2 REFERENCES

.1 American National Standards Institute (ANSI)/ National Fire Protection Association (NFPA)
- .1 ANSI/NFPA 96-04, Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.

.2 American Society for Testing and Materials International (ASTM)
- .1 ASTM E90-04, Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.

.3 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
- .1 Material Safety Data Sheets (MSDS).

.4 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)

.5 Society of Automotive Engineers (SAE)

1.3 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.

1.4 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.
  - .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.
- .2 Indicate following:
  - .1 Pressure drop.
  - .2 Face area.
  - .3 Free area.

.2 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 Test Reports:

.1 Submit certified data from independent laboratory substantiating acoustic and aerodynamic performance to ASTM E90.

1.5 QUALITY ASSURANCE

.1 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 30 - Health and Safety Requirements.

2 Products

2.1 FIXED LOUVRES - ALUMINUM

.1 Construction: welded with exposed joints ground flush and smooth. Blade and frame fillet welds concealed from view.

.2 Material: extruded aluminum alloy 6063-T5; blades and frames minimum 2.7 mm thick.

.3 Blade: stationary with drainable gutters, reinforcing bosses and maximum blade length of 1500 mm or manufacturer’s recommendations.

.4 Frame, head, sill and jamb: 100 or 150 mm deep one piece extruded aluminum, minimum 2 mm thick with approved caulking slot, integral to unit. Depth as indicated. Frames shall be jointed at each corner with full length weld.

.5 Mullions: at 1500 mm maximum centres, visible vertical mullions.

.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: factory applied enamel. Colour: as selected by Departmental Representative.

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 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 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

1 General

1.1 REFERENCES

.1 American National Standards Institute/National Fire Prevention Association (ANSI/NFPA)
- .1 ANSI/NFPA 96- 1994, Ventilation Control and Fire Protection of Commercial Cooking Operations.

.2 American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE)
- .1 ASHRAE 52.1- 1992, Gravimetric And Dust Spot for Testing Air-cleaning Devices Used in General Ventilation for Removing Particulate Matter.

.3 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 (Reaffirmed April 1985).
- .3 CAN/CGSB-115.12- M85, Filters, Air, Medium Efficiency, Disposable, Bag Type (Reaffirmed April 1985).
- .4 CAN/CGSB-115.13- 85, Filter Media, Automatic Roll (Reaffirmed April 1985).
- .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.

.4 Underwriters' Laboratories of Canada
- .1 ULC -S111- M80, "Fire Tests for Air Filter Units".
- .2 ULC-S649-1993, Grease Filters for Commercial and Institutional Kitchen Exhaust Systems.

1.2 SHOP DRAWINGS AND PRODUCT DATA

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

1.3 CLOSEOUT SUBMITTALS

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

1.4 QUALITY ASSURANCE

.1 Filters shall be product of and supplied by one manufacturer. Filter components assembled to form filter banks shall be products of same manufacturer.

.2 Filter media shall be UL listed, Class I or Class II, as approved by local authority.

1.5 MAINTENANCE 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.

1.6 ALTERNATIVES

.1 Size, media face area, Merv rating, initial and final resistance of alternative manufacturer’s shall be same as type specified.

1.7 EXTRA MATERIALS

.1 Spare filters: in addition to filters to be installed immediately prior to acceptance by Departmental Representative , supply one complete set of filters for each filter unit or filter bank in accordance with section 01 78 00 - Closeout Submittals. Total number of filters for each and every filter bank as follows:

- .1 One set for testing, balancing and commissioning.
- .2 One set to be installed at acceptance.
- .3 One spare set to be used by Owner during first year of operation.

2 Products

2.1 GENERAL

.1 Media: suitable for air at 100% RH and air temperatures between minus 40 and 50 °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.

.4 Fire rated to: ULC S111

.5 Final filters for all supply air systems shall be MERV 14 to meet LEED requirements.

2.2 ACCESSORIES

.1 Seals: to ensure leakproof operation.

.2 Blank-off plates: as required, to fit all openings and of same material as holding frames.

.3 Access and servicing: through doors/panels on each side and/or from upstream or downstream face of filter bank.

2.3 FIBROUS GLASS PANEL FILTERS

.1 Disposable fibrous glass media: to CAN/CGSB-115.10 with adhesive.

.2 Holding frame: 1.2 mm minimum thick galvanized steel with 3 mm diam hinged wire mesh screen.

.3 Performance: as indicated, to ASHRAE 52.2.

.4 Fire rated: to ULC -S111.

.5 Nominal thickness: as indicated.

2.4 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: as indicated, to ASHRAE 52.2.

.4 Fire Rated: to ULC -S111.

.5 Nominal thickness: as indicated.

2.5 FILTER GAUGES - MANOMETER TYPE

.1 Direct Reading Dial: 90 mm diameter diaphragm actuated dial in metal case, vent valves, black figures on white background, front recalibration adjustment, range 0 Pa to two times initial pressure, 2 percent of full scale accuracy.

.2 Inclined Manometer: One piece moulded plastic with epoxy coated aluminum scale, inclined-vertical indicating tube and built-in spirit level, range 0 Pa to two times initial pressure, 3 percent of full scale accuracy.

.3 Accessories: Static pressure tips with integral compression fittings, 6 mm aluminum tubing, 2-way or 3-way vent valves.

2.6 RIGID, SUPPORTED BAG TYPE FILTERS

.1 Media: disposable preformed fibrous glass, cartridge with approximately 4.6 sq.m. (50 sq.ft.) of media per 472 l/s capacity (1000 CFM).

.2 Holding frame: galvanized steel with bracing. Provision for front mounted panel pre-filter and front or rear removal of filter media.

.3 Media support: welded wire grid.

.4 High efficiency: to CAN/CGSB-115.11.

.5 Medium efficiency: to CAN/CGSB-115.12

.6 Nominal thickness: as indicated.

2.7 CARTRIDGE FILTERS

.1 Media: deep pleated, disposable, high efficiency, to CAN/CGSB-115.14.

.2 Holding frame: galvanized steel with bracing.

.3 Media support: welded wire grid.

2.8 FILTER FRAMES AND HOUSINGS

.1 General: Fabricate filter frames and supporting structures of 1.50 mm (16 gauge) galvanized steel or extruded aluminum T-section construction with necessary gasketing between frames and walls.

.2 Standard Sizes: Provide for interchangeability of filter media of other manufacturers; for panel filters; for extended surface and high efficiency particulate air filters, provide for upstream mounting of panel filters.

.3 Side Servicing Housings: Flanged for insertion into ductwork, of reinforced 1.5 mm galvanized steel; access doors with continuous gasketing and positive locking devices on both sides; extruded aluminum tracks or channels for primary and secondary filters with positive sealing gaskets.

3 Execution

3.1 INSTALLATION GENERAL

.1 Install in accordance with manufacturer’s recommendations and with adequate space for access, maintenance and replacement.

.2 Filter banks shall have removal and access indicated.

.3 Do not operate fan systems without filtration in place.

3.2 REPLACEMENT MEDIA

.1 Replace all media with new upon acceptance.

.2 Filter media to be new and clean, as indicated by pressure gauge, at time of acceptance.

3.3 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.

END OF SECTION

1 General

1.1 SUMMARY

.1 Section Includes:
- .1 Materials and installation for piping and fittings used in HVAC heat exchangers.
- .2 Sustainable requirements for construction and verification:

1.2 REFERENCES

.1 American Society of Mechanical Engineers (ASME)
- .1 ASME Boiler and Pressure Vessel Code.
  - .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 Canadian Standards Association (CSA International)
- .1 CSA B51-03, Boiler, Pressure Vessel, and Pressure Piping Code.

.3 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
- .1 Material Safety Data Sheets (MSDS).

1.3 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 heat exchangers.
- .2 Submit WHMIS MSDS in accordance with Section 02 61 33 - 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 of heat exchangers and system. Indicate following information:
  - .1 Manufacturer's recommended clearances for tube withdrawal and manipulation of tube cleaning tools.
  - .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 Manufacturer's Field Reports: manufacturer's field reports specified.
  - .6 Closeout Submittals: submit maintenance and engineering data for incorporation into manual specified in Section 01 78 00 - Closeout.

1.4 QUALITY ASSURANCE

.1 Pre-Installation Meeting:
- .1 Convene pre-installation meeting one week prior to beginning work of this Section and on-site installations in accordance with Section 01 32 18 - Construction Progress Schedules - Bar (GANTT) Chart.
  - .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 30 - Health and Safety Requirements.

1.5 MAINTENANCE

.1 Maintenance Materials:
- .1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.

.2 Supply following spare parts:
- .1 Head gaskets.

1.6 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.
- .3 Store and manage hazardous materials in accordance with cepa, tdga and Regional and Municipal Regulations.

.2 Waste Management and Disposal:Remove from site and dispose of packaging materials at appropriate recycling facilities.
- .1 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.
- .2 Divert unused metal materials from landfill to metal recycling facility as approved by Departmental Representative.
- .3 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.
- .4 Fold up metal and plastic banding, flatten and place in designated area for recycling.
- .5 Handle and dispose of hazardous materials in accordance with CEPA, TDGA, Regional and Municipal regulations.
- .6 Disposal of asbestos waste generated by removal activities must comply with Federal, Provincial, Territorial and Municipal regulations. Dispose of asbestos

waste in sealed double thickness 6 ml bags or leak proof drums. Label containers with appropriate warning labels.

.7 Provide manifests describing and listing waste created. Transport containers by approved means to licensed landfill for burial**.**

2 Products

2.1 PLATE HEAT EXCHANGER

.1 General:

.1 Steam to water as indicated.

.2 Designed, constructed and tested in with accordance ASME Boiler and Pressure Vessel Code, Section VIII, CSA B51 and provincial pressure vessel regulations.

.2 Frames: carbon steel with baked epoxy enamel paint, stainless steel side bolts and shroud.

.3 Plates: type 316 gasketted stainless steel.

.4 Gaskets: as recommended by manufacturer to suit fluid temperature and composition.

.5 Nozzles: 1034 kPa, ASA rubber rated flange type.

.6 Supports: mounting legs.

.7 Piping connections: as indicated or required to suit piping.

.8 Capacity: as indicated.

.9 Dimensions: as indicated.

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 General: install level and firmly anchored to supports as indicated and in accordance with manufacturer's recommendations.

.2 Plate exchangers: install in accordance with manufacturer's recommendations; ensure installation permits removal panels without disturbing installed equipment or piping.

.3 Heat exchanger shall be insulated in accordance with National Energy Code using removable insulation to permit inspection by TSASK. Refer to insulation specifications.

3.3 APPURTENANCES

.1 Steam Side: Install with valves as indicated on Schematic.

.2 Water Side: Install with valves as indicated on Schematic including safety relief valve piped to drain.

.3 Install pressure gauge on steam inlet.

3.4 FIELD QUALITY CONTROL

.1 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.

.2 Upon completion of work, after cleaning is carried out.

.3 Obtain reports within 3 days of review and submit immediately to Departmental Representative.

.4 Start-up:
- .1 General: perform start-up operations in accordance with manufacturer's requirements and 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.

.5 Performance Verification:
- .1 General: perform performance verification in accordance with manufacturer's requirements, supplemented as specified.
- .2 Timing: only after TAB of hydronic systems have been successfully completed.
- .3 Primary side:
  - .1 Measure flow rate, pressure drop, and either one steam pressure and temperature at heater inlet or two water temperature at heater inlet and outlet.
  - .2 Verify operation of steam traps. Measure temperature of condensate return at trap outlet.
- .4 Control valve: verify proper operation without binding, slack in components. Measure either steam pressure and temperature at control valve inlet or if control is three-port type, pressure drop across inlet to common, bypass to common, inlet to bypass.

.5 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.
.6 Calculate heat transfer from primary and secondary sides.
.7 Simulate heating water temperature schedule and repeat above procedures.
.8 Verify settings, operation, safe discharge from safety valves and relief valves.
.9 Verify settings, operation of operating, limit and safety controls and alarms.
.10 Reports:
  .1 Manufacturers start-up reports, supplemented as specified herein.

3.5 DEMONSTRATION

.1 Training: provide training in accordance with Section 20 02 00 - General Mechanical Provisions, supplemented as specified.

3.6 CLEANING

.1 Perform cleaning operations and in accordance with manufacturer's recommendations.

.2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

1 General

1.1 SECTION INCLUDES

.1 Air handling units.
.2 Heating coils.
.3 Filter sections.
.4 Cooling coils.

1.2 REFERENCES

.1 AFBMA 9 - Load Ratings and Fatigue Life for Ball Bearings.
.2 AFBMA 11 - Load Ratings and Fatigue Life for Roller Bearings.
.3 AMCA 99 - Standards Handbook.
.4 AMCA 210 - Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.
.5 AMCA 300 - Reverberant Room Method for Sound Testing of Fans.
.6 AMCA 301 - Method of Publishing Sound Ratings for Air Moving Devices.
.7 AMCA 500 - Method of Testing Louvres for Ratings.
.8 AMCA 5000 - Method of Testing Dampers for Ratings.
.9 ARI 410 - Forced-Circulation Air-Cooling and Air-Heating Coils.
.10 ARI 430 - Fabrication of Central Station Air Handling Units.
.11 ARI 435 - Application of Central-Station Air-Handling Units.
.12 SMACNA - HVAC Duct Construction Standards - Metal and Flexible.
.13 UL 900 - Air Filter Units.
.14 ASHRAE 90.1 Energy Code.
.15 NEMA MG1 - Motors and Generators.
.16 NFPA 70 - National Electrical Code.
.17 UL 723 - Test for Surface Burning Characteristics of Building Materials.
.18 UL 1995 - Standard for Heating and Cooling Equipment.
.19 UL 94 - Test for Flammability of Plastic Materials for Parts in Devices and Appliances.
.20 IBC 2000, 2003 - International Building Code.
.21 NFPA 90A - Standard for the Installation of Air Conditioning and Ventilating Systems.
.22 NFPA 5000 - Building Construction and Safety Code.

1.3 SUBMITTALS

.1 Section 01 33 00: Procedures for submittals.

.2 Shop Drawings: Indicate assembly, unit dimensions, weight loading, required clearances, construction details, field connection details, and electrical characteristics and connection requirements.

.3 Product Data:
- .1 Provide literature which indicates dimensions, weights, capacities, ratings, fan performance, gauges and finishes of materials, and electrical characteristics and connection requirements.
- .2 Provide data of filter media, filter performance data, filter assembly, and filter frames.
- .3 Provide fan curves with specified operating point clearly plotted and fan efficiencies.
- .4 Submit sound power level data for both fan outlet and casing radiation at rated capacity.
- .5 Submit electrical requirements for power supply wiring including wiring diagrams for interlock and control wiring, clearly indicating factory-installed and field-installed wiring.

.4 Manufacturer's Installation Instructions.

1.4 OPERATION AND MAINTENANCE DATA

.1 Maintenance Data: Include instructions for lubrication, filter replacement, motor and drive replacement, spare parts lists, and wiring diagrams.

1.5 DELIVERY, STORAGE, AND HANDLING

.1 Accept products on site in factory-fabricated protective containers, with factory-installed shipping skids and lifting lugs. Inspect for damage.

.2 Store in clean dry place and protect from weather and construction traffic. Handle carefully to avoid damage to components, enclosures, and finish.

1.6 ENVIRONMENTAL REQUIREMENTS

.1 Do not operate units for any purpose, temporary or permanent, until ductwork is clean, filters are in place, bearings lubricated, and fan has been test run under observation.

1.7 EXTRA MATERIALS

.1 Provide one set of spare fan belts for each fan.

.2 Provide extra filter sets as indicated, refer to Section 23 41 00 - Particulate Air Filtration.

1.8 QUALITY ASSURANCE

.1 Units shall be produced by a recognized manufacturer who maintains a local service agency, parts stock, is regularly engaged in production of such units, and issues complete catalogue data on such products. Unit shall be factory built.

.2 Air handling units and major components shall be products of manufacturing firms regularly engaged in production of such equipment whose products have been in satisfactory use in similar service for not less than 10 years

.2 Units shall carry the label of a Nationally Recognized Testing Laboratory (NRTL) or a Standards Council of Canada (SCC) approved lab (Testing Organization and Certifying Body).

.3 Units shall be constructed in accordance with CAN/CSA C22.2 No. 236 and UL 1995 (Heating and Cooling Equipment). Each unit shall bear an ETL or UL label under UL Standard 1995 indicating the complete unit is listed as an assembly. ETL or UL listing of individual components, or control panels only, is not acceptable.

.4 Units shall be constructed to provide smooth interior surfaces.

.5 Units shall comply with NFPA 70, "National Electrical Code," as applicable for installation and electrical connections of ancillary electrical components of air handling units.

.6 Unit internal insulation must have a flame spread rating not over 25 and smoke developed rating no higher than 50 complying with NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems."

.7 Units shall deliver the specified volume of air at the scheduled static pressure.

.8 Airflow data shall comply with AMCA 210 method of testing.

.9 All electrical components and assemblies shall comply with NEMA standards.

.10 The following shall be used as selection criteria and shall be as specified: air flow rates, external static pressures, water flow rates. The following are to be equaled or bettered: coil face velocities, filter face velocities, casing leakage rates, casing and base deflection. The following shall be met within 10% of specified values: water pressure drop

2 Products

2.1 GENERAL DESCRIPTION

.1 Configuration (refer to drawings): Fabricate with fan plus accessories, including:
- .1 Heating coil.
- .2 Filter section.
- .5 Heating coil section.

.2 Performance Base: 566m (1860') above Sea level conditions.

.3 Fabrication: Conform to AMCA 99 and ARI 430.

2.2 CASING

.1 Double wall construction: Fabricate on channel base and drain pan of welded galvanized steel with perforated inside casing. Assemble sections with gaskets and bolts.
- .1 Outside Casing: Galvanized Steel: 1.2 mm.
- .2 Inside Casing: Galvanized Steel: 0.6 mm.
- .3 Floor Plate: Galvanized Steel: 3.3 mm.

.2 Insulation: 50 mm thick, 24 kg per cu m density, neoprene coated, glass fibre insulation, "ksi" value at 42 degrees C maximum 0.037 W/m/Degree K, applied to internal surfaces with adhesive and weld pins. Coat exposed edges of insulation with adhesive. OR injected foam to R-13.

