



# SEPW Architecture Inc.

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PROJECT

**25A Range Renovation  
Regina, Saskatchewan**

PROJECT No.

**27/2015**

SET No.

DATE

**2016-07-21**

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**END OF SECTION**

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**Part 1            General**

**1.1                WORK COVERED BY CONTRACT DOCUMENTS**

- .1        Work of this Contract comprises of renovating approximately 750 m<sup>2</sup> of an existing firing range, new bullet trap, new target systems, new ceiling baffles, wall protection upgrades, roof and truss replacement, structural upgrades, modifications to the fire sprinkler system, modifications to the existing mechanical systems, and modifications to the electrical system. The project site is located in Regina, Saskatchewan and further identified as “25A Range Renovation, Regina, SK”.
- .2        During demolition and construction the Contractor will be responsible for protection of all existing items (electronics, plumbing fixtures, glazing, furniture, casework, etc.) that remain in the work area and areas adjacent to the work area during demolition and construction.
- .3        The Owner will complete a lead abatement of the space prior to the contractor taking the space over for construction. Though every attempt will be made to remove the lead dust from the space, it is possible that lead dust may still be found once the contractor takes over the work area. For this reason the contractor will include basic lead safety within their safety plan for the site.

**1.2                WORK SEQUENCE**

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

**1.3                CONTRACTOR USE OF PREMISES**

- .1        Coordinate use of premises under direction of Departmental Representative.
- .2        Obtain and pay for use of additional storage or work areas needed for operations under this Contract.
- .3        Cooperate with other contractors employed by the Departmental Representative for other work within the building.

**1.4                EXISTING SERVICES**

- .1        Notify Departmental Representative and utility companies of intended interruption of services and obtain required permission.
- .2        Where Work involves breaking into or connecting to existing services, give Departmental Representative 48 hours of notice for necessary interruption of mechanical or electrical service throughout course of work. 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 when directed by Departmental Representative 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.

**END OF SECTION**



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**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        Hours of operation vary. Potential for activities between 06:00 – 18:00, Monday to Sunday.
- .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 48 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        Ensure that Contractor personnel employed on site become familiar with and obey regulations including safety, fire, traffic and security regulations.
- .2        Keep within limits of work and avenues of ingress and egress.

**1.4                GENERAL PROTECTION**

- .1        Do not disrupt range activities except as permitted by Departmental Representative.
- .2        Provide temporary protection for safe movement and activities for all personnel.
- .3        Provide barricades and enclosures to restrict access to designated work areas within the building and on the roof.

**1.5                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.

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**1.6 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.

**1.7 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.

**1.8 OCCUPIED SPACES**

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

**1.9 SITE RESTRICTIONS**

- .1 Adjacent buildings are used as active firing ranges. Limit access to the range being renovated and identify path of travel for workers onto the site. Departmental Representative will provide direction for access to the area to be renovated.

**1.10 DELIVERY, STORAGE AND HANDLING OF HAZARDOUS MATERIALS**

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions and Section 01 61 00 - Common Product Requirements.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Transport hazardous materials and wastes in accordance with Transportation of Dangerous Goods Act, Transportation of Dangerous Goods Regulations, and applicable provincial regulations.
  - .1 When exporting hazardous waste to another country, ensure compliance with Export and Import of Hazardous Waste and Hazardous Recyclable Materials Regulations.
- .4 Storage and Handling Requirements:
  - .1 Co-ordinate storage of hazardous materials with Departmental Representative and abide by internal requirements for labelling and storage of materials and wastes.
  - .2 Store and handle hazardous materials and wastes in accordance with applicable federal and provincial laws, regulations, codes, and guidelines.
  - .3 Store and handle flammable and combustible materials in accordance with National Fire Code of Canada requirements.
  - .4 Keep no more than 45 litres of flammable and combustible liquids such as gasoline, kerosene and naphtha for ready use.
    - .1 Store flammable and combustible liquids in approved safety cans bearing the Underwriters' Laboratory of Canada or Factory Mutual seal of approval.

- .2 Storage of quantities of flammable and combustible liquids exceeding 45 litres for work purposes requires the written approval of the Departmental Representative.
- .5 Transfer of flammable and combustible liquids is prohibited within buildings.
- .6 Transfer flammable and combustible liquids away from open flames or heat-producing devices.
- .7 Solvents or cleaning agents must be non-flammable or have flash point above 38 degrees C.
- .8 Store flammable and combustible waste liquids for disposal in approved containers located in safe, ventilated area. Keep quantities to minimum.
- .9 Observe smoking regulations, smoking is prohibited in areas where hazardous materials are stored, used, or handled.
- .10 Storage requirements for quantities of hazardous materials and wastes in excess of 5 kg for solids, and 5 litres for liquids:
  - .1 Store hazardous materials and wastes in closed and sealed containers.
  - .2 Label containers of hazardous materials and wastes in accordance with WHMIS.
  - .3 Store hazardous materials and wastes in containers compatible with that material or waste.
  - .4 Segregate incompatible materials and wastes.
  - .5 Ensure that different hazardous materials or hazardous wastes are stored in separate containers.
  - .6 Store hazardous materials and wastes in secure storage area with controlled access.
  - .7 Maintain clear egress from storage area.
  - .8 Store hazardous materials and wastes in location that will prevent them from spilling into environment.
  - .9 Have appropriate emergency spill response equipment available near storage area, including personal protective equipment.
  - .10 Maintain inventory of hazardous materials and wastes, including product name, quantity, and date when storage began.
- .11 Ensure personnel have been trained in accordance with Workplace Hazardous Materials Information System (WHMIS) requirements.
- .12 Report spills or accidents immediately to Departmental Representative. Submit a written spill report to Departmental Representative within 24 hours of incident.
- .13 Develop Construction Waste Management Plan and Waste Reduction Workplan related to Work of this Section.
- .14 Packaging Waste Management: remove for reuse and return of pallets, crates, padding, packaging materials as specified in Construction Waste Management Plan and Waste Reduction Workplan in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