.3 Inspection Doors: 450 x 550 mm of galvanized steel for flush mounting, with gasket, latch, and handle assemblies and 300 x 300 mm inspection window of 6 mm thick plexiglass. Provide welded channel frame to set door out from casing to permit external insulation.

.4 Walk-in Access Doors: 450 x 1000 mm of galvanized steel insulated sandwich construction, for flush mounting, with hinges, gasket, latch, and handle assemblies and 300 x 300 mm inspection window of 6 mm thick plexiglass. Provide welded channel frame to set door out from casing to permit external insulation.

.5 Lights: Provide in accessible sections suitable for damp locations with wire guards, factory wired to weatherproof switch and pilot light mounted on casing exterior. In sprayed coil sections, provide lights suitable for wet locations.

.6 Drain Pans: Construct from single thickness galvanized steel with insulation between layers with welded corners. Cross break and pitch to drain connection. Provide drain pans under fan section.

.7 Strength: Provide structure to brace casings for suction pressure of 600 Pa, with maximum deflection of 1 in 200.

2.3 FANS

.1 Type: Forward curved, type fan.

.2 Performance Ratings: Conform to AMCA 210 and bear the AMCA Certified Rating Seal.

.3 Sound Ratings: AMCA 301; tested to AMCA 300 and bear AMCA Certified Sound Rating Seal.

.4 Bearings: Self-aligning, grease lubricated, ball or roller bearings with lubrication fittings extended to exterior of casing with copper tube and grease fitting rigidly attached to casing.

.5 Mounting: Locate fan and motor internally on welded steel base coated with corrosion resistant paint. Factory mount motor on slide rails. Provide access to motor, drive, and bearings through removable casing panels or hinged access doors. Mount base on vibration isolators.

.6 Flexible Connection: Separate fan and coil sections.

2.4 BEARINGS AND DRIVES

.1 Bearings: Basic load rating computed in accordance with AFBMA - ANSI Standards. The bearings shall be designed for service with an L-50 life of 200,000 hours and shall be a heavy duty pillow block, self-aligning, grease-lubricated ball or spherical roller bearing type.

.2 Shafts: Solid, hot rolled steel, ground and polished, with key-way, and protectively coated with lubricating oil.

.3 V-Belt Drive: Cast iron or steel sheaves, dynamically balanced, bored to fit shafts and keyed. Variable and adjustable pitch sheaves for motors 11.2 kW and under selected so required rpm is obtained with sheaves set at mid-position; fixed sheave for 15 kW and over, matched belts, and drive rated as recommended by manufacturer or minimum 1.5 times nameplate rating of the motor.

.4 Belt Guard: Fabricate to SMACNA Standard; 2.8 mm thick, 20 mm diamond mesh wire screen welded to steel angle frame or equivalent, prime coated. Secure to fan or fan supports without short circuiting vibration isolation, with provision for adjustment of belt tension, lubrication, and use of tachometer with guard in place.

2.5 ELECTRICAL CHARACTERISTICS AND COMPONENTS

.1 Motor: Refer to Mechanical Equipment Schedule and coordinate with Electrical

.2 Wiring Terminations: Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated.

.3 Fan motors shall be 1800 RPM, open drip-proof (ODP) type, inverter duty suitable for variable speed operation. Motors shall be premium efficiency. Electrical characteristics shall be as shown in schedule.

.4 Provide marine light and GFI receptacle in each fan section mounted and wired to a junction box and on-off switch mounted on the outside of the cabinet.

.5 Variable frequency inverters to be packaged with Air Handling Equipment.

2.6 COILS

.1 Casing: Provide access to both sides of coils. Enclose coils with headers and return bends exposed outside casing. Slide coils into casing through removable end panel with blank off sheets and sealing collars at connection penetrations.

.2 Drain Pans: 600 mm downstream of coil and down spouts for cooling coil banks more than one coil high.

.3 Eliminators: Three break of galvanized steel, mounted over drain pan.

.4 Air Coils: Certify capacities, pressure drops, and selection procedures to ARI 410.

.5 Fabrication:
- .1 Tubes: 16 mm OD seamless copper expanded into fins, brazed joints.
- .2 Fins: Aluminum.
- .3 Casing: Die formed channel frame of galvanized steel.

.6 Water Heating Coils:
- .1 Headers: Cast iron, seamless copper tube, or prime coated steel pipe with brazed joints.
- .2 Configuration: Drainable, with threaded plugs for drain and vent; serpentine type with return bends on smaller sizes and return headers on larger sizes.

.7 Water Cooling Coils:
- .1 Headers: Cast iron, seamless copper tube, or prime coated steel pipe with brazed joints.
- .2 Configuration: Drainable, with threaded plugs for drain and vent; threaded plugs in return bends and in headers opposite each tube

2.7 FILTERS

.1 Filter Box: Section with filter guides, access doors from sides indicated on drawings, for side loading.

.2 Filter Media: UL 900 listed, Class I or Class II, approved by local authorities.

.3 Refer to equipment schedule for filter depth and required performance.

.4 Extended Surface: Filter box with holding frames and blank-off sheets, extended surface retained media filters. Refer to Section 23 40 00.

.5 Filter Gauges: 90 mm diameter diaphragm actuated dial in metal case, with static pressure tips.

2.8 DAMPERS

.1 Associated dampers shall meet requirements of Section 23 33 30 and be field installed on ductwork.

3 Execution

3.1 INSTALLATION

.1 Install to manufacturer's written instructions.

.2 Install to ARI 435.

.3 Assemble high pressure units by bolting sections together. Isolate fan section with flexible duct connections.

.4 Install assembled unit on vibration isolators. Refer to Section 23 05 48.

.5 Do not operate units for any purpose, temporary or permanent, until ductwork is clean, filters are in place, bearings lubricated, and fan has been test run under observation.

.6 Fabricate to provide smooth air flow through components. Limit air leakage to 1% of rated air flow at 2.5 kPa suction pressure.

.7 Remove all internal hold-down bolts and shipping fasteners and install any parts which were shipped loose. Level spring isolators.

.8 Check and re-align all access doors and dampers to ensure smooth operating through the entire range of travel.

.9 Upon start-up, each fan motor is to be checked for fan rotations, and amp draw for each phase. Amp readings are to be marked on the fan scroll and recorded in the Operation and Maintenance Manual.

.10 All belt drives are to be re-adjusted for tension and alignment.

.11 Provide a drain valve on each coil drain fitting and a vent valve on each coil vent.

.12 All pipe and conduit penetrations to the casing are to be thoroughly sealed and caulked to prevent air leakage.

.13 All floor penetrations are to be thoroughly sealed to ensure the water tightness and integrity of the entire floor.

.14 The Contractor shall provide certified wiring schematics to the electrical division for the equipment and controls.

.15 The Controls Contractor shall provide all necessary control wiring as recommended by the manufacturer.

END OF SECTION

1 General

1.1 SUMMARY

.1 Section Includes.

.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.

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 Include measurements, final settings and certified test results.

.2 Bear signature of commissioning technician and supervisor

.3 Report format to be approved by Departmental Representative before commissioning is started.

.4 Report to include complete point-to-point verification, including details on all corrective action taken and calibration

.5 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.

.6 Recommend additional changes and/or modifications deemed advisable in order to improve performance, environmental conditions or energy consumption.

.7 Controls report to be submitted prior to implementation of witnessed Cx Performance Verification Tests.

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 Carry out commissioning under direction of Departmental Representative and in presence of Departmental Representative, unless specifically arranged otherwise.

.2 Inform, and obtain approval from, Departmental Representative in writing at least 14 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.

.3 Correct deficiencies, re-test in presence of Departmental Representative until satisfactory performance is obtained.

.4 Acceptance of tests will not relieve Contractor from responsibility for ensuring that complete systems meet every requirement of Contract.

.5 Load system with project software.

.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.

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 2 months prior to tests.

.4 Locations to be approved, readily accessible and readable.

.5 Application: to conform to normal industry standards.

3 Execution

3.1 PROCEDURES

.1 Test each system independently and then in unison with other related systems.

.2 Controls Contractor to calibrate all sensors and complete point-to-point verification on entire EMCS (i.e. from operator screen to on-site device) and document on standard form. Form to be reviewed with departmental representative prior to start of verification to ensure sufficient information will be recorded.

.3 Verify every sequence of operation.

.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.

.7 Retest in presence of Departmental Representative once system passes Controls Contractor’s verification.

3.2 FIELD QUALITY CONTROL

.1 Pre-Installation Testing.
- .1 General: consists of field tests of equipment just prior to installation.
- .2 Testing may be on site or at Contractor's premises as approved by Departmental Representative.
- .3 Configure major components to be tested in same architecture as designed system. Include BECC equipment and 2 sets of Building Controller's including MCU's, LCU's, and TCU's.
- .4 Equip each Building Controller with sensor and controlled device of each type (AI, AO, DI, DO).
- .5 Additional instruments to include:
  - .1 DP transmitters.
  - .2 VAV supply duct SP transmitters.
  - .3 DP switches used for dirty filter indication and fan status.
- .6 In addition to test equipment, provide inclined manometer, digital micro-manometer, milli-amp meter, source of air pressure infinitely adjustable between 0 and 500 Pa, to hold steady at any setting and with direct output to milli-amp meter at source and to BECC.
- .7 After setting, test zero and span in 10 % increments through entire range while both increasing and decreasing pressure.
- .8 Contractor to mark instruments tracking within 0.5% in both directions as "approved for installation".

.9 Transmitters above 0.5% error will be rejected.
.10 DP switches to open and close within 2% of setpoint.
.11 Be prepared to re-test as Departmental Representative witnesses.

.2 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 on commissioning technician and Departmental Representative. This document will be used in final startup testing.
.3 Final Startup Testing: Upon satisfactory completion of tests, perform system tests 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 O&M personnel to assist in commissioning procedures as part of training.
.6 Commissioning to be supervised by qualified supervisory personnel and Departmental Representative.
.7 Commission systems considered as life safety systems before affected parts of the facility are occupied.
.8 Operate systems as long as necessary to commission entire project.
.9 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.

.5 Departmental Representative 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.

END OF SECTION

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 Sustainable requirements for construction and verification.

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: composed of two parts, point identifier and point expansion.
.1 Point identifier: comprised of three descriptors, "area" descriptor, "system" descriptor and "point" descriptor, for which database to provide 25 character field for each point identifier. "System" is system that point is located on.

.1 Area descriptor: building or part of building where point is located.
.2 System descriptor: system that point is located on.
.3 Point descriptor: physical or logical point description. For point identifier "area", "system" and "point" will be shortforms or acronyms. Database must provide 25 character field for each point identifier.

.2 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.

.3 Bilingual systems to include additional point identifier expansion fields of equal capacity for each point name for second language.
.1 System to support use of numbers and readable characters including blanks, periods or underscores to enhance user readability for each of the above strings.

.3 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 Pulse inputs.

.4 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 SYSTEM DESCRIPTION

.1 Energy Management Control System (EMCS) shall consist of modular microcomputer controllers providing distributed processing capability, and allowing future expansion of both input/output points and processing control functions. Provide 10% spare capacity for both digital and analog point types. Provide 25% spare programming capacity for the above spare points. The system shall have further capabilities to expand and control a further 25% increase in points (including spare capacity above) without degrading the systems specified performance. The new controls shall be an expansion of the existing EMCS systems operating at the Central Heating Plant (Andover or Honeywell only)

.2 Each field panel shall utilize direct digital control (DDC). DDC is defined to be where the field panel contains it=s own microprocessor and control algorithms to control the points connected directly without the need for communication with other panels.

.3 The EMCS shall effectively manage the facility and its activities to optimize the operation of HVAC systems to minimize energy consumption and extend equipment life during variations in occupancy, loads, schedules and weather conditions.

.4 The EMCS shall operate by enabling automatic operation and requiring minimal manual intervention and supervision.

.5 The modular design of the system software and hardware shall ensure easy maintenance and repairability. Self diagnostic programs will report errors without the need for operator interrogation. Maintenance on one module shall not affect the operation of other system components.

.6 Backup and fail safe criteria must be inherent. Any failure will not place the system in a hazardous condition.

.7 Output current and historical data on energy, building loads, equipment operation and control status.

.8 Provide English language operator interface using readily understand English language abbreviations and mnemonics.

.9 Controls Systems as provided shall incorporate, at minimum, the following integral features, functions and services:

.1 All automated monitoring, supervision, control, information storage and presentation as required by these Specifications.

.2 Operator information on all supervised building arrangements including but not limited to current status and value, historical archived information, summaries, analysis, displays, reports and operator control and management functions as required by the Specifications.

.3 The detection, annunciation and management of all alarm and non-expected conditions as required by the Specifications.

.4 The diagnostic monitoring and reporting of system functions, Nodes and communication networks.

.5 Interfaces between individual elements and the systems and networks provided by other trades as required by the Contract Documents.

.6 All other Controls Systems functions as required by the Contract Documents.

.10 The Controls System as provided shall comprise, at a minimum, the following primary elements:

.1 Existing Operator Workstation(s) (located in Central Heating Plant)

.2 Network and Application Nodes.

.3 Field Devices.

.4 Control wiring.

.11 The Controls System and all components shall be protected from power surges.

.12 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, 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.

.3 Reporting function such as trend log, trend graphics, alarm report logs, energy report logs, maintenance generated logs.

1.6 COORDINATION

.1 Mechanical Contractor shall mount all motorized dampers supplied by Controls Contractor in their respective locations in the ductwork. The Mechanical Contractor shall also be responsible for distribution of dampers to the various locations on the job site.

.2 All electrical low-voltage control wiring, including interlock wiring, required for the equipment supplied by Mechanical, except where otherwise noted, shall be supplied and installed by the Control Supplier.

.3 All mechanical control wiring 50 volts or more shall be a minimum of #14 gauge wire. All mechanical control wiring less than 50 volts shall be minimum #18 gauge wire.

.4 All mechanical control wiring installed by the control supplier shall conform with the requirements of the local electrical authority and the Division 26 Electrical specifications.

.5 Electrical Contractor: Electrical shall provide the following:

- .1 All power wiring to equipment.
- .2 One 15 amp, 120V/60/1 phase fused power supply to each DDC control panel (assumed to be 3 circuits, 2 in AHU Mechanical Room, 1 in the facility). Electrical Contractor shall coordinate location and number with the controls contractor. Controls transformer shall be located within 5m (15ft) of electrical panel
- .3 Wiring of inline control devices on 120 Vac as indicated on drawings (remote solid state speed controllers for fan operation).

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 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 Existing devices intended for re-use: submit test report.

1.8 QUALITY ASSURANCE

.1 Have local office within Province staffed by trained personnel capable of providing instruction, routine maintenance and emergency service on systems for the existing EMCS systems installed and connected to the Central Heating Plant,

.2 Have access to local supplies of essential parts and provide 7 year guarantee of availability of spare parts after obsolescence.

.3 Ensure qualified supervisory personnel continuously direct and monitor Work and attend site meetings.

2 Products

2.1 EQUIPMENT

.1 Control Network Protocol and Data Communication Protocol: to CEA 709.1 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.

2.2 ADAPTORS

.1 Provide adaptors between metric and imperial components.

2.3 CONTROLS SYSTEM ARCHITECTURE

.1 General

- .1 The Controls Systems shall consist of Network and Application Nodes and their associated equipment connected by an industry standard communication network.
- .2 The Interfaces provided shall incorporate complete tool sets, operational information displays, multi-Window displays and other interactive aids to assist interpretation and ease of use.
- .3 The Workstations, Servers and principal network computer equipment shall be standard products of recognized major manufacturers available through normal PC and computer vendor channels. Clones assembled by a third-party subcontractor are not acceptable.
- .4 Provide licenses for all software residing on and used by the Controls Systems and transfer these licenses to the Owner prior to completion.
- .5 The networks shall, at minimum, comprise, as necessary, the following:
  - .1 Existing Workstation located in Central Heating Plant.
  - .2 Network computer processing, data storage and communication equipment including Servers and digital data processors.
  - .3 Routers, bridges, switches, hubs, modems, interfaces and the like communication equipment.
  - .4 Active processing Network and Application Nodes including programmable field panels and controllers together with their power supplies and associated equipment.
  - .5 Addressable elements, sensors, transducers and end devices.
  - .6 Third-party equipment interfaces as required by the Contract Documents.
  - .7 Other components required for a complete and working Control Systems as specified.

.6 The system shall be modular in nature, and shall permit easy expansion through the addition of software applications, workstation hardware, network and application nodes sensors and actuators. The system architecture shall support 300% expansion capacity of all types of nodes and point types included in the initial installation and planned future expansion.

.7 The Specifications for the individual elements and component subsystems shall be minimum requirements and shall be augmented as necessary by the Contractor to achieve both compliance with all applicable codes, standards, the requirements of the AHJ (Authority having jurisdiction) at the site and to meet all requirements of the Contract Documents.

.8 The system shall have a concurrent, multi-tasking graphic operator interface with an easy-to-use, high level programming language and English language 13 character point descriptors.

.9 The system shall be usable in a standalone or network architectural with full peer-to-peer communication, remote access capacity, and four level password security resident on the single board machine.

.10 Controller shall provide commanded override capability from an operator interface.

.11 Each control panel shall provide adjustments for the functions specified. In addition, adjustments shall be provided for throttling ranges, setpoints, proportional bands, integral time, damper positioning, etc.

.2 Network

.1 The Controls Systems shall incorporate a primary Tier 1 network(s) utilizing standard Ethernet communications operating at a minimum speed of 10 Mb/sec. All Network Nodes, Web Servers, Configuration and Operator Workstations as a minimum shall reside on the primary Tier 1 network. At the Controls Contractor's option, they may also incorporate multiple and integrated secondary Tier 2 and tertiary Tier 3 networks.

.2 At least one level of the communication Network shall be based upon the following open architecture(s); BACnet in accordance with ANSI/ASHRAE Standard 135-2001 or LonMark as per ANSI/EAI 709 (LonWorks).

.3 The networks shall utilize only copper and optical fiber communication media as appropriate and to comply with the applicable codes, ordinances and regulations and the AHJ. They may also utilize digital wireless technologies if required by the Project and approved by the Architect or Owner and the AHJ.

.4 The control network shall NOT be connected through private or public telephones lines, ISDN lines etc. to an Internet Service Provider or have any external remote connection. The Controls Contractor shall identify the specific requirements in their shop drawing submittal.

2.4 OPERATOR INTERFACES

.1 Shall utilize existing operator workstation in Central Heating Plant.

.2 System shall be capable of being accessed locally through a portable operator terminal.

2.5 CONFIGURATION INTERFACES

.1 The Controls Systems Configuration Interface shall include all of the utilities, features and capabilities of the Operator Interface and in addition shall have the capability to create, modify and download the Controls Systems operating programs and databases to Web Servers, OWS, Network and Application Nodes.

.2 Workstations

.1 Provide the ability to add, replace, delete and configure Operator Workstations.

.3 Network and Application Nodes
- .1 Provide the ability to add, delete, modify Network Nodes including the following:
  - .1 Add, Delete Nodes
  - .2 Add, delete, modify job specific programming
  - .3 Upload and Download operating and job specific databases and programming.
- .2 Provide the ability to add, delete, modify Application Nodes including the following;
  - .1 Add, Delete Nodes
  - .2 Add, delete, modify points (hardware inputs and software variables) associated with Application Nodes
  - .3 Add, delete, modify job specific programming
  - .4 Upload and Download operating and job specific databases and programming.

2.6 NETWORK AND APPLICATION NODES

.1 General
- .1 The Controls Systems shall be composed of a mixture of Network and Application Nodes as required to meet the project requirements.
- .2 The Nodes shall be designed, packaged, installed, programmed and commissioned in consideration of their specific service and prevailing operating conditions. They shall be proven standard product of their original manufacturer.
- .3 A failure at a Node shall not cause failures or non-normal operation at any other system Node other than the possible loss of active real-time information from the failed Node.
- .4 Ancillary equipment, including interfaces and power supplies, shall not be operated at more than 80% of their rated service capacity.

.2 Network Nodes
- .1 The Controls Systems Tier 1 Network Nodes shall be designed and implemented entirely for use and operation on an Ethernet TCP/IP network such as the Internet or the Owner's Intranet. This functionality for operational access shall extend down to the field panel and field point level.
- .2 The Tier 1 Network Nodes shall be fully IT compatible operating over industry standard IT infrastructure. The Controls Contractor shall coordinate with the IT infrastructure support staff or trade contractors to ensure compatibility and performance of the operation of the Controls Systems over the LAN/WAN made available for its shared use.
- .3 The Tier 1 network shall be configured on IT industry standard off-the-shelf technologies
- .4 Network Nodes may act as Application Nodes.

.3 Application Nodes:
- .1 Application Nodes (AN) shall provide both standalone and networked direct digital control of mechanical and electrical building systems as required by the Specifications.
- .2 Each AN shall retain program, control algorithms, and setpoint information for at least 72 hours in the event of a power failure and shall return to normal operation upon stable restoration of normal line power.
- .3 Each AN shall monitor its communication status and provide a system advisory upon communication failure and restoration.
- .4 The AN shall provide the functionality to download and upload configuration data locally from a portable service terminal, over the network
- .5 The AN shall perform the functional monitoring of all Controls Application variables, both from real hardware points, software variables, and controller parameters such as setpoints.

.6 The AN shall be designed, packaged, installed, programmed and commissioned in consideration of their specific service and prevailing operating conditions. They shall be proven standard product of their original manufacturer and not a custom product for this project.

.7 Each AN shall directly support the temporary use of a portable service terminal to access the controls network based upon the security clearance of the operator.

.8 HVAC Systems

.1 Central HVAC Systems

.1 Standalone AN(s) shall be provided and programmed to control the Central Air Handlers, Heating and Cooling Plants as described in the sequence of operation

.2 Terminal HVAC Systems

.1 Standalone AN(s) shall be provided and configured to control heating and cooling elements such as Wall Fin Radiation, In-floor radiant Heating, Unit Heaters and Force Flows as called for in the sequences of operation.

.3 Mechanical Equipment with Microprocessor based Controls

.1 Controls Contractor shall integrate real-time data from building systems supplied by other trades and databases originating from other trades as called for in the sequences of operation.

.2 The Controls Systems shall include necessary hardware, equipment and software to allow data communications between the Controls Systems and building systems supplied by other trades.

.3 The trade contractors supplying other associated systems and equipment shall provide their necessary hardware and software at their cost and shall cooperate fully with the Controls Contractor in a timely manner and at their cost to ensure complete functional integration.

2.7 SOFTWARE

.1 General.

.1 Include as minimum: operating system executive, communications, application programs, operator interface, and systems sequence of operation - CDL's.

.2 Include "firmware" or instructions which are programmed into ROM, EPROM, EEPROM or other non-volatile memory.

.3 Include initial programming of Controllers, for entire system.

.2 Program and data storage.

.1 Store executive programs and site configuration data in ROM, EEPROM or other non-volatile memory.

.2 Maintain CDL and operating data including setpoints, operating constants, alarm limits in battery-backed RAM or EEPROM for display and modification by operator.

.3 Programming languages.

.1 Program Control Description Logic software (CDL) using English like or graphical, high level, general control language.

.2 Structure software in modular fashion to permit simple restructuring of program modules if future software additions or modifications are required. GO TO constructs not allowed unless approved by Consultant.

.4 Operator Terminal interface.

.1 Operating and control functions include:

.1 Multi-level password access protection to allow user/manager to limit workstation control.

.2 Alarm management: processing and messages.

.3 Operator commands.

.4 Reports.
.5 Displays.
.6 Point identification.

.5 Pseudo or calculated points.
.1 Software to provide access to value or status in controller or other networked controller in order to define and calculate pseudo point. When current pseudo point value is derived, normal alarm checks must be performed or value used to totalize.
.2 Inputs and outputs for process: include data from controllers to permit development of network-wide control strategies. Processes also to permit operator to use results of one process as input to number of other processes (e.g. cascading).

.6 Control Description Logic (CDL):
.1 Capable of generating on-line project-specific CDLs which are software based, programmed into RAM or EEPROM and backed up to OWS. Owner must have access to these algorithms for modification or to be able to create new ones and to integrate these into CDLs on BC(s) from OWS.
.2 Write CDL in high level language that allows algorithms and interlocking programs to be written simply and clearly. Use parameters entered into system (e.g. setpoints) to determine operation of algorithm. Operator to be able to alter operating parameters on-line from OWS and BC(s) to tune control loops.
.3 Perform changes to CDL on-line.
.4 Control logic to have access to values or status of points available to controller including global or common values, allowing cascading or inter-locking control.
.5 Energy optimization routines including enthalpy control, supply temperature reset, to be LCU or MCU resident functions and form part of CDL.
.6 MCU to be able to perform following pre-tested control algorithms:
.1 Two position control.
.2 Proportional Integral and Derivative (PID) control.
.7 Control software to provide ability to define time between successive starts for each piece of equipment to reduce cycling of motors.
.8 Provide protection against excessive electrical-demand situations during start-up periods by automatically introducing time delays between successive start commands to heavy electrical loads.
.9 Power Fail Restart: upon detection of power failure system to verify availability of Emergency Power as determined by emergency power transfer switches and analyze controlled equipment to determine its appropriate status under Emergency power conditions and start or stop equipment as defined by I/O Summary. Upon resumption of normal power as determined by emergency power transfer switches, MCU to analyze status of controlled equipment, compare with normal occupancy scheduling, turn equipment on or off as necessary to resume normal operation.

.7 Equipment Cycling Protection: Control software shall include a provision for limiting the number of times each piece of equipment may be cycled within any one-hour period. Limitations for each piece of equipment shall be determined in accordance with manufacturer's recommendations.

.8 The Application and/or Network Nodes shall support the following standard programming capabilities as required to achieve the specified sequences of operation.
.1 Execute custom, job-specific processes defined by the user to automatically perform calculations and special control routines using:
.1 System measured point data
.2 Calculated data
.3 The results from other processes
.4 User defined constants
.5 Arithmetic functions
.6 Boolean Logic Operators
.7 Proportional plus Integral plus Derivative Control Algorithms as required.
.8 Automatic control loop tuning

.2 The Application and/or Network Nodes shall incorporate the following software features:

.1 Event Messaging: Provide for the automatic execution of user-defined messages on the occurrence of each predefined real-time event including equipment/point status change, approaching limit or alarm, time of day and the like.

.2 Optimum Start/Stop: Provide software to start equipment on a sliding schedule based upon indoor and outdoor conditions. Determine the minimum time of HVAC system operation needed to satisfy the space environmental requirements. The program shall also determine the earliest possible time to stop the mechanical systems. The optimum start/stop program shall operate in conjunction with, and be coordinated with, the scheduled start/stop and night setback programs.

.3 Auto Alarm Lockout: Provide for scheduled and automatic lockout of alarm annunciation from equipment during non-normal operating conditions including shutdown, emergency power operation, filter alarm and the like.

.4 Event Initiated Programs and Custom Logic: Provide software to define custom logic sequences that reside in the Application and/or Network Nodes.

.3 Energy Management Applications: Network panels shall perform any and all of the following energy management routines applicable to the systems being controlled:

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. Optimized Speed control.
9. Heating/cooling interlock (system shall prevent simultaneous heating and cooling)
10. Hot water reset (I/O).
11 Hot Water Space Demand Reset.
12 Differential Enthalpy (economizer) Switchover.

All programs shall be executed automatically without the need for operator intervention, and shall be flexible enough to allow user customization. Programs shall be applied to building equipment as described under Sequence of Operation.

.4 Custom Process Programming Capability: Network panels shall be able to execute custom, job-specific processes defined by the user, to automatically perform calculations and special control routines.

1. Process Inputs and Variables: It shall be possible to use any of the following in a custom process:
   a) Any system-measured point data or status
   b) Any calculated data
   c) Any results from other processes
   d) User-defined constants
   e) Arithmetic functions (+,-,*,/, square root, exp, etc.)
   f) Boolean logic operators (and, or, exclusive or, etc.)
   g) On-delay/Off-delay/One-shot timers
2. Process Triggers: Custom processes may be triggered based on any combination of the following:
   a) Time interval
   b) Time of day
   c) Date
   d) Other processes
   e) Time programming
   f) Events (e.g., point alarms)

3. Dynamic Data Access: A single process shall be able to incorporate measured or calculated data from any and all other network panels on the local area network. In addition, a single process shall be able to issue commands to points in any land all other network panels on the local area network.
4. Advisory/Message Generation: Processes shall be able to generate operator messages and advisories to operator I/O devices. A process hall be able to directly send a message to a specified device, buffer the information in a follow-up file, or cause the execution of a dial-up connection to a remote device such as a printer or pager.
5. Custom Process Documentation: The custom control programming feature shall be self-documenting. All interrelationships defined by this feature shall be documented via graphical flowcharts and English language descriptors.

.5 Alarm Management: Alarm management shall be provided to monitor, buffer, and direct alarm reports to operator devices and memory files. Each network panel shall perform distributed, independent alarm analysis and filtering to minimize operator interruptions due to non-critical alarms, minimize network traffic, and prevent alarms from being lost. At no time shall the network panel's ability to report alarms be affected by either operator activity at a PC workstation or local I/O device, or communications with other panels on the network.

1. Point Change Report Description: All alarm or point change reports shall include the point's English language description, and the time and date of occurrence.
2. Prioritization: The user shall be able to define the specific system reaction for each point. Alarms shall be prioritized to minimize nuisance reporting and to speed operator response to critical alarms. A minimum of three priority levels shall be provided. Each network panel shall automatically inhibit the reporting of selected alarms during system shutdown and start-up. Users shall have the ability to manually inhibit alarm reporting for each point. The user shall also be able to define under which conditions point changes need to be acknowledged by an operator, and/or sent to follow-up files for retrieval and analysis at a later date.
3. Use management by exception concept for Alarm Reporting. This is system wide requirement. This approach will insure that only principal alarms are reported to OWS. Events which occur as direct result of primary event to be suppressed by system and only events which fail to occur to be reported. Such event sequence to be identified in I/O Summary and sequence of operation. Examples of above are, operational temperature alarms limits which are exceeded when main air handler is stopped, or General Fire condition shuts air handlers down, only Fire alarm status shall be reported. Exception is, when air handler which is supposed to stop or start fails to do so under event condition
4. Report Routing: Alarm reports, messages, and files will be directed to a user-defined list of operator devices, or PCs used by archiving alarm information. Alarms shall also be automatically directed to a default device in the event a primary device is found to be off-line.
5. Alarm Messages: In addition to the point=s descriptor and the time and date, the user shall be able to print, display or store a 65 character alarm message to more fully describe the alarm condition or direct operator response. Each standalone network panel shall be capable of storing a library of at least 250 alarm messages. Each message may be assignable to any number of points in the panel.
6. Auto-Dial Alarm Management: In Dial-up applications, only critical alarms shall initiate a call to a remote operator device. In all other cases, call activity shall be minimized by time-stamping and saving reports until an operator scheduled time, a manual request, or until the buffer space is full. The alarm buffer must store a minimum of 50 alarms.

.6 Transaction Logging: Operator commands and system events shall be automatically logged to disk in Personal Computer industry standard database format. Operator commands initiated from direct-connected workstations, dial-up workstations, and local network panel Network Terminal devices shall all be logged to this transaction file. This data shall be available at the Operator Workstation. Facility shall be provided to allow the user to search the transaction file using standard database query techniques, including searching by dates, operator name, data point name, etc. In addition, this transaction file shall be accessible with standard third party database and spreadsheet packages.

.7 Historical Data and Trend Analysis: A variety of historical data collection utilities shall be provided to automatically sample, store, and display system data in all of the following ways:

1. Continuous Point Histories: Standalone network panels shall store Point History Files for all analog and binary inputs and outputs. The point history routine shall continuously and automatically sample the value of all analog inputs at half hour intervals. Samples for all points shall be stored for the past 24 hours to allow the user to immediately analyze equipment performance and all problem-related events for the past day. Point History Files for binary input or output points and analog output points shall include a continuous record of the last ten status changes or commands for each point.
2. Control Loop Performance Trends: Standalone network panels shall also provide high resolution sampling capability with an operator-adjustable resolution of 10-300 seconds in one-second increments for verification of control loop performance.
3. Extended Sample Period Trends: Measured and calculated analog and binary data shall also be assignable to user-definable trends for the purpose of collecting operator-specified performance data over extended periods of time. Sample intervals of 1 minute to 2 hours, in one-minute intervals, shall be provided. Each standalone network panel shall have a dedicated buffer for trend data, and shall be capable of storing a minimum of 5000 data samples.
4. Data Storage and Archiving: Trend data shall be stored at the standalone network panels, and uploaded to hard disk storage when archival is desired. Uploads shall occur based upon either user-defined interval, manual commend, or when the trend buffers become full. All trend data shall be available in disk file form for use in 3rd Party personal computer applications.

.8 Runtime Totalization: Standalone network panels shall automatically accumulate and store runtime hours for binary input and output points as specified in the Execution portion of this specification.

1. The totalization routine shall have a sampling resolution of one minute or less.
2. The user shall have the ability to define a warning limit for runtime totalization. Unique, user-specified messages shall be generated when the limit is reached.

.9 Analog/Pulse Totalization: Standalone network panels shall automatically sample, calculate and store consumption totals on a daily, weekly, or monthly basis for user-selected analog and binary pulse input-type points.

1. Totalization shall provide calculation and storage of accumulations of up to 99,999.9 units (e.g. KWH, gallons, KBTU, tons, etc.)
2. The totalization routine shall have a sampling resolution of one minute or less.
3. The user shall have the ability to define a warning limit. Unique, user-specified messages shall be generated when the limit is reached.

.10 Event Totalization: Standalone network panels shall have the ability to count events such as the number of times a pump or fan system is cycled on and off. Event totalization shall be performed on a daily, weekly, or monthly basis.

1. The event totalization feature shall be able to store the records associated with a minimum of 9,999,999 events before reset.
2. The user shall have the ability to define a warning limit. Unique, user-specified messages shall be generated when the limit is reached.
3 Totalization routine to have sampling resolution of 1 min or less for analog inputs.

3 Execution

3.1 MANUFACTURER'S RECOMMENDATIONS

.1 Installation: to manufacturer's recommendations.

3.2 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.
- .4 Paint unfinished equipment installed indoors to EEMAC 2Y-1.

END OF SECTION

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).

1.2 DEFINITIONS

.1 Acronyms and definitions: refer to Section 25 05 01 - EMCS: General Requirements.

1.3 DESIGN REQUIREMENTS

.1 Preliminary Design Review: to contain following contractor and systems information.
- .1 Location of local office.
- .2 Description and location of installing and servicing technical staff.
- .3 Location and qualifications of programming design and programming support staff.
- .4 List of spare parts.
- .5 Location of spare parts stock.
- .6 Names of sub-contractors and site-specific key personnel.
- .7 Sketch of site-specific system architecture.
- .8 Specification sheets for each item including memory provided, programming language, speed, type of data transmission.
- .9 Descriptive brochures.
- .10 Sample CDL and graphics (systems schematics).
- .11 Response time for each type of command and report.
- .12 Item-by-item statement of compliance.
- .13 Proof of demonstrated ability of system to communicate utilizing Proprietary Communications Protocol, BACnet or Lontalk.

1.4 SUBMITTALS

.1 Submittals in accordance with Section 01 33 00 - Submittal Procedures and coordinate with requirements in this Section.

.2 Submit preliminary design document within 30 working days after tender closing and before contract award, for review by Departmental Representative.

.3 Shop Drawings to consist of one digital copy of design documents, shop drawings, product data and software.

.4 Hard copy to be completely indexed and coordinated package to assure compliance with contract requirements and arranged in same sequence as specification and cross-referenced to specification section and paragraph number.