**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**



Page 1 of 2

PLEASE PRINT LEGIBLY / ALL INFORMATION MUST BE PROVIDED

<b><u>CONTRACTORS / CONSULTANTS TO COMPLETE</u></b>	
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: <p align="center"><b>RCMP Depot Security Administration</b>  <b>Attention: Security Clearances</b>  <b>Fort Dufferin Dorm, 5600 – 11 Avenue</b>  <b>Regina, SK S4P 3J7</b></p>	
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)	Depot B Blck-WindowReplacement-Construction <b>SRCL #2013-11122229</b> RCMP Project Manager: Allan Currie, NPDO
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: _____
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**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: \_\_\_\_\_

**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);

<b>CONTRACTORS/CONSULTANTS MUST PROVIDE PHOTOCOPIES OF:</b>	
<b>I HAVE ATTACHED THE FOLLOWING DOCUMENTS TO THE ABOVE NOTED FORMS:</b>	<b>YES / NO</b>
<b>1. Driver's License</b> (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). <i>Note:</i> 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.	
<b>2. Birth Certificate</b> (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). <i>Note:</i> 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:

<b>CONTRACTORS/CONSULTANTS MUST PROVIDE PHOTOCOPIES OF:</b>	
<b>I HAVE ATTACHED THE FOLLOWING DOCUMENTS TO THE ABOVE NOTED FORMS:</b>	<b>YES / NO</b>
<b>1. Driver's License</b> (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). <i>Note:</i> 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.	
<b>1. Birth Certificate</b> (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). <b>DOCUMENT MUST BE PROVIDED FOR RRS CLEARANCES – NO ALTERNATE DOCUMENTS IN LIEU OF BIRTH CERTIFICATE.</b>	
<b>2. Two current Passport Style Photographs</b> (do not have to be certified)	
<b>3. Two sets of Fingerprints</b> ("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.**



**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 \_\_\_\_\_

**1** Apartment number \_\_\_\_\_ Street number \_\_\_\_\_ Street name \_\_\_\_\_ Civic number (if applicable) \_\_\_\_\_ From Y | | | M | | | To present

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 | |





PERSONNEL SCREENING, CONSENT AND AUTHORIZATION FORM

Form header with fields for Surname and full given names, and Date of birth (Y, M, D).

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

Table with 5 rows and 5 columns: Checks Required, Applicant's initials, Name of official (print), Official's initials, Official's Telephone number.

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...

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.

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)

Form with fields for Name and title, Telephone number, Address, Facsimile number.

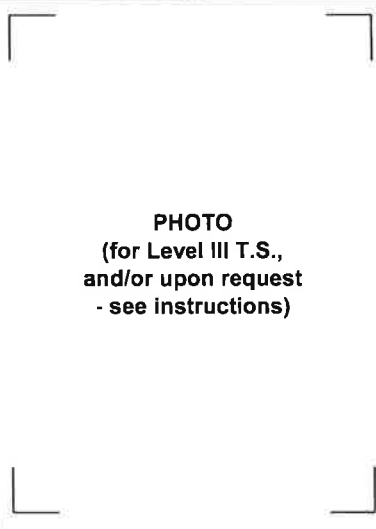
E APPROVAL (To be completed by authorized Departmental/Agency/Organizational Security Official only)

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

Reliability Status section with checkboxes for Approved and Not approved, and fields for Name and title, Signature, Date.

Security Clearance (if applicable) section with checkboxes for Level I, II, III, and Not recommended, and fields for Name and title, Signature, Date.

Comments section.







## 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, 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".

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)**

3	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	
4	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	
5	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	
6	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	
7	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	
8	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	
9	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	
10	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	
11	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	
12	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	
13	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	

**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 “4<sup>th</sup> 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.