1.5 PRELIMINARY SHOP DRAWING REVIEW

.1 Submit preliminary shop drawings within 30 working days of award of contract and include following:
- .1 Specification sheets for each item. To include 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.
- .2 Detailed system architecture showing all points associated with each controller including, signal levels, pressures where new EMCS ties into existing control equipment.
- .3 Spare point capacity of each controller by number and type.
- .4 Controller locations.
- .5 Auxiliary control cabinet locations.
- .6 Single line diagrams showing cable routings, conduit sizes, spare conduit capacity between control centre, field controllers and systems being controlled.
- .7 Valves: complete schedule listing including following information: designation, service, manufacturer, model, point ID, design flow rate, design pressure drop, required Cv, Valve size, actual Cv, spring range, pilot range, required torque, actual torque and close off pressure (required and actual).
- .8 Dampers: sketches showing module assembly, interconnecting hardware, operator locations, operator spring range, pilot range, required torque, actual torque.
- .9 Flow measuring stations: complete schedule listing designation, service, point ID, manufacturer, model, size, velocity at design flow rate, manufacturer, model and range of velocity transmitter.

1.6 DETAIL SHOP DRAWING REVIEW

.1 Submit detailed shop drawings within 60 working days after award of contract and before start of installation and include following:
- .1 Corrected and updated versions (hard copy only) of submissions made during preliminary review.
- .2 Wiring diagrams.
- .3 Piping diagrams and hook-ups.
- .4 Interface wiring diagrams showing termination connections and signal levels for equipment to be supplied by others.
- .5 Shop drawings for each input/output point, sensors, transmitters, showing information associated with each particular point including:
  - .1 Sensing element type and location.
  - .2 Transmitter type and range.
  - .3 Associated field wiring schematics, schedules and terminations.
  - .4 Complete Point Name Lists.
  - .5 Setpoints, curves or graphs and alarm limits (high and low, 3 types critical, cautionary and maintenance), signal range.
  - .6 Software and programming details associated with each point.
  - .7 Manufacturer's recommended installation instructions and procedures.
  - .8 Input and output signal levels or pressures where new system ties into existing control equipment.

.6 Control schematics, narrative description, CDL's fully showing and describing automatic and manual procedure required to achieve proper operation of project, including under complete failure of EMCS.
.7 Graphic system schematic displays of air and water systems with point identifiers and textual description of system, and typical floor plans as specified.
.8 Complete system CDL's including companion English language explanations on same sheet but with different font and italics. CDL's to contain specified energy optimization programs.
.9 Listing and example of specified reports.
.10 Listing of time of day schedules.
.11 Type and size of memory with statement of spare memory capacity.
.12 Full description of software programs provided.
.13 Sample of "Operating Instructions Manual" to be used for training purposes.
.14 Outline of proposed start-up and verification procedures. Refer to Section 25 01 11 - EMCS: Start-up, Verification and Commissioning.

1.7 QUALITY ASSURANCE

.1 Preliminary Design Review Meeting: Convene meeting within 45 working days of award of contract to:
.1 Undertake functional review of preliminary design 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 Contractor's programmer to attend meeting.

.3 Departmental Representative retains right to revise sequence or subsequent CDL prior to software finalization without cost to Departmental Representative.

2 Products

2.1 NOT USED

.1 Not Used.

3 Execution

3.1 NOT USED

.1 Not Used.

END OF SECTION

1 General

1.1 SUMMARY

.1 Section Includes.

.1 Requirements and procedures for final control diagrams and operation and maintenance (O&M) manual, for building Energy Monitoring and Control System (EMCS) Work.

1.2 DEFINITIONS

.1 BECC - Building Environmental Control Centre.

.2 OWS - Operator Work Station.

.3 For additional acryonyms and definitions refer to Section 25 05 01 - EMCS: General Requirements.

1.3 SUBMITTALS

.1 Submittals in accordance with Section 01 78 00 - Closeout Procedures, supplemented and modified by requirements of this Section.

.2 Submit Record Documents, As-built drawings, and Operation and Maintenance Manual to Departmental Representative in English.

.3 Provide soft copies and hard copies in hard-back, 50 mm 3 ring, D-ring binders.

.1 Binders to be 2/3 maximum full.
.2 Provide index to full volume in each binder.
.3 Identify contents of each manual on cover and spine.
.4 Provide Table of Contents in each manual.
.5 Assemble each manual to conform to Table of Contents with tab sheets placed before instructions covering subject.

1.4 AS-BUILTS

.1 Provide 2 copies of detailed shop drawings generated in Section 25 05 02 - EMCS: Submittals and Review Process and include:

.1 Changes to contract documents as well as addenda and contract extras.
.2 Changes to interface wiring.
.3 Routing of conduit, wiring and control air lines associated with EMCS installation.
.4 Locations of all devices to be indicated on drawings.
.5 Listing of alarm messages.
.6 Panel/circuit breaker number for sources of normal/emergency power.
.7 Names, addresses, telephone numbers of each sub-contractor having installed equipment, local representative for each item of equipment, each system.
.8 Test procedures and reports: provide records of start-up procedures, test procedures, checkout tests and final commissioning reports as specified in Section 25 01 11 - EMCS: Start-up, Verification and Commissioning.
.9 Basic system design and full documentation on system configuration.
.10 Update sequence of operations for all equipment as required to match exact site conditions and operation.

.2 Submit for final review by Departmental Representative.

.3 Provide before acceptance six (6) copies of all as-built documentation for inclusion in Mechanical Operating and Maintenance Manuals. Final copies shall incorporate all changes made during final review.

1.5 OPERATION AND MAINTENANCE MANUALS

.1 Custom design O&M Manuals (both hard and soft copy) to contain material pertinent to this project only, and to provide full and complete coverage of subjects referred to in this Section.

.2 Provide 2 complete sets of hard and soft copies prior to system or equipment tests

.3 Include complete coverage in concise language, readily understood by operating personnel using common terminology of functional and operational requirements of system. Do not presume knowledge of computers, electronics or in-depth control theory.

.4 Functional description to include:
- .1 Functional description of theory of operation.
- .2 Design philosophy.
- .3 Specific functions of design philosophy and system.
- .4 Full details of data communications, including data types and formats, data processing and disposition data link components, interfaces and operator tests or self-test of data link integrity.
- .5 Explicit description of hardware and software functions, interfaces and requirements for components in functions and operating modes.
- .6 Description of person-machine interactions required to supplement system description, known or established constraints on system operation, operating procedures currently implemented or planned for implementation in automatic mode.

.5 System operation to include:
- .1 Complete step-by-step procedures for operation of system including required actions at each OWS.
- .2 Operation of computer peripherals, input and output formats.
- .3 Emergency, alarm and failure recovery.
- .4 Step-by-step instructions for start-up, back-up equipment operation, execution of systems functions and operating modes, including key strokes for each command so that operator need only refer to these pages for keystroke entries required to call up display or to input command.

.6 Software to include:
- .1 Documentation of theory, design, interface requirements, functions, including test and verification procedures.
- .2 Detailed descriptions of program requirements and capabilities.
- .3 Data necessary to permit modification, relocation, reprogramming and to permit new and existing software modules to respond to changing system functional requirements without disrupting normal operation.
- .4 Software modules, fully annotated source code listings, error free object code files ready for loading via peripheral device.
- .5 Complete program cross reference plus linking requirements, data exchange requirements, necessary subroutine lists, data file requirements, other information necessary for proper loading, integration, interfacing, program execution.
- .6 Software for each Controller and single section referencing Controller common parameters and functions.

.7 Maintenance: document maintenance procedures including inspection, periodic preventive maintenance, fault diagnosis, repair or replacement of defective components, including calibration, maintenance, repair of sensors, transmitters, transducers, controller and interface firmware's, plus diagnostics and repair/replacement of system hardware.

.8 System configuration document:

.1 Provisions and procedures for planning, implementing and recording hardware and software modifications required during operating lifetime of system.

.2 Information to ensure co-ordination of hardware and software changes, data link or message format/content changes, sensor or control changes in event that system modifications are required.

.9 Programmer control panel documentation: provide where panels are independently interfaced with BECC, including interfacing schematics, signal identification, timing diagrams, fully commented source listing of applicable driver/handler.

.10 Provide copies (hard and soft, each) of final Controls Operation and Maintenance manuals for inclusion in Mechanical Operation and Maintenance Manuals, refer to 21 05 01 for count. Final copies shall incorporate all changes made during final review and during construction.

1.6 SOFTWARE

.1 Provide back-up for source code following any and all modifications and/or corrections implemented throughout the verification and commissioning of EMCS.

.2 Provide one copy of back-up for source code in each of the six Mechanical Operation and Maintenance Manuals.

2 Products

2.1 NOT USED

.1 Not Used.

3 Execution

3.1 NOT USED

.1 Not Used.

END OF SECTION

1 General

1.1 SUMMARY

.1 Section Includes.

.1 Requirements and procedures for identification of devices, sensors, wiring tubing, conduit and equipment, for building Energy Monitoring and Control System (EMCS) Work and nameplates materials, colours and lettering sizes.

1.2 REFERENCES

.1 Canadian Standards Association (CSA International).

.1 CSA C22.1-02, The Canadian Electrical Code, Part I (19th Edition), Safety Standard for Electrical Installations.

1.3 DEFINITIONS

.1 For acronyms and definitions refer to Section 25 05 01 - EMCS: General Requirements.

1.4 SYSTEM DESCRIPTION

.1 Language Operating Requirements: provide identification for control items in English.

1.5 SUBMITTALS

.1 Submittals in accordance with Section 01 33 00 - Submittal Procedures supplemented and modified by requirements of this Section.

.2 Submit to Departmental Representative for approval samples of nameplates, identification tags and list of proposed wording.

2 Products

2.1 NAMEPLATES FOR PANELS

.1 Identify by Plastic laminate, 3 mm thick, matt white finish, black core, square corners, lettering accurately aligned and engraved into core.

.2 Sizes: 25 x 67 mm minimum.

.3 Lettering: minimum 7 mm high, black.

.4 Inscriptions: machine engraved to identify function.

2.2 NAMEPLATES FOR FIELD DEVICES

.1 Identify by plastic encased cards attached by chain or plastic tie.

.2 Sizes: 50 x 100 mm minimum.

.3 Lettering: minimum 5 mm high produced from laser printer in black.

.4 Data to include: point name, point type, point address, associated controller, and description of service.

.5 Companion cabinet: identify interior components using plastic enclosed cards with point name and point address.

2.3 NAMEPLATES FOR ROOM SENSORS

.1 Identify by lamicoids using point identifier.

.2 Location: on sensor cover.

.3 Letter size: to suit, clearly legible.

2.4 WARNING SIGNS

.1 Equipment including motors, starters under remote automatic control: supply and install orange coloured signs warning of automatic starting under control of EMCS.

.2 Sign to read: "Caution: This equipment is under automatic remote control of EMCS".

2.5 WIRING

.1 Supply and install numbered tape markings on wiring at panels, junction boxes, splitters, cabinets and outlet boxes.

.2 Colour coding: to CSA C22.1. Use colour coded wiring in communications cables, matched throughout system.

.3 Power wiring: identify circuit breaker panel/circuit breaker number inside each EMCS panel.

2.6 CONDUIT

.1 Colour code EMCS conduit.

.2 Pre-paint box covers and conduit fittings.

.3 Coding: use fluorescent orange paint.

3 Execution

3.1 NAMEPLATES AND LABELS

.1 Ensure that manufacturer's nameplates, CSA labels and identification nameplates are visible and legible at all times.

.2 All labelling to follow RCMP site standards and the Signage Drawings for room names and numbers. Note that the signage drawings will match room labelling to be utilized in space but do not match the room numbering utilized for the construction set.

END OF SECTION

1 General

1.1 SUMMARY

.1 Section Includes.
- .1 Requirements and procedures for warranty and activities during warranty period and service contracts, for building Energy Monitoring and Control System (EMCS).

.2 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 BC(s) - Building Controller(s).

.2 OWS - Operator Work Station.

.3 For additional 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.

.2 Submit detailed preventative maintenance schedule for system components to Departmental Representative.

.3 Submit detailed inspection reports to Departmental Representative.

.4 Submit dated, maintenance task lists to Departmental Representative and include the following sensor and output point detail, as proof of system verification:
- .1 Point name and location.
- .2 Device type and range.
- .3 Measured value.
- .4 System displayed value.
- .5 Calibration detail
- .6 Indication if adjustment required,
- .7 Other action taken or recommended.

.5 Submit network analysis report showing results with detailed recommendations to correct problems found.

.6 Records and logs: in accordance with Section 01 78 00 - Closeout Submittals.
- .1 Maintain records and logs of each maintenance task on site.
- .2 Organize cumulative records for each major component and for entire EMCS chronologically.
- .3 Submit records to Departmental Representative, after inspection indicating that planned and systematic maintenance have been accomplished.

.7 Revise and submit to Departmental Representative in accordance with Section 01 78 00 - Closeout Submittals "As-built drawings" documentation and commissioning reports to reflect changes, adjustments and modifications to EMCS made during warranty period.

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 Operation: foregoing and other servicing to provide proper sequencing of equipment and satisfactory operation of EMCS based on original design conditions and as recommended by manufacturer.

.4 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.

.5 Provide system modifications in writing.
- .1 No system modification, including operating parameters and control settings, to be made without prior written approval of Departmental Representative.

.6 Back-up software.

2 Products

2.1 NOT USED

3 Execution

3.1 FIELD QUALITY CONTROL

.1 Perform as minimum two major inspections (more often if required by manufacturer) per year; one at start of heating season and one at start of cooling season. Provide detailed written report to Departmental Representative as described in Submittal article.

.2 Perform inspections during regular working hours, 0800 to 1630 h, Monday through Friday, excluding statutory holidays.

.3 Following inspections are minimum requirements and should not be interpreted to mean satisfactory performance:
- .1 Perform calibrations using test equipment having traceable, certifiable accuracy at minimum 50% greater than accuracy of system displaying or logging value.
- .2 Check and calibrate each field input/output device in accordance with Canada Labour Code - Part I and CSA Z204.
- .3 Provide dated, maintenance task lists, as described in Submittal article, as proof of execution of complete system verification.

.4 Minor inspections to include, but not limited to:
- .1 Perform visual, operational checks to BC's, peripheral equipment, interface equipment and other panels.
- .2 Check equipment cooling fans as required.
- .3 Review system performance with Departmental Representative to discuss suggested or required changes.

.5 Major inspections to include, but not limited to:
- .1 Minor inspection.
- .2 Clean OWS(s) peripheral equipment, BC(s), interface and other panels, micro-processor interior and exterior surfaces.
- .3 Check signal, voltage and system isolation of BC(s), peripherals, interface and other panels.
- .4 Verify calibration/accuracy of each input and output device and recalibrate or replace as required.
- .5 Run system software diagnostics as required.
- .6 Install software and firmware enhancements to ensure components are operating at most current revision for maximum capability and reliability.
  - .1 Perform network analysis and provide report as described in Submittal article.

.6 Rectify deficiencies revealed by maintenance inspections and environmental checks.

.7 Continue system debugging and optimization.

.8 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.

END OF SECTION

1 General

1.1 SUMMARY

.1 Section Includes:
- .1 System requirements for Local Area Network (LAN) for Building Energy Monitoring and Control System (EMCS).

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, TIA/EIA-568, CSA T530, TIA/EIA-569-A 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 EMCS-LAN to: Proprietary Protocol.
- .3 Each EMCS-LAN to be capable of supporting at least 50 devices.
- .4 Support of combination of MCUs and OWSs directly connected to EMCS-LAN.
- .5 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.
- .6 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.
- .7 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: shielded twisted cable, or fibre optic cable compatible with network protocol to be used within buildings.

2 Products

2.1 NOT USED

3 Execution

3.1 NOT USED

END OF SECTION

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).

1.2 REFERENCES

.1 American Society of Heating, Refrigeration and Air-Conditioning Engineers, Inc. (ASHRAE).
  .1 ASHRAE 2003, Applications Handbook, SI 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 required 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 reviewed and approved by Consultant at time of preliminary design review. Any approval does not negate the Contractors duty to fulfill the requirements of the Contract.

.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).

.3 Interface to include provisions for use of dial-up modem for interconnection with remote modem.
  .1 Dial-up communications to use 56 Kbit modems and voice grade telephone lines.
  .2 Each stand-alone panel may have its own modem or group of stand-alone panels may share modem.

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 25 % 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 Lockable wall cabinet.
.4 Required communications equipment and wiring (if remote units).
.5 Leave controlled system in "fail-safe" mode in event of loss of communication with, or failure of, processor unit.
.6 Input Output interface to accept as minimum AI, AO, DI, DO functions as specified.
.7 Wiring terminations: use conveniently located screw type or spade lug terminals.
.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:
.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.
.1 Provide for conduit entrance from top, bottom or sides of panel.

.2 ECUs and TCUs to be mounted in equipment enclosures or separate enclosures.
.3 Mounting details as approved by Consultant for ceiling mounting.

.6 Cabinets to provide protection from water dripping from above, while allowing sufficient airflow to prevent internal overheating.

.7 Provide surge and low voltage protection for interconnecting wiring connections.

1.6 MAINTENANCE PROCEDURES

.1 Provide manufacturers recommended maintenance procedures for insertion in Operation and Maintenance Manuals.

2 Products

2.1 MASTER CONTROL UNIT (MCU)

.1 General: primary function of MCU is to provide co-ordination and supervision of subordinate devices in execution of optimization routines such as demand limiting or enthalpy control.

.2 Include high speed communication LAN Port for Peer to Peer communications with OWS(s) and other MCU level devices.
.1 MCU must support Proprietary Protocol.

.3 MCU local I/O capacity as follows:
.1 MCU I/O points as allocated in I/O Summary Table referenced in MD13800.
.2 LCUs may be added to support system functions.

.4 Central Processing Unit (CPU).
.1 Processor to consist of minimum 16 bit microprocessor capable of supporting software to meet specified requirements.
.2 CPU idle time to be more than 30 % when system configured to maximum input and output with worst case program use.
.3 Minimum addressable memory to be at manufacturer's discretion but to support at least performance and technical specifications to include but not limited to:
.1 Non-volatile EEPROM to contain operating system, executive, application, sub-routine, other configurations definition software. Tape media not acceptable.
.2 Battery backed (72 hour minimum capacity) RAM (to reduce the need to reload operating data in event of power failure) to contain CDLs, application parameters, operating data or software that is required to be modifiable from operational standpoint such as schedules, setpoints, alarm limits, PID constants and CDL and hence modifiable on-line through operator panel or remote operator's interface. RAM to be downline loadable from OWS.
.4 Include uninterruptible clock accurate to plus or minus 5 secs/month, capable of deriving year/month/day/hour/minute/second, with rechargeable batteries for minimum 72 hour operation in event of power failure.
.5 Local Operator Terminal (OT): Provide OT for each MCU
.1 Mount access/display panel in MCU or in suitable enclosure beside MCU as approved by Consultant.
.2 Support operator's terminal for local command entry, instantaneous and historical data display, programs, additions and modifications.
.3 Display simultaneously minimum of 16 point identifiers to allow operator to view single screen dynamic displays depicting entire mechanical systems. Point identifiers to be in English.
.4 Functions to include, but not be limited to, following:
.1 Start and stop points.
.2 Modify setpoints.

.3 Modify PID loop parameters.
.4 Override PID control.
.5 Change time/date.
.6 Add/modify/start/stop weekly scheduling.
.7 Add/modify setpoint weekly scheduling.
.8 Enter temporary override schedules.
.9 Define holiday schedules.
.10 View analog limits.
.11 Enter/modify analog warning limits.
.12 Enter/modify analog alarm limits.
.13 Enter/modify analog differentials.

.6 Provide access to real and calculated points in controller to which it is connected or to other controller in network. This capability not to be restricted to subset of predefined "global points" but to provide totally open exchange of data between OT and other controller in network.

.7 Operator access to OTs: same as OWS user password and password changes to automatically be downloaded to controllers on network.

.8 Provide prompting to eliminate need for user to remember command format or point names. Prompting to be consistent with user's password clearance and types of points displayed to eliminate possibility of operator error.

.9 Identity of real or calculated points to be consistent with network devices. Use same point identifier as at OWS's for access of points at OT to eliminate cross-reference or look-up tables.

2.2 LOCAL CONTROL UNIT (LCU)

.1 Provide multiple control functions for typical built-up and package HVAC systems, hydronic systems and electrical systems.

.2 Minimum of 16 I/O points of which minimum be 4 AOs, 4 AIs, 4 DIs, 4 DOs.

.3 Points integral to one Building System to be resident on only one controller.

.4 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.

2.3 TERMINAL/EQUIPMENT CONTROL UNIT (TCU/ECU)

.1 Microprocessor capable of supporting necessary software and hardware to meet TCU/ECU functional specifications.
.1 TCU/ECU definition to be consistent with those defined in ASHRAE HVAC Applications Handbook section 45.

.2 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.

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 point naming convention as defined in Section 25 05 01 - EMCS: General Requirements.

3 Execution

3.1 LOCATION

.1 Location of Controllers to be approved by Consultant.

3.2 INSTALLATION

.1 Install Controllers in secure locking enclosures as indicated.

.2 Provide necessary power from local 120V branch circuit panel for equipment.

.3 Install tamper locks on breakers of circuit breaker panel.

.4 Use uninterruptible Power Supply (UPS) and emergency power when equipment must operate in emergency and co-ordinating mode.

END OF SECTION

1 General

1.1 SUMMARY

.1 Section Includes:
  .1 Control devices integral to the Building Energy Monitoring and Control System (EMCS)

1.2 REFERENCES

.1 American National Standards Institute (ANSI).
  .1 ANSI C12.7-1993(R1999), Requirements for Watthour Meter Sockets.
  .2 ANSI/IEEE C57.13-1993, Standard Requirements for Instrument Transformers.
.2 American Society for Testing and Materials International, (ASTM).
  .1 ASTM B148-97(03), Standard Specification for Aluminum-Bronze Sand Castings.
.3 National Electrical Manufacturer's Association (NEMA).
  .1 NEMA 250-03, Enclosures for Electrical Equipment (1000 Volts Maximum).
.4 Air Movement and Control Association, Inc. (AMCA).
  .1 AMCA Standard 500-D-98, Laboratory Method of Testing Dampers For Rating.
.5 Canadian Standards Association (CSA International).
  .1 CSA-C22.1-02, Canadian Electrical Code, Part 1 (19th Edition), Safety Standard for Electrical Installations.

1.3 DEFINITIONS

.1 Acronyms and Definitions: refer to Section 25 05 01 - EMCS: General Requirements.

1.4 SUBMITTALS

.1 Submit shop drawings and manufacturer's installation instructions in accordance with Section 25 05 01 EMCS: General Requirements

1.5 EXISTING CONDITIONS

.1 Cutting and Patching: in accordance with Section 23 05 00 General Mechanical Requirements and Division 1 supplemented as specified herein.

.2 Repair surfaces damaged during execution of Work.

2 Products

2.1 GENERAL

.1 Control devices of each category to be of same type and manufacturer.

.2 External trim materials to be corrosion resistant. Internal parts to be assembled in watertight, shockproof, vibration-proof, heat resistant, assembly.

.3 Operating conditions: 0 - 32 degrees C with 10 - 90% RH (non-condensing) unless otherwise specified.

.4 Terminations: use standard conduit box with slot screwdriver compression connector block unless otherwise specified.

.5 Transmitters and sensors to be unaffected by external transmitters including walkie talkies.

.6 Account for hysteresis, relaxation time, maximum and minimum limits in applications of sensors and controls.

.7 Outdoor installations: use weatherproof construction in NEMA 4 enclosures.

.8 Devices installed in user occupied space not exceed Noise Criteria (NC) of 35. Noise generated by any device must not be detectable above space ambient conditions.

.9 Range: including temperature, humidity, pressure, as required to accomplish Sequence of Operation.

2.2 TEMPERATURE SENSORS

.1 General: except for room sensors to be resistance or thermocouple type to following requirements:
- .1 Thermocouples: limit to temperature range of 200 degrees C and over.
- .2 RTD's: 1000 ohm at 0 degrees C (plus or minus 0.2 ohms) platinum element or better with strain minimizing construction, 3 integral anchored leadwires. Coefficient of resistivity: 0.00385 ohms/ohm degrees C.
- .3 Sensing element: hermetically sealed.
- .4 Stem and tip construction: copper or type 304 stainless steel.
- .5 Time constant response: less than 3 seconds to temperature change of 10 deg.C.
- .6 Immersion wells: NPS 3/4, stainless steel spring loaded construction, with heat transfer compound compatible with sensor. Insertion length 100 mm as indicated.
- .7 Analog temperature sensors shall provide an output signal that varies continuously with the sensed temperature, within a specified range.
- .8 Binary temperature sensors shall provide an output signal that is either on or off depending upon whether the sensed temperature is above or below the setpoint temperature.

.2 Room temperature sensors and display wall modules.
- .1 Temperature sensing and display wall module.
  - .1 LCD display to show space temperature ed and temperature setpoint.
  - .2 Buttons for occupant selection of temperature setpoint and occupied/ unoccupied mode.
  - .3 Jack connection for plugging in laptop personal computer and contractor supplied zone terminal unit for access to zone bus.
  - .4 Integral thermistor sensing element 10,000 ohm at 24 degrees.
  - .5 Accuracy 0.2 degrees C over range of 0 to 70 degrees C.
  - .6 Stability 0.02 degrees C drift per year.
  - .7 Separate mounting base for ease of installation.
- .2 Room temperature sensors.
  - .1 Wall mounting, in slotted type covers having brushed aluminum finish, with guard as indicated.
  - .2 Element 10-50mm long RTD with ceramic tube or equivalent protection or thermistor, 10,000 ohm, accuracy of plus or minus 0.2 degrees C.

.3 Duct temperature sensors:
- .1 General purpose duct type: suitable for insertion into ducts at various orientations, insertion length 460 mm and complete with moisture resistant transmitter.

.2 Averaging duct type: incorporates numerous sensors inside assembly which are averaged to provide one reading. Minimum insertion length 6000 mm. Bend probe at field installation time to 100 mm radius at point along probe without degradation of performance. The output shall be compatible with the panel it serves. The sensing element shall be of sufficient length to provide a minimum of one (1) foot of element for every two (2) square feet of coil area.

.4 Outdoor air temperature sensors:

.1 Outside air type: complete with probe length 100 - 150 mm long, non-corroding shield to minimize solar and wind effects, threaded fitting for mating to 13 mm conduit, weatherproof construction in NEMA 4 enclosure. Transmitter shall be mounted to minimize building film effects.

.5 Pipe / Tank Temperature Transmitter:

.1 Shall contain an RTD sensing element to monitor water temperature. The Contractor shall provide brass wells of sufficient size for the pipe to be installed. The output shall be compatible with the panel it serves. Transmitter shall be factory calibrated to an accuracy of + 1% over the full range. Immersion element shall be installed complete with heat transfer compound.

.6 Low Limit Thermostats

.1 Shall be of manual reset type, with setpoint adjustment.

.2 The sensing element shall be of sufficient length to provide a minimum of one (1) foot of element for every two (2) square feet of coil area. The element shall run fully across the coil on each pass. When any one foot of the element senses a temperature as low as the setpoint, the thermostat contacts shall open. These shall contain double pole switches for simultaneous remote alarms.

2.3 TEMPERATURE TRANSMITTERS

.1 Requirements:

.1 Input circuit: to accept 3-lead, 1000 ohm at 0 degrees C, platinum resistance detector type sensors.

.2 Power supply: 24 V DC into load of 575 ohms. Power supply effect less than 0.01 degrees C per volt change.

.3 Output signal: 4 - 20 mA into500 ohm maximum load.

.4 Input and output short circuit and open circuit protection.

.5 Output variation: less than 0.2 % of full scale for supply voltage variation of plus or minus 10 %.

.6 Combined non-linearity, repeatability, hysteresis effects: not to exceed plus or minus 0.5 % of full scale output.

.7 Maximum current to 100 or 1000 ohm RTD sensor: not to exceed 25 mA.

.8 Integral zero and span adjustments.

.9 Temperature effects: not to exceed plus or minus 1.0 % of full scale/ 50degrees C.

.10 Long term output drift: not to exceed 0.25 % of full scale/ 6 months.

.11 Transmitter ranges: select narrowest range to suit application from following:

.1 Minus 50 degrees C to plus 50 degrees C, plus or minus 0.5 degrees C.

.2 0 to 100 degrees C, plus or minus 0.5 degrees C.

.3 0 to 50 degrees C, plus or minus 0.25 degrees C.

.4 0 to 25 degrees C, plus or minus 0.1 degrees C.

.5 10 to 35 degrees C, plus or minus 0.25 degrees C.

2.4 PRESSURE TRANSDUCERS

.1 Requirements:
- .1 Combined sensor and transmitter measuring pressure.
  - .1 Internal materials: suitable for continuous contact with industrial standard instrument air, compressed air, water, steam, as applicable.
- .2 Output signal: 4 - 20 mA into 500 ohm maximum load.
- .3 Output variations: less than 0.2 % full scale for supply voltage variations of plus or minus 10 %.
- .4 Combined non-linearity, repeatability, and hysteresis effects: not to exceed plus or minus 0.5 % of full scale output over entire range.
- .5 Temperature effects: not to exceed plus or minus 1.5 % full scale/ 50 degrees C.
- .6 Over-pressure input protection to at least twice rated input pressure.
- .7 Output short circuit and open circuit protection.
- .8 Accuracy: plus or minus 1% of Full Scale.
- .9 Shall be suitable for the media and pressure measured.
- .10 Units shall have temperature compensation so that thermal effects are no more then 0.05% of the full scale from 0 - 175 Deg.F.

2.5 DIFFERENTIAL PRESSURE TRANSMITTERS

.1 Requirements:
- .1 Internal materials: suitable for continuous contact with industrial standard instrument air, compressed air, water, steam, as applicable.
- .2 Output signal: 4 - 20 mA into 500 ohm maximum load.
- .3 Output variations: less than 0.2 % full scale for supply voltage variations of plus or minus 10 %.
- .4 Combined non-linearity, repeatability, and hysteresis effects: not to exceed plus or minus 0.5 % of full scale output over entire range.
- .5 Integral zero and span adjustment.
- .6 Temperature effects: not to exceed plus or minus 1.5 % full scale/ 50 degrees C.
- .7 Over-pressure input protection to at least twice rated input pressure.
- .8 Output short circuit and open circuit protection.
- .9 Unit to have 12.5 mm N.P.T. conduit connection. Enclosure to be integral part of unit.
- .10 Shall be suitable for the media and pressure measured.
- .11 Units shall have temperature compensation so that thermal effects are no more then 0.05% of the full scale from 0 - 175 Deg.F.

.2 Differential Pressure Switch for water shall have a single-pole, single-throw (SPST) contact, adjustable setpoint, UL rated 6 amperes at 120 volts, 100 psig design.

.3 Differential Pressure Switch for air shall have a single-pole, single-throw (SPST) contact, adjustable setpoint, UL rated 9.8 amperes at 120 volts

2.6 STATIC PRESSURE SENSORS

.1 Requirements:
- .1 Multipoint element with self-averaging manifold.
  - .1 Maximum pressure loss: 160 Pa at 10 m/s. (Air stream manifold).
- .2 Accuracy: plus or minus 1 % of actual duct static pressure.

2.7 STATIC PRESSURE TRANSMITTERS

.1 Requirements:
- .1 Output signal: 4 - 20 mA linear into 500 ohm maximum load.
- .2 Calibrated span: not to exceed 150 % of duct static pressure at maximum flow.
- .3 Accuracy: 0.4 % of span.
- .4 Repeatability: within 0.5 % of output.
- .5 Linearity: within 1.5 % of span.
- .6 Deadband or hysteresis: 0.1% of span.
- .7 External exposed zero and span adjustment.
- .8 Unit to have 12.5 mm N.P.T. conduit connection. Enclosure to be integral part of unit

2.8 VELOCITY PRESSURE SENSORS

.1 Requirements:
- .1 Multipoint static and total pressure sensing element with self-averaging manifold with integral air equalizer and straightener section.
- .2 Maximum pressure loss: 37Pa at 1000 m/s.
- .3 Accuracy: plus or minus 1 % of actual duct velocity.

2.9 VELOCITY PRESSURE TRANSMITTERS

.1 Requirements:
- .1 Output signal: 4 - 20 mA linear into 500 ohm maximum load.
- .2 Calibrated span: not to exceed 125 % of duct velocity pressure at maximum flow.
- .3 Accuracy: 0.4 % of span.
- .4 Repeatability: within 0.1 % of output.
- .5 Linearity: within 0.5 % of span.
- .6 Deadband or hysteresis: 0.1% of span.
- .7 External exposed zero and span adjustment.
- .8 Unit to have 12.5 mm N.P.T. conduit connection. Enclosure to be integral part of unit.

2.10 PRESSURE AND DIFFERENTIAL PRESSURE SWITCHES

.1 Requirements:
- .1 Internal materials: suitable for continuous contact with compressed air, water, steam, etc., as applicable.
- .2 Adjustable setpoint and differential.
- .3 Switch: snap action type, rated at 120V, 15 amps AC.
- .4 Switch assembly: to operate automatically and reset automatically when conditions return to normal. Over-pressure input protection to at least twice rated input pressure.
- .5 Accuracy: within 2% repetitive switching.
- .6 Provide switches with isolation valve and snubber, where code allows, between sensor and pressure source.
- .7 Switches on steam and high temperature hot water service: provide pigtail syphon.

2.11 TEMPERATURE SWITCHES

.1 Requirements:
- .1 Operate automatically. Reset automatically, except as follows:
  - .1 Low temperature detection: manual reset.

.2 High temperature detection: manual reset.

.2 Adjustable setpoint and differential.

.3 Accuracy: plus or minus 1degrees C.

.4 Snap action rating: 120V, 15 amps as required. Switch to be DPST for hardwire and EMCS connections.

.5 Type as follows:

.1 Room: for wall mounting on standard electrical box with protective guard as indicated.

.2 Duct, general purpose: insertion length = 460 mm.

.3 Thermowell: stainless steel, with compression fitting for NPS 3/4 thermowell. Immersion length: 100 mm.

.4 Low temperature detection: continuous element with 6000 mm insertion length, duct mounting, to detect coldest temperature in any 30 mm length.

.5 Strap-on: with helical screw stainless steel clamp.

2.12 AIR PRESSURE GAUGES

.1 Diameter: 38 mm minimum.

.2 Range: zero to two times operating pressure of measured pressure media or nearest standard range.

2.13 ELECTROMECHANICAL RELAYS

.1 Requirements:

.1 Double voltage, DPDT, plug-in type with termination base.

.2 Coils: rated for 120V AC. Other voltage: provide transformer.

.3 Contacts: rated at 5 amps at 120 V AC.

.4 Relay to have visual status indication

2.14 SOLID STATE RELAYS

.1 General:

.1 Relays to be socket or rail mounted.

.2 Relays to have LED Indicator

.3 Input and output Barrier Strips to accept 14 to 28 AWG wire.

.4 Operating temperature range to be -20 degrees C to 70 degrees C.

.5 Relays to be CSA Certified.

.6 Input/output Isolation Voltage to be 4000 VAC at 25 degrees C for 1 second maximum duration.

.7 Operational frequency range, 45 to 65 HZ.

.2 Input:

.1 Control voltage, 3 to 32 VDC.

.2 Drop out voltage, 1.2 VDC.

.3 Maximum input current to match AO (Analog Output) board.

.3 Output.

.1 AC or DC Output Model to suit application.

2.15 CURRENT TRANSDUCERS

.1 Requirements:

.2 Purpose: combined sensor/transducer, to measure line current and produce proportional signal in one of following ranges:
- .1 4-20 mA DC.
- .2 0-1 volt DC.
- .3 0-10 volts DC.
- .4 0-20 volts DC.

.3 Frequency insensitive from 10 - 80 hz.

.4 Accuracy to 0.5% full scale.

.5 Zero and span adjustments. Field adjustable range to suit motor applications.

.6 Adjustable mounting bracket to allow for secure/safe mounting inside MCC.