*Updated July 22, 2013*

# SAMPLE OF COMPLETED Document

## 1 of 3



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/PRU/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): SMITH   
 Full given names (no initials) underline or circle usual name used: John (nomiddle name)   
 Family name at birth: SMITH

All other names used (i.e. Nickname): Johnny   
 Sex:  Male  Female   
 Date of birth: 11/6/01   
 Country of birth: CANADA   
 Date of entry into Canada if born outside Canada: \_\_\_\_\_

**RESIDENCE** (provide addresses for the last five years, starting with the most current)

Home address: \_\_\_\_\_   
 Daytime telephone number: (306) 201-1433   
 E-mail address: JSmith@telus.net

1	Apartment number	Street number	Street name	Civic number (if applicable)	From	To
		<u>1257</u>	<u>Cooper Avenue</u>		<u>2011001</u>	<u>present</u>
	City		Province or state	Postal code	Country	Telephone number
	<u>PEACE RIVER</u>		<u>ALBERTA</u>	<u>T63 2X9</u>	<u>CANADA</u>	<u>(780) 261-1493</u>

2	Apartment number	Street number	Street name	Civic number (if applicable)	From	To
			<u>12-13-57-W2</u>		<u>2010903</u>	<u>2011001</u>
	City		Province or state	Postal code	Country	Telephone number
	<u>GRAND CACHE</u>		<u>ALBERTA</u>	<u>TOG 7X3</u>	<u>CANADA</u>	<u>(780) 234-2102</u>

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 2011

**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): <u>DRIVING UNDER THE INFLUENCE OF ALCOHOL</u>	Name of police force: <u>EDMONTON POLICE SERVICE</u>	City: <u>EDMONTON</u>
Province/State: <u>ALBERTA</u>	Country: <u>CANADA</u>	Date of conviction: <u>2010102011</u>



2 of 3

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

**RESIDENCE (Additional Information)**

3	Apartment number	Street Number	Street Name		Civic Number (if applicable)	From		To	
						Y	M	Y	M
			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	Apartment number	Street Number	Street Name		Civic Number (if applicable)	From		To	
						Y	M	Y	M
		20	HILL AVENUE			2004	01	2007	01
	City		Province or state	Postal code	Country	Telephone number			
	CALGARY		ALBERTA	T0G3C0	CANADA	(403) 239-7186			
5	Apartment number	Street Number	Street Name		Civic Number (if applicable)	From		To	
						Y	M	Y	M
	City		Province or state	Postal code	Country	Telephone number			
6	Apartment number	Street Number	Street Name		Civic Number (if applicable)	From		To	
						Y	M	Y	M
	City		Province or state	Postal code	Country	Telephone number			
7	Apartment number	Street Number	Street Name		Civic Number (if applicable)	From		To	
						Y	M	Y	M
	City		Province or state	Postal code	Country	Telephone number			
8	Apartment number	Street Number	Street Name		Civic Number (if applicable)	From		To	
						Y	M	Y	M
	City		Province or state	Postal code	Country	Telephone number			
9	Apartment number	Street Number	Street Name		Civic Number (if applicable)	From		To	
						Y	M	Y	M
	City		Province or state	Postal code	Country	Telephone number			
10	Apartment number	Street Number	Street Name		Civic Number (if applicable)	From		To	
						Y	M	Y	M
	City		Province or state	Postal code	Country	Telephone number			
11	Apartment number	Street Number	Street Name		Civic Number (if applicable)	From		To	
						Y	M	Y	M
	City		Province or state	Postal code	Country	Telephone number			
12	Apartment number	Street Number	Street Name		Civic Number (if applicable)	From		To	
						Y	M	Y	M
	City		Province or state	Postal code	Country	Telephone number			
13	Apartment number	Street Number	Street Name		Civic Number (if applicable)	From		To	
						Y	M	Y	M
	City		Province or state	Postal code	Country	Telephone number			



**PERSONNEL SCREENING, CONSENT AND AUTHORIZATION FORM**

PROTECTED (when completed)

Surname and full given names <b>SMITH, John (nomiddle name)</b>	Date of birth <b>11 19 60   01 12 7</b>
--	--

**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. <input checked="" type="checkbox"/> Date of birth, address, education, professional qualifications, employment history, personal character references	JS			( )
2. <input checked="" type="checkbox"/> Criminal record check	JS			( )
3. <input checked="" type="checkbox"/> Credit check (financial assessment, including credit records check)	JS			( )
4. <input checked="" type="checkbox"/> Loyalty (security assessment only)	JS			( )
5. <input checked="" type="checkbox"/> 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 017 (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 006 (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

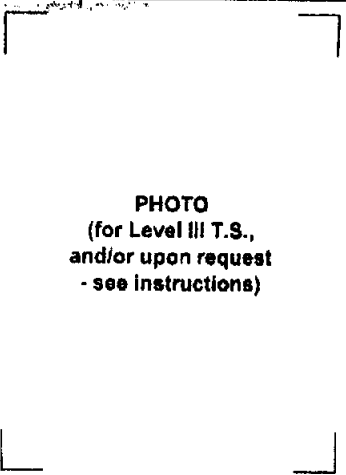
\_\_\_\_\_  
Name and title

\_\_\_\_\_  
Signature

\_\_\_\_\_  
Date (Y/M/D)

Comments

\_\_\_\_\_





INSTRUCTIONS FOR PERSONNEL SCREENING CONSENT AND AUTHORIZATION FORM TBS/SCT 330-23E (Rev. 2002/02)

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. Hereafter 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 (Rcm 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)



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**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    The Consultant shall chair