.7 Current Sensing Transducers shall be self-powered, solid state with adjustable trip current. Each transducer shall be selected to match the current and voltage of the application. The output shall be compatible with the panel it serves. Each transducer shall include an LED to indicate output status.

2.16 CURRENT SENSING RELAYS

.1 Requirements:
- .1 Suitable to detect belt loss or motor failure.
- .2 Trip point adjustment, output status LED.
- .3 Split core for easy mounting.
- .4 Induced sensor power.
- .5 Relay contacts: capable of handling 0.5 amps at 30 VAC / DC. Output to be NO solid state.
- .6 Suitable for single or 3 phase monitoring. For 3-Phase applications: provide for discrimination between phases.
- .7 Adjustable latch level.

2.17 CONTROL VALVES

.1 Valves shall be sized by the control manufacturer and guaranteed to meet the required capacity. Valve shall be sized to achieve reasonable authority at minimum pressure drop. In general, valve shall have pressure drop equal to pressure drop of controlled device. In general valve shall be line size or one size smaller.

.2 Nominal body rating shall be not less than 125 PSI. However, the valve body and packing selected shall be sized to withstand the system static head plus the maximum pump head and the maximum temperature of the control medium.

.3 Two-way modulating valves shall have close-off ratings exceeding the maximum pressure difference, at any load condition, between the outlet and inlet. Each valve shall be equipped with proper packing to assure there will be no leakage at the valve stem.

.4 Terminal unit two-way control valves shall have equal percentage characteristics. Terminal unit three-way control valves shall have linear flow characteristics.

.5 Physical sizes of valves will be such that they will fit within the physical space provided within equipment enclosures. Verify before ordering materials.

.6 NPS 50mm (2") and under:
- .1 Screwed National Pipe Thread (NPT) tapered female connections.
- .2 Valves to ANSI Class 250, valves to bear ANSI mark.
- .3 Rangeability 50:1minimum.

.7 NPS 64mm (2-1/2") and larger:
- .1 Flanged connections.
- .2 Valves to ANSI Class 150 or 250 as indicated, valves to bear ANSI mark.
- .3 Rangeability 100:1minimum.

.8 Valves are to be provided complete with mounting plate for installation of actuators.

.9 Leakage rate ANSI class IV, 0.01% of full open valve capacity.

2.18 ELECTRONIC / ELECTRIC VALVE AND DAMPER ACTUATORS

.1 Damper and valve operator shall be electric and be provided for each automatic damper or valve and shall be of sufficient capacity to operate the damper or valve under all conditions and to guarantee tight close-off of valves, as specified, against system pressure encountered.

.2 Each central system damper or valve operator shall be provided with spring-return for normally closed or normally open position for fail safe operation to account for fire, low temperatures, or power interruption as indicated or as appropriate.

.3 Valve Actuator Requirements:
- .1 Construction: steel, cast iron, aluminum.
- .2 Control signal: 0-10V DC.
- .3 Positioning time: to suit application. 90 sec maximum.
- .4 Scale or dial indication of actual control valve position.
- .5 Size actuator to meet requirements and performance of control valve specifications.
- .6 For interior and perimeter terminal heating and cooling applications floating control actuators are acceptable.

.4 Damper Actuator Requirements:
- .1 Direct mount proportional type as indicated.
- .2 Operator: size to control dampers against maximum pressure and dynamic closing/opening pressure, whichever is greater.
- .3 Power requirements: 5 VA maximum at 24 V AC.
- .4 Operating range: 0 - 10 V DC or 4 - 20 mA DC.
- .5 For VAV box applications floating control type actuators may be used.
- .6 Damper actuator to drive damper from full open to full closed in less than 120 seconds.
- .7 Damper motors shall be provided with adjustable metal mounting brackets. Damper motor shall be rigidly attached so as not to deflect when operating damper from 0 to 100% position.
- .8 Damper operator arms shall be double yoke linkages with double set screws for fastening to damper shaft.
- .9 Damper operators shall be direct drive and equal to those manufactured by Belimo. Provide sufficient quantity of damper operators to provide a minimum of 5 in-lbs of torque for every square foot of damper area.

2.19 PANELS

.1 Free-standing enamelled steel cabinets with hinged and key-locked front door.

.2 Multiple panels as required to handle requirements with additional space to accommodate 25% additional capacity as required by Consultant without adding additional cabinets.

.3 Panels to be lockable with same key.

2.20 WIRING

.1 In accordance with Division 26.

.2 For wiring under 70 volts use FT6 rated wiring where wiring is not run in conduit. Other cases use FT4 wiring.

.3 Wiring must be continuous without joints.

.4 Sizes:
- .1 Field wiring to digital device: #18AWG.
- .2 Analog input and output: shielded #18 minimum solid copper.

3 Execution

3.1 INSTALLATION

.1 Install equipment, components so that manufacturer's and CSA labels are visible and legible after commissioning is complete.

.2 Install field control devices in accordance with manufacturers recommended methods, procedures and instructions.

.3 Temperature transmitters, humidity transmitters, current-to-pneumatic transducers, solenoid air valves, controllers, relays: install in NEMA I enclosure or as required for specific applications. Provide for electrolytic isolation in cases when dissimilar metals make contact.

.4 Support field-mounted panels, transmitters and sensors on pipe stands or channel brackets.

.5 Fire stopping: provide space for fire stopping in accordance with Division 7 - Firestopping. Maintain fire rating integrity.

.6 Electrical:
- .1 Complete installation in accordance with Division 26.
- .2 Modify existing starters to provide for EMCS as indicated in I/O Summaries and as indicated.
- .3 Terminate wires with screw terminal type connectors suitable for wire size, and number of terminations.
- .4 Install communication wiring in conduit.
  - .1 Provide complete conduit system to link Building Controllers, field panels and OWS(s).
  - .2 Conduit sizes to suit wiring requirements and to allow for future expansion capabilities specified for systems.
  - .3 Maximum conduit fill not to exceed 40%.

.4 Design drawings do not show conduit layout.

.5 Do not run exposed conduits in normally occupied spaces unless otherwise indicated or unless impossible to do otherwise. Consultant to review before starting Work. Wiring in mechanical rooms, wiring in service rooms and exposed wiring must be in conduit.

3.2 TEMPERATURE

.1 Stabilize to ensure minimum field adjustments or calibrations.

.2 Readily accessible and adaptable to each type of application to allow for quick easy replacement and servicing without special tools or skills.

.3 Outdoor installation:
- .1 Protect from solar radiation and wind effects by non-corroding shields.
- .2 Install in NEMA 4 enclosures.

.4 Duct installations:
- .1 Do not mount in dead air space.
- .2 Locate within sensor vibration and velocity limits.
- .3 Securely mount extended surface sensor used to sense average temperature.
- .4 Thermally isolate elements from brackets and supports to respond to air temperature only.
- .5 Support sensor element separately from coils, filter racks.

.5 Averaging duct type temperature sensors.
- .1 Install averaging element horizontally across the ductwork starting 300 mm from top of ductwork. Each additional horizontal run to be no more than 300 mm from one above it. Continue until complete cross sectional area of ductwork is covered. Use multiple sensors where single sensor does not meet required coverage.
- .2 Wire multiple sensors in series for low temperature protection applications.
- .3 Wire multiple sensors separately for temperature measurement.
- .4 Use software averaging algorithm to derive overall average for control purposes.

.6 Thermowells: install for piping installations.
- .1 Locate well in elbow where pipe diameter is less than well insertion length.
- .2 Thermowell to restrict flow by less than 30%.
- .3 Use thermal conducting paste inside wells.

3.3 PANELS

.1 Arrange for conduit and tubing entry from top, bottom or either side.

.2 Wiring and tubing within panels: locate in trays or individually clipped to back of panel.

.3 Identify wiring and conduit clearly.

3.4 MAGNEHELIC PRESSURE INDICATORS

.1 Install adjacent to fan system static pressure sensor and duct system velocity pressure sensor as reviewed by Consultant.

.2 Locations: as indicated.

3.5 PRESSURE AND DIFFERENTIAL PRESSURE SWITCHES AND SENSORS

.1 Install isolation valve and snubber on sensors between sensor and pressure source where code allows.

.1 Protect sensing elements on steam and high temperature hot water service with pigtail syphon between valve and sensor.

3.6 I/P TRANSDUCERS

.1 Install air pressure gauge on outlet.

3.7 AIR PRESSURE GAUGES

.1 Install pressure gauges on pneumatic devices, I/P, pilot positioners, motor operators, switches, relays, valves, damper operators, valve actuators.

.2 Install pressure gauge on output of auxiliary cabinet pneumatic devices.

3.8 AIR FLOW MEASURING STATIONS

.1 Protect air flow measuring assembly until cleaning of ducts is completed.

3.9 TESTING AND COMMISSIONING

.1 Calibrate and test field devices for accuracy and performance in accordance with Section 25 01 11 - EMCS: Start-up, Verification and Commissioning.

END OF SECTION

1 General

1.1 SYSTEM DESCRIPTION

.1 This section defines the manner and method by which controls function.

.2 Requirements for each type of control system operation are specified.

.3 Equipment, devices, and system components required for control systems are specified in other Sections.

1.2 SUBMITTALS FOR REVIEW

.1 Division 1: Procedures for submittals.

1.3 SUBMITTALS AT PROJECT CLOSEOUT

.1 Division 1: Submittals for project closeout.

.2 Project Record Documents: Record actual locations of components and set points of controls, including changes to sequences made after submission of shop drawings.

1.4 QUALITY ASSURANCE

.1 Design system under direct supervision of a Professional Engineer experienced in design of this Work and licensed in Canada.

2 Products

2.1 Not Used

3 Execution

3.1 GENERAL DEFINITIONS

.1 Terminal Unit Valve Position: actual or calculated position based on stroke.

.2 Damper Position: actual or calculated position based on stroke. Dampers separating building from exterior shall be complete with end switch to alarm on failure to close.

3.2 ENERGY MANAGEMENT ROUTINES

.1 The Energy Management Routines stated below shall be incorporated under each and every Sequence of Operation to which they apply. Controls Contractor shall write energy management routines into Sequence of Operation submitted for review. This includes, but is not limited to, the following:

- .1 Optimal Start/Stop: To be incorporated for each and every system being scheduled through the EMCS. Optimal start/stop to include recovery time from night setback.
- .2 Night Setback Control: To be incorporated for each and every comfort heating and cooling systems that are operational through unoccupied periods, unless noted otherwise.
- .3 Hot Water Reset: Hot water loop to be reset based on ambient conditions and space demand (indoor/outdoor reset and demand reset).
- .4 Fan Speed/Flow Rate Control: EMCS to control and optimize variable flow rate systems based on space demand reset in accordance with ASHRAE 90.1.

.5 Night Purge Control: To be incorporated for each and every comfort heating and cooling systems that are operational through unoccupied periods, unless noted otherwise.
.6 Optimized demand control ventilation both on a zone level and system level.
.7 Contractor shall establish actual schedules for all spaces with owner during training.

3.3 AIR HANDLING UNIT AHU-1 and CC-1

.1 Schedule of Operation:
.1 EMCS shall have ability to schedule occupied/unoccupied control. Initial schedule shall be determined during commissioning, assumed to be Mon – Fri: 6AM-9PM, Sat 7AM-7PM, Sun 8AM-8PM.

.2 EMCS shall control ventilation system comprised of air handling unit with hot water heating coil, coil circ pump, supply fan, return fan, chilled water coil and economizer dampers.

.3 Fan Control:
.1 When system is off (unoccupied schedule), close outside air and relief dampers and open mixed air damper 100%. System shall be on during occupied periods and as required for primary heat during unoccupied periods.
.2 At start, EMCS shall energize the supply fan and return fan. Once flow is established, system shall modulate control dampers to occupied setpoint.
.3 Supply fan speed shall modulate to maintain airflow demand as determined by space demand reset, refer to heating/cooling mode.
.4 Return fan speed shall track supply fan with flow offset based on remote exhaust airflow loads and 10% building pressurization. The balancer and the controls contractor shall establish offset for entire operating range in accordance with balancing standard utilized.
.5 Remote constant speed exhaust fans shall be monitored to determine make-up air requirement, values to be determined with balancer. (EF-2, EF-3, EF-4, EF-5, and EF-6)
.6 EMCS shall monitor high static pressure alarm sensors and alarm and shut down AHU if limits are breached.
.7 High static pressure sensors shall be located as follows:
.1 One in outside air intake duct, upstream from AHU.
.2 One in the supply air discharge plenum
.8 Failure of SF and/or RF shall shut down system and initiate alarm.
.9 Provide airflow stations to monitor gymnasium airflow, office (remaining building area) airflow and return airflow.
.10 EMCS shall modulate the office volume damper to maintain office constant airflow.
.11 EMCS shall modulate gymnasium damper in conjunction with fan to adjust gymnasium airflow to suit space.

.4 Outside Air Control:
.1 System shall incorporate differential dry-bulb economizer control to increase outside air for free cooling when ambient conditions permit.
.2 When system is not in economizer mode. The EMCS shall use flow offset to maintain ventilation rate matched to building exhaust with 10% pressurization.
.3 EMCS shall monitor CO2 in gymnasium and office and modulate outside air percentage between minimum for exhaust and ASHRAE 62 ventilation requirement to maintain CO2 setpoint.

.5 Temperature Control:
.1 EMCS shall maintain discharge air temperature based on space demand reset from the gymnasium, refer to heating mode.

.2 When cooling with economizer air, discharge air temperature shall be permitted to rise to a maximum, initially set to 17 Deg.C.

.6 Economizer Mode:

.1 When mechanical heating is required, system shall operate under minimum ventilation (Exhaust plus 10%) unles CO2 demands more fresh air.

.2 In economizer mode, economizer dampers shall modulate to maintain discharge air temperature setpoint until system is on 100% fresh air.

.3 When mechanical cooling is required, the EMCS shall continue to use 100% outside air if the outside air is 1 Deg.C. DB (adjustable) below the return air temperature.

.4 When Outside air approaches return Air (less than 1 Deg.C below exhaust air) system shall revert to minimum ventilation.

.7 Heating Mode:

.1 Discharge air shall reset between 12.8 Deg.C (55 Deg.F) and 27.2 Deg.C (81 Deg.F) to suit gymnasium space temperature, system shall operate coil pump and modulate three way control valve to maintain discharge air temperature setpoint.

.2 When heating during occupied periods, airflow for gymnasium shall be maintained at minimum until discharge temperature rises to 21 Deg.C (70 Deg.F), to be adjustable.

.3 On a further call for heat, airflow shall increase while maintaining discharge air temperature at first stage heating maximum.

.4 On a further call for heat, air temperature shall increase to maximum.

.5 When ambient temperatures fall below low temperature setpoint, initially set to 5 Deg.F. (-15 Deg.C.), the pump shall run continuously regardless of fan operation.

.6 During heating, the chilled water coil shall be off.

.8 Cooling Mode:

.1 Discharge air shall reset down to 12.8 Deg.C (55 Deg.F) to suit gymnasium space temperature. System shall operate economizer dampers or mechanical cooling with existing chilled water coil pump and modulating three way control valve on CC-1 to suit.

.2 When cooling with the economizer during occupied periods, airflow shall be permitted to increase to maximum until discharge temperature rises to economizer maximum, assumed to be 17 Deg.C (62.6 Deg.F). System shall revert to mechanical cooling once space cannot be maintained with economizer.

.3 When mechanical cooling during occupied periods, airflow for gymnasium shall be maintained at minimum until discharge temperature drops to 12.8 Deg.C (55 Deg.F).

.4 On a further call for cooling, airflow shall increase while maintaining discharge air temperature.

.5 When in cooling mode the heating coil control valve shall be closed and the coil pump off.

.9 Protection:

.1 One manually reset low temperature freeze stat located downstream of the heating coil will shut down the fans, close the outside air dampers and modulate heating coil valves to maintain the heating coil discharge air temperature. A second digital sensor shall monitor temperature downstream of heating coil but upstream of cooling coil.

.2 Monitor Relief discharge static pressure and alarm if high static setpoint is reached (Initially set to 1.5 times maximum working pressure). High static alarm shall shut down system.

.3 Monitor Outside air intake static pressure and alarm if high negative static setpoint is reached (Initially set to 1.5 times maximum working pressure). High static alarm shall shut down system.

.4 Monitor Supply discharge static pressure and alarm if high static setpoint is reached (Initially set to 1.5 times maximum working pressure. High static alarm shall shut down system.

.10 Operator Work Station: The operator will be able to view and/or modify the following.
- .1 Supply Fan: Start, Stop, Speed, Status, Alarm.
- .2 All System damper positions (each damper shall be controlled individually as follows - outside air, Mixed Air Damper, Relief Air Damper.
- .3 Freezestat digital alarm setpoint
- .4 Freezestat temperature (minimum of two sensors, one hard-wired, one digital)
- .5 Supply air discharge air temperature
- .6 Supply air discharge air temperature setpoint range (12.8 Deg.C. to 27.2 Deg.C, reset by space demand)
- .7 Pump P-3 - Start, Stop, Status, Alarm
- .8 Heating Coil control valve
- .9 Heating Coil leaving water temperature
- .10 Heating Coil entering water temperature
- .11 Gymnasium Cooling Coil control valve
- .12 Cooling Coil leaving water temperature
- .13 Cooling Coil entering water temperature
- .14 Return Air Temperature (discharge from fan)
- .15 Mixed Air Temperature (upstream of heating coil)
- .16 Return Fan: Start, Stop, Speed, Status, Alarm.
- .17 Gymnasium airflow (measured)
- .18 Change Room airflow (measured)
- .19 Office airflow (measured)
- .20 Exhaust airflow (summation of exhaust fans, each fan flow rate determined with balancer)
- .21 Return fan flow (measured)
- .22 Return fan flow offset setpoint (total supply airflow less total exhaust airflow less 10% of total exhaust airflow).

.11 Alarm Conditions:
- .1 The following system alarms will shut down the system on which the alarm occurs:
  - .1 Freeze stat trip (Mechanical)- manual reset, initial setpoint 3 Deg.C., 5 minute delay
  - .2 Supply Fan failure
  - .3 Return Fan failure
  - .4 High Negative Static on intake
  - .5 Failure of heating coil circ pump when outside air temperature is below -20 Deg.C.
  - .6 High Relief static pressure
  - .7 High supply air static pressure
- .2 The following system alarms will not shut down the system on which the alarm occurs:
  - .1 Exhaust Fan failure
  - .2 Failure of heating coil circ pump when outside air temperature is above -20 Deg.C.

3.4 HEATING PLANT

.1 Schedule of Operation:
- .1 An EMCS adjustable summer/winter flag shall enable and disable the heating plant based on date.
- .2 Within season, the EMCS shall enable the heating plant any time the ambient temperature falls below an operator adjustable low temperature setpoint, initially set to 15 Deg.C.

.2 Heat Exchanger Control:

.1 The EMCS shall control the heat exchanger (HX-1 and HX-2) low pressure steam control valves and primary pumps (P-1 and P-2), and.

.2 EMCS shall control the HWS setpoint complete with reset based on outside air and space demand. Outdoor air reset shall be initially set as follows:

Outdoor Temperature	Heating Water Supply Temperature
5 Deg.C. and above	140 Deg.F. (60 Deg.C.)
at -20 Deg.C	190 Deg.F. (87.8 Deg.C.)

.3 Provide wiring for all controls and safeties.

.4 EMCS contractor shall implement space demand reset to automatically adjust setpoint to suit space demand.

.5 EMCS algorithm shall control Lead/Lag sequence complete with alternating schedule to equalize run times. Operator shall be able to adjust the desired alternating time frame.

.6 On a call for heat, EMCS shall open isolation valve and circulate water through lead heat exchanger. Isolation valve on lag heat exchanger shall be closed. Valve positions shall be proven.

.7 Lead isolation valve shall remain open when EMCS enables primary pump during post purge or warm standby (ambient temperature below primary pump low temperature setpoint, refer to pump sequence)

.7 EMCS shall modulate the 1/3 – 2/3 steam control valves on lead heat exchanger to suit hot water supply setpoint. Valves shall be complete with position feedback.

.8 System is 100% redundant and should not require both heat exchangers to operate at the same time.

.3 Primary Heating Pump Control:

.1 An EMCS control algorithm shall provide lead/lag and alternator sequencing of the main heating Pumps P-1 and P-2. Pumps to operate in parallel and matched to heat exchanger with 100% standby.

.2 Self-sensing VFD pumps to modulate speed to suit space requirements.

.3 Pumps shall circulate on a call for heat from the space or when ambient temperatures are below primary pump low temperature setpoint, initially set to 5 Deg.C. Below this temperature, pumps shall operate continuously in accordance with sequencing.

.4 Following any pump initiation, the pump shall operate a minimum of 30 minutes before shutting off.

.5 Lead pump shall not be enabled until heat exchanger isolation valve is proven open.

.4 Operator Work Station: The operator will be able to view and/or modify the following:

.1 HX-1 Enable.

.2 HX-2 Enable.

.3 Primary Circ Pump P-1 Start, Stop, Status, Alarm (shall monitor speed from self-sensing VFD)

.4 Primary Circ Pump P-2 Start, Stop, Status, Alarm (shall monitor speed from self-sensing VFD)

.5 System seasonal shut down/start (date)

.6 Plant temperature enable flag (initially 15 Deg.C.) – disables plant above setpoint.

.7 HX hot water two-position isolation valve with feedback to prove position (both HXs)

.8 HX 1/3 modulating valve position with feedback to prove position (Both HXs)

.9 HX 2/3 modulating valve position with feedback to prove position (Both HXs)

.10 Pump auto-run setpoint (initially 5 Deg.C.) – keeps system in warm stand-by despite call for heat from space

.11 HWS temperature Setpoint (Indoor/Outdoor reset with a space demand adjustment)

.12 Plant HWS temperature

.13 Plant HWR temperature

.14 HX HWS temperature (both HXs)

.15 HX HWR temperature (may be common)
.16 outdoor air temperature
.17 HX run times (both HXs)
.18 HX lead/lag alternator setpoint
.19 Pump run times (P-1 and P-2)
.20 Pump lead/lag alternator setpoint
.21 HX-1 high temperature alarm (initially set to 93.3 deg.C)
.22 HX-2 high temperature alarm (initially set to 93.3 deg.C)

.5 Alarm Conditions:
.1 The following alarms will not shut the system down:
.1 Heat exchanger high temperature alarm (Both HXs)
.2 Pump Failure (alarm shall note pump)

3.5 GLYCOL FILL

.1 Wire any and all remote devices for the packaged glycol fill.

.2 Wire alarm from glycol fill to EMCS.

.3 Operator Work Station: The operator will be able to view and/or modify the following:
.1 System Fill Alarm.

3.6 CHILLED WATER PUMP

.1 Schedule of Operation:
.1 EMCS shall schedule existing chilled water pump. Pump operation shall be enabled when associated chiller is enabled.
.2 When system is enabled, pump shall operate on a call for mechanical cooling from CC-1 or CC-2.

.2 Operator Work Station: The operator will be able to view and/or modify the following:
.1 Chilled Water Pump P-3 Start, Stop, Status, Alarm.
.2 Building leaving water temperature
.3 Building entering water temperature

.3 Alarm Conditions:
.1 The following alarms will not shut the system down:
.1 Pump Failure

3.7 OFFICE COOLING COIL CONTROL CC-2

.1 Schedule of Operation:
.1 EMCS shall schedule occupied/unoccupied zone control. Schedule shall match office schedule.

.2 Temperature Control:
.1 When a set number of spaces, adjustable, have a call for mechanical cooling (reheat valve is closed and space is calling for cooling) the cooling coil CC-2 shall be enabled.
.2 EMCS shall control modulating three-way control valve on CC-2 to temper air to suit critical zone. Critical zone shall have reheat coil valve closed.

.4 Operator Work Station: The operator will be able to view and/or modify the following:
.1 Cooling Coil control valve position
.2 Cooling Coil leaving water temperature
.3 Cooling Coil entering water temperature

.4 Cooling coil discharge air temperature
.5 # spaces calling for cooling.
.6 # of space calling before mechanical cooling is enabled.
.7 Identification of critical zone.

3.8 OFFICE ZONE CONTROL - REHEAT

.1 Schedule of Operation:
.1 EMCS shall schedule occupied/unoccupied zone control. Initial schedule shall be as follows:

Occupied Monday to Friday: 7:00 AM to 6:00 PM

.2 Temperature Control:
.1 Wall sensor to be an adjustable sensor.
.2 Adjustable sensors shall have a midpoint setpoint with a space adjustable slider to increase and decrease setpoint by an operator adjustable amount, initially set to 1.5 Deg.C. The midpoint shall reset between an adjustable summer setpoint, initially set to 24 Deg.C and an adjustable winter setpoint, initially set to 22 Deg.C. Reset shall be based on a scheduled date.
.3 Modulate reheat coil valve to satisfy the space.
.4 When reheat valve is fully closed and space calls for more cooling, place demand call for mechanical cooling.
.5 During unoccupied periods, EMCS shall control heating to unoccupied setpoint. Cooling shall be disabled. Optimum start shall ensure space is at setpoint prior to next scheduled occupied period.

.4 Operator Work Station: The operator will be able to view and/or modify the following:
.1 Reheat coil discharge air Temperature
.2 Reheat Coil Valve Position
.3 Space temperature
.4 Space temperature median setpoint
.5 Space Temperature occupancy offset
.6 Temperature sensor occupancy adjustment limits
.7 Low temperature alarm, initially set to 10 Deg.C.

.5 Alarm Conditions: The following alarms will not shut the system down:
.1 Low temperature alarm: 15 minute delay

3.9 NEW EXHAUST FAN CONTROL (EF-3, EF-4 and EF-6)

.1 Schedule of Operation:
.1 EMCS shall schedule occupied/unoccupied control matched to air handling unit.

.2 Operator Work Station: The operator will be able to view and/or modify the following:
.1 Fan start/stop alarm (EF-3, EF-4)

.3 Alarm Conditions: The following alarms will not shut the system down:
.1 Fan failure: 1 minute delay

3.10 EXISTING EXHAUST FAN CONTROL (EF-2 and EF-5)

.1 Schedule of Operation:
.1 EMCS shall schedule occupied/unoccupied control matched to air handling unit.
.2 Controls contractor shall interrupt existing power to exhaust fan to install low voltage switch and current sensor.

.2 Operator Work Station: The operator will be able to view and/or modify the following:
.1 Fan start/stop alarm (EF-2, EF-5)

.3 Alarm Conditions: The following alarms will not shut the system down:
.1 Fan failure: 1 minute delay

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

.1 ASTM International

.1 ASTM D698-07e1, Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (600 kN-m/m3).

.2 Underwriters' Laboratories of Canada (ULC)

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Sustainable Design Submittals:

.1 Construction Waste Management:

.1 Erosion and Sedimentation Control: submit copy of erosion and sedimentation control plan in accordance with authorities having jurisdiction.

1.3 EXISTING CONDITIONS

.1 Known underground and surface utility lines and buried objects are as indicated on site plan. Contractor to verify and protect all underground and surface utility lines and buried objects.

.2 Refer to dewatering in Section 31 23 33.01 - Excavating, Trenching and Backfilling.

Part 2 Products

2.1 MATERIALS

.1 Fill material: Refer to Section 31 23 33.01 - Excavating, Trenching and Backfilling.

.2 Excavated or graded material existing on site suitable to use as fill for grading work if approved by Departmental Representative.

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 rough grading installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate in presence of Departmental Representative.

.2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 GRADING

.1 Rough grade to levels, profiles, and contours allowing for surface treatment as indicated.

.2 Rough grade to following depths below finish grades: 100 mm

.3 Slope rough grade away from building matching existing site elevations.

.4 Grade ditches to depth required for maximum run-off.

.5 Prior to placing fill over existing ground, scarify surface to depth of 150 mm minimum before placing fill over existing ground. Maintain fill and existing surface at approximately same moisture content to facilitate bonding.

.6 Compact filled and disturbed areas to maximum dry density to ASTM D698, as follows:

.1 95% under landscaped areas.

.2 97% under paved and walk areas.

.7 Do not disturb soil within branch spread of trees or shrubs to remain.

3.3 TESTING

.1 Inspection and testing of soil compaction will be carried out by testing laboratory designated by ULC. Costs of tests will be paid by Contractor.

.2 Submit testing procedure, frequency of tests, testing laboratory as designated by ULC or certified testing personnel to Departmental Representative for review.

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 and 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 existing trees, landscaping, natural features, bench marks, buildings, walkways, pavement, surface and underground utility lines which are to remain as directed by Departmental Representative. If damaged, restore to original or better condition unless directed otherwise.

.2 Maintain roads to prevent accumulation of construction related debris on roads.

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

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

- .1 ASTM C117-04, Standard Test Method for Material Finer than 0.075 mm (No.200) Sieve in Mineral Aggregates by Washing.
- .2 ASTM C136-05, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
- .3 ASTM D422-632002, Standard Test Method for Particle-Size Analysis of Soils.
- .4 ASTM D698-00ae1, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3) (600 kN-m/m3).
- .5 ASTM D1557-02e1, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3) (2,700 kN-m/m3).
- .6 ASTM D4318-05, Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

.2 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.

.3 Canadian Standards Association (CSA International)

- .1 CAN/CSA-A3000-03, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).
  - .1 CSA-A3001-03, Cementitious Materials for Use in Concrete.
- .2 CSA-A23.1/A23.2-04, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.

1.2 DEFINITIONS

.1 Unclassified excavation: excavation of deposits of whatever character encountered in Work.

.2 Topsoil:

- .1 Material capable of supporting good vegetative growth and suitable for use in top dressing, landscaping and seeding.
- .2 Material reasonably free from subsoil, clay lumps, brush, objectionable weeds, and other litter, and free from cobbles, stumps, roots, and other objectionable material larger than 25 mm (1") in any dimension.

.3 Waste material: excavated material unsuitable for use in Work or surplus to requirements.

.4 Borrow material: material obtained from locations outside area to be graded and required for construction of fill areas or for other portions of Work.

.5 Recycled fill material: material, considered inert, obtained from alternate sources and engineered to meet requirements of fill areas.

.6 Unsuitable materials:

.1 Weak, chemically unstable, and compressible materials.

.2 Frost susceptible materials:

.1 Fine grained soils with plasticity index less than 10 when tested to ASTM D4318, and gradation within limits specified when tested to ASTM C136 and ASTM D422: Sieve sizes to CAN/CGSB-8.2.

.2 Table:

Sieve Designation	% Passing
2.00 mm	100
0.10 mm	45 - 100
0.02 mm	10 - 80
0.005 mm	0 - 45

.3 Coarse grained soils containing more than 20% by mass passing 0.075 mm sieve.

.7 Unshrinkable fill: very weak mixture of cement, concrete aggregates and water that resists settlement when placed in utility trenches, and capable of being readily excavated.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

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

.1 Submit condition survey of existing conditions as described in EXISTING CONDITIONS article of this Section.

.2 Submit for review by Departmental Representative proposed dewatering methods as described in PART 3 of this Section.

.3 Submit to Departmental Representative written notice at least 7 days prior to excavation work, to ensure cross sections are taken.

.4 Submit to Departmental Representative written notice when bottom of excavation is reached.

.5 Submit to Departmental Representative results and reports as described in PART 3 of this Section.

.3 Preconstruction Submittals:

.1 Submit construction equipment list for major equipment to be used in this section prior to start of Work.

.2 Submit records of underground utility locates, indicating: location plan of existing utilities as found in field and clearance record from utility authority.

.4 Samples:

.1 Submit samples in accordance with Section 01 33 00 - Submittal Procedures.

.2 Inform Departmental Representative at least 4 weeks prior to beginning Work, of proposed source of fill materials and provide access for sampling.

.3 Submit 70 kg samples of type of fill specified including representative samples of excavated material.

.4 Ship samples prepaid to Departmental Representative, in tightly closed containers to prevent contamination and exposure to elements.

1.4 QUALITY ASSURANCE

.1 Submit design and supporting data at least 2 weeks prior to beginning Work.

.2 Design and supporting data submitted to bear stamp and signature of qualified professional engineer registered or licensed in Province of Saskatchewan, Canada.

.3 Keep design and supporting data on site.

.4 Engage services of qualified professional Engineer who is registered or licensed in Province of Saskatchewan, Canada in which Work is to be carried out to design and inspect cofferdams, shoring, bracing and underpinning required for Work.

.5 Do not use soil material until written report of soil test results are reviewed by Departmental Representative.

.6 Health and Safety Requirements:

.1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

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.

.2 Divert excess materials from landfill to local facility, where available.

1.6 EXISTING CONDITIONS

.1 Buried services:

.1 Before commencing work verify and protect location of buried services on and adjacent to site.

.2 Arrange with appropriate authority for relocation of buried services that interfere with execution of work: pay costs of relocating services.

.3 Remove obsolete buried services within 2 m of foundations: cap cut-offs.

.4 Size, depth and location of existing utilities and structures as indicated are for guidance only. Completeness and accuracy are not guaranteed.

.5 Prior to beginning excavation Work, notify applicable Departmental Representative and authorities having jurisdiction, establish location and state of use of buried utilities and structures. Contractor to clearly mark such locations to prevent disturbance during Work.

.6 Confirm locations of buried utilities by careful soil hydrovac methods and test excavations.

.7 Maintain and protect from damage, water, sewer, gas, electric, telephone and other utilities and structures encountered.

.8 Where utility lines or structures exist in area of excavation, obtain direction of Departmental Representative before removing or re-routing. Costs for such Work to be borne by the Contractor.

.9 Record location of maintained, re-routed and abandoned underground lines.

.10 Confirm locations of recent excavations adjacent to area of excavation.

.2 Existing buildings and surface features:

.1 Conduct, with Departmental Representative, condition survey of existing buildings, trees and other plants, lawns, fencing, service poles, wires, pavement, survey bench marks and monuments which may be affected by Work.

.2 Protect existing buildings and surface features from damage while Work is in progress. In event of damage, immediately make repair as directed by Departmental Representative.

.3 Where required for excavation, cut roots or branches as directed by Departmental Representative.

Part 2 Products

2.1 MATERIALS

.1 Type 1 and Type 2 fill: properties to meet the following requirements:

.1 Crushed, pit run or screened stone, gravel or sand.

.2 Gradations to be within limits specified when tested to ASTM C117 and ASTM C136. Sieve sizes to CAN/CGSB-8.1 and CAN/CGSB-8.2.

.3 Table:

Sieve Designation	% Passing	
	Aggregate Base (Type 1)	Granular Sub-base (Type 2)
75 mm	-	100
50 mm	-	-
37.5 mm	-	-
25 mm	100	-
19 mm	75-100	-
12.5 mm	-	-
9.5 mm	50-100	-
4.75 mm	30-70	22-85
2.00 mm	20-45	-
0.425 mm	10-25	5-3
0.180 mm	-	-
0.075 mm	3-8	0-10

.2 Type 3 fill: selected material from excavation or other sources, approved by Departmental Representative for use intended, unfrozen and free from rocks larger than 75 mm, cinders, ashes, sods, refuse or other deleterious materials.

.3 Unshrinkable fill: proportioned and mixed to provide:

.1 Maximum compressive strength of 0.4 MPa at 28 days.

.2 Maximum cement content of 25 kg/m³: to CSA-A3001.

.3 Minimum strength of 0.07 MPa at 24 h.

.4 Concrete aggregates: to CSA-A23.1/A23.2.

.5 Cement: Type GU.

.6 Slump: 160 to 200 mm.

.4 Geotextile filter:

.1 Non-woven synthetic fibre fabric, supplied in rolls.

.2 Composed of: minimum 85% by mass of polyester or polypropylene with inhibitors added to base plastic to resist deterioration by ultra-violet and heat exposure for 60 days.

.5 Topsoil:

.1 The mix shall be 65% loamy topsoil and 35% peat moss, by volume. Topsoil shall be a friable loam, neither heavy clay nor of a light sandy nature, and shall be capable of supporting good plant growth.

.2 The topsoil shall be taken from a source free from couch grass and other noxious weeds and grasses.

.6 Granular Drain Rock:

.1 Crushed pit run or screened stone or gravel.

.2 Gradations to be within limits specified when tested to ASTM C136 and ASTM C117. Sieve sizes to CAN/CGSB-8.1 and CAN/CGSB-8.2.

Table:

Sieve Designation	% Passing
19 mm	100
12.5 mm	-
9.5 mm	-
4.75 mm	25-85
2.00 mm	-
0.425 mm	5-30
0.180 mm	-
0.075 mm	0-10

.7 Earth fill: unfrozen, clean medium plasticity silty clay or silty clay matrix till, free of sticks, roots, stones larger than 75 mm, concrete, and other debris.

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.

3.2 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.

3.3 PREPARATION/PROTECTION

.1 Protect existing features in accordance with Section 01 56 00 - Temporary Barriers and Enclosures and applicable local regulations.

.2 Keep excavations clean, free of standing water, and loose soil.

.3 Where soil is subject to significant volume change due to change in moisture content, cover and protect to Departmental Representative approval.

.4 Protect natural and man-made features required to remain undisturbed. Unless otherwise indicated or located in an area to be occupied by new construction, protect existing trees from damage.

.5 Protect buried services that are required to remain undisturbed.

3.4 STOCKPILING

.1 Stockpile fill materials in areas designated by Departmental Representative.

.1 Stockpile granular materials in manner to prevent segregation.

.2 Protect fill materials from contamination.

.3 Implement sufficient erosion and sediment control measures to prevent sediment release off construction boundaries and into water bodies.

3.5 COFFERDAMS, SHORING, BRACING AND UNDERPINNING

.1 Maintain sides and slopes of excavations in safe condition by appropriate methods and in accordance with Section 01 35 29.06 - Health and Safety Requirements and Health and Safety Act for the Province of Saskatchewan.

.1 Where conditions are unstable, Departmental Representative to verify and advise methods.

.2 Obtain permit from authority having jurisdiction for temporary diversion of water course.

.3 Construct temporary Works to depths, heights and locations as indicated.

.4 During backfill operation:

.1 Unless otherwise indicated or directed by Departmental Representative, remove sheeting and shoring from excavations.

.2 Do not remove bracing until backfilling has reached respective levels of such bracing.

.3 Pull sheeting in increments that will ensure compacted backfill is maintained at elevation at least 500 mm above toe of sheeting.

.5 When sheeting is required to remain in place, cut off tops at elevations as indicated.

.6 Upon completion of substructure construction:

.1 Remove cofferdams, shoring and bracing.

.2 Remove excess materials from site and restore watercourses.

3.6 DEWATERING AND HEAVE PREVENTION

.1 Keep excavations free of water while Work is in progress.

.2 Provide for approval by Departmental Representative review details of proposed dewatering or heave prevention methods, including dikes, well points, and sheet pile cut-offs.

.3 Avoid excavation below groundwater table if quick condition or heave is likely to occur.

.1 Prevent piping or bottom heave of excavations by groundwater lowering, sheet pile cut-offs, or other means.

.4 Protect open excavations against flooding and damage due to surface run-off.

.5 Dispose of water in manner not detrimental to public and private property, or portion of Work completed or under construction.

.1 Provide and maintain temporary drainage ditches and other diversions outside of excavation limits.

3.7 EXCAVATION

.1 Excavate to lines, grades, elevations and dimensions as indicated and as directed by Departmental Representative.

.2 Remove all obstructions encountered during excavation.

.3 Excavation must not interfere with bearing capacity of adjacent foundations.

.4 Do not disturb soil within branch spread of trees or shrubs that are to remain.

.1 If excavating through roots, excavate by hand and cut roots with sharp axe or saw.

.5 For trench excavation, unless otherwise authorized by Departmental Representative in writing, do not excavate more than 30m of trench in advance of installation operations and do not leave open more than 15m at end of day's operation.

.6 Keep excavated and stockpiled materials safe distance away from edge of trench as directed by Departmental Representative.

.7 Restrict vehicle operations directly adjacent to open trenches.

.8 Dispose of surplus and unsuitable excavated material off site.

.9 Do not obstruct flow of surface drainage or natural watercourses.

.10 Earth bottoms of excavations to be undisturbed soil, level, free from loose, soft or organic matter.

.11 Notify Departmental Representative when bottom of excavation is reached.

.12 Obtain Departmental Representative approval of completed excavation.

.13 Remove unsuitable material from trench bottom including those that extend below required elevations to extent and depth as directed by Departmental Representative.

.14 Correct unauthorized over-excavation as follows:

.1 Fill under bearing surfaces and footings with fill concrete, Type 2 fill compacted to not less than 100% of corrected Standard Proctor maximum dry.

.2 Fill under other areas with Type 2 fill compacted to not less than 95% of corrected Standard Proctor maximum dry density.

.15 Hand trim, make firm and remove loose material and debris from excavations.

.1 Where material at bottom of excavation is disturbed, compact foundation soil to density at least equal to undisturbed soil.

.2 Clean out rock seams and fill with concrete mortar or grout to approval of Departmental Representative.

.16 Install geotextiles where indicated.

3.8 FILL TYPES AND COMPACTION

.1 Use types of fill as indicated or specified below. Compaction densities are percentages of maximum densities obtained from ASTM D698 and ASTM D1557.

.1 Exterior side of perimeter walls: use Type 3 fill to subgrade level. Compact to 95% of corrected maximum dry density.

.2 Within building area: use Type 2 to underside of base course for floor slabs. Compact to 100% of corrected maximum dry density.

.3 Under concrete slabs: provide 150 mm compacted thickness base course of Type 1 fill to underside of slab. Compact base course to 100%.

.4 Under sodded areas: refer to Section 32 92 23 - Sodding.

.5 Place unshrinkable fill in areas as indicated.

3.9 BEDDING AND SURROUND OF UNDERGROUND SERVICES

.1 Place and compact granular material for bedding and surround of underground services as indicated.

.2 Place bedding and surround material in unfrozen condition.

3.10 BACKFILLING

.1 Vibratory compaction equipment: provide list of equipment.

.2 Do not proceed with backfilling operations until completion of following:

.1 Departmental Representative has reviewed and approved installations.

.2 Departmental Representative has reviewed and approved of construction below finish grade.

.3 Inspection, testing, approval, and recording location of underground utilities.

.4 Removal of shoring and bracing; backfilling of voids with satisfactory soil material.

.3 Areas to be backfilled to be free from debris, snow, ice, water and frozen ground.

.4 Do not use backfill material which is frozen or contains ice, snow or debris.

.5 Place backfill material in uniform layers not exceeding 150 mm compacted thickness up to grades indicated. Compact each layer before placing succeeding layer.

.6 Backfilling around installations:

.1 Place bedding and surround material as specified.

.2 Do not backfill around or over cast-in-place concrete within 24 hours after placing of concrete.

.3 Place layers simultaneously on both sides of installed Work to equalize loading.

.4 Where temporary unbalanced earth pressures are liable to develop on walls or other structures:

.1 If approved by Departmental Representative, erect bracing or shoring to counteract unbalance, and leave in place until removal is approved by Departmental Representative.

.7 Place unshrinkable fill in areas as indicated.

.8 Consolidate and level unshrinkable fill with internal vibrators.

.9 Install drainage system in backfill as indicated.

3.11 RESTORATION

.1 Upon completion of Work, remove waste materials and debris in accordance to Section 01 74 21 - Construction/Demolition Waste Management and Disposal, trim slopes, and correct defects as directed by Departmental Representative.

.2 Replace topsoil as indicated and as directed by Departmental Representative.

.3 Reinstate lawns to elevation which existed before excavation.

.4 Reinstate pavements and sidewalks disturbed by excavation to thickness, structure and elevation which existed before excavation.

.5 Clean and reinstate areas affected by Work as directed by Departmental Representative.

.6 Use temporary plating to support traffic loads over unshrinkable fill for initial 24 hours.

.7 Protect newly graded areas from traffic and erosion and maintain free of trash or debris.

END OF SECTION

Part 1 General

1.1 ADMINISTRATIVE REQUIREMENTS

.1 Scheduling:

.1 Schedule sod laying to coincide with preparation of soil surface.

.2 Schedule sod installation when frost is not present in ground.

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 sod, geotextile and fertilizer and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Submit 1 copy of WHMIS MSDS in accordance with Section 01 35 29.06 - Health and Safety Requirements.

.3 Certificates: submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements of seed mix, seed purity, and sod quality.

1.3 QUALITY ASSURANCE

.1 Qualifications:

.1 Landscape Planting Supervisor: Landscape Industry Certified Technician with Softscape Installation designation.

.2 Landscape Maintenance Supervisor: Landscape Industry Certified Technician with Turf Maintenance designation.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and 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 in accordance with supplier's recommendations.

.2 Replace defective or damaged materials with new.

Part 2 Products

2.1 MATERIALS

.1 Number One Turf Grass Nursery Sod: sod that has been especially sown and cultivated in nursery fields as turf grass crop.

.1 Turf Grass Nursery Sod types:

.1 Number One Kentucky Bluegrass Sod - Fescue Sod: Nursery Sod grown solely from seed mixture of cultivars of Kentucky Bluegrass and Chewing Fescue or Creeping Red Fescue, containing not less than 75% Kentucky Bluegrass cultivars and 15% Chewing Fescue or Creeping Red Fescue cultivar.

.2 Turf Grass Nursery Sod quality:

.1 Not more than 1 broadleaf weed and up to 1% native grasses per 40 square metres.

.2 Density of sod sufficient so that no soil is visible from height of 1500 mm when mown to height of 50 mm.

.3 Mowing height limit: 35 to 65 mm.

.4 Soil portion of sod: 6 to 15 mm in thickness.

.2 Sod establishment support:

.1 Geotextile fabric: biodegradable, Non-woven synthetic fibre fabric.

.2 Wooden pegs: 17 x 8 x 200 mm.

.3 Biodegradable starch pegs: 17 x 8 x 200 mm.

.3 Water:

.1 Supplied by Departmental Representative at designated source.

.4 Fertilizer:

.1 To Canada "Fertilizers Act" and Fertilizers Regulations.

.2 Complete, synthetic, slow release with 65% of nitrogen content in water-insoluble form.

2.2 SOURCE QUALITY CONTROL

.1 Obtain written approval from Departmental Representative of sod at source.

.2 When proposed source of sod is approved, use no other source without written authorization from Departmental Representative.

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 sod installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate in presence of Departmental Representative.

.2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 PREPARATION

.1 Verify that grades are correct and prepared in accordance with Section 31 23 33 - Excavating, Trenching, and Backfilling. If discrepancies occur, notify Departmental Representative and commence work when instructed by Departmental Representative.

.2 Do not perform work under adverse field conditions such as frozen soil, excessively wet soil or soil covered with snow, ice, or standing water.

.3 Fine grade surface free of humps and hollows to smooth, even grade, to match existing elevations, to tolerance of plus or minus 8 mm, for Turf Grass Nursery Sod, surface to drain naturally.

.4 Remove and dispose of weeds; debris; stones 50 mm in diameter and larger; soil contaminated by oil, gasoline and other deleterious materials; off site in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

3.3 SOD PLACEMENT

.1 Ensure sod placement is done under supervision.

.2 Lay sod within 24 hours of being lifted if air temperature exceeds 20 degrees C.

.3 Lay sod sections in rows, joints staggered. Butt sections closely without overlapping or leaving gaps between sections. Cut out irregular or thin sections with sharp implements.

.4 Roll sod as per supplier’s written instructions. Provide close contact between sod and soil by light rolling. Use of heavy roller to correct irregularities in grade is not permitted.

3.4 SOD PLACEMENT ON SLOPES AND PEGGING

.1 Install and secure geotextile fabric in areas indicated, in accordance with manufacturer's instructions.

.2 Start laying sod at bottom of slopes.

.3 Peg sod on slopes steeper than 3 horizontal to 1 vertical, within 1 m of catch basins and within 1 m of drainage channels and ditches to following pattern:

- .1 100 mm below top edge at 200 mm on centre for first sod sections along contours of slopes.
- .2 Not less than 6 pegs per square metre.
- .3 Not less than 9 pegs per square metre in drainage structures. Adjust pattern as directed by Departmental Representative.
- .4 Drive pegs to 20 mm above soil surface of sod sections.

3.5 FERTILIZING PROGRAM

.1 Fertilize during establishment and warranty periods. Fertilize at application rates as per printed instruction from fertilizer manufacturer.

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 Keep pavement and area adjacent to site clean and free from mud, dirt, and debris at all times.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

.1 Clean and reinstate areas affected by Work.

3.7 PROTECTION BARRIERS

.1 Protect newly sodded areas from deterioration with snow fence on rigid frame.

.2 Remove protection after inspection and acceptance from Departmental Representative.

3.8 MAINTENANCE DURING ESTABLISHMENT PERIOD

.1 Perform following operations from time of installation until acceptance.

.1 Water sodded areas in sufficient quantities and at frequency required to maintain optimum soil moisture condition to depth of 75 to 100 mm.

.2 Cut grass to 50 mm when or prior to it reaching height of 75mm.

.3 Maintain sodded areas 95% weed free.

.4 Fertilize areas in accordance with fertilizing program. Spread half of required amount of fertilizer in one direction and remainder at right angles. Water immediately following application.

.5 Temporary barriers or signage to be maintained where required to protect newly established sod.

3.9 ACCEPTANCE

.1 Turf Grass Nursery Sod areas will be accepted by Departmental Representative provided that:

.1 Sodded areas are properly established.

.2 Sod is free of bare and dead spots.

.3 No surface soil is visible from height of 1500 mm when grass has been cut to height of 50 mm.

.4 Sodded areas have been cut minimum 2 times prior to acceptance.

.2 Areas sodded in fall will be accepted in following spring one month after start of growing season provided acceptance conditions are fulfilled.

.3 When environmental conditions allow, all sodded areas showing shrinkage cracks shall be top-dressed and seeded with a seed mix matching the original.

3.10 MAINTENANCE DURING WARRANTY PERIOD

.1 Perform following operations from time of acceptance until end of warranty period:

.1 Water sodded Turf Grass Nursery Sod areas at weekly intervals to obtain optimum soil moisture conditions to depth of 100 mm.

.2 Repair and resod dead or bare spots to satisfaction of Departmental Representative.

.3 Cut grass and remove clippings as directed by Departmental Representative to height as follows:

.1 Turf Grass Nursery Sod:

.1 50 mm during normal growing conditions.

.2 Cut grass at 2-week intervals or as directed by Departmental Representative, but at intervals so that approximately one third of growth is removed in single cut.

.3 Fertilize areas in accordance with fertilizing program. Spread half of required amount of fertilizer in one direction and remainder at right angles and water in well.

.4 Eliminate weeds by mechanical or chemical means to extent acceptable to Departmental Representative.

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

.1 ASTM International

.1 ASTM D698-07e1, Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3(600 kN-m/m3)).

.2 CSA International

.1 CSA A23.1/A23.2-09, Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete.

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 drainage material 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 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 accordance with manufacturer's recommendations.

.2 Store and protect from damage.

.3 Replace defective or damaged materials with new.

1.4 SITE CONDITIONS

.1 Known underground utility lines and buried objects are as indicated on plans. Locate, verify, and protect all underground services utilities prior to commencement of work.

Part 2 Products

2.1 BEDDING AND SURROUND MATERIALS

.1 Coarse filter aggregate: to CSA A23.1/A23.2, Group 1, 20-5 mm.

.2 Fine filter aggregate: to CSA A23.1/A23.2.

.3 Flexible plastic tubing and fittings: perforated, nominal inside diameter 100 mm.

.4 Geotextile filter: see Section 31 23 33.01 - Excavating, Trenching and Backfilling.

2.2 BACKFILL MATERIAL

.1 Type 2, in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.

.2 Excavated or graded material existing on site may be suitable to use if approved by Departmental Representative.

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 drainage materials installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate in presence of Departmental Representative.

.2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

.2 Make sure graded base conforms with required drainage pattern before placing bedding material.

.3 Make sure improper slopes, unstable areas, areas requiring additional compaction or other unsatisfactory conditions are corrected to approval of Departmental Representative.

3.2 BEDDING PREPARATION

.1 Cut trenches in subgrade and place bedding materials in uniform layers not exceeding 150 mm compacted thickness to depth as indicated.

.2 Shape bed true to grade and to provide continuous, uniform bearing surface for tubing.

.3 Shape transverse depressions, as required, to suit joints.

.4 Compact each layer full width of bed to at least 95% maximum density to ASTM D698.

.5 Fill excavation below design elevation of bottom of specified bedding with compacted bedding material.

3.3 PIPE OR TUBING INSTALLATION

.1 Make sure tubing interior and coupling surfaces are clean before laying.

.2 Lay perforated tubing to slope of 1:100. For pipe face perforations and coupling slots downward.

.3 Grade bedding to establish tubing slope.

.4 Install end plugs at ends of collector drains to protect tubing ends from damage and ingress of foreign material.

.5 Provide flush cleanouts where directed by Departmental Representative.

.6 Connect drainage system to building weeping tile system, as indicated.

3.4 PIPE OR TUBING SURROUND MATERIAL

.1 Upon completion of tubing laying and after Departmental Representative has reviewed and approved Work in place, surround, cover and install geotextile filter and tubing as indicated.

.2 Hand place surround material in uniform layers not exceeding 150 mm compacted thickness, as indicated. Do not drop material within 300 mm of tubing.

.3 Place layers uniformly and simultaneously on each side of tubing.

.4 Compact each layer from tubing invert to mid-height of tubing to at least 95% maximum density to ASTM D698.

.5 Compact each layer from mid-height of tubing to underside of backfill to at least 95% maximum density to ASTM D698.

.6 Place low strength unshrinkable fill where compaction cannot be achieved using mechanical methods.

3.5 BACKFILL MATERIAL

.1 Place backfill material above tubing surround in uniform layers not exceeding 150 mm compacted thickness up to grades as indicated.

.2 Compact to at least 95% maximum density to ASTM D698.

.3 Use appropriate compaction equipment.

.1 Conduct hand tamping around confined areas of pipe.

.2 Do not use water or other hydraulic means to place or consolidate backfill material.

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 and 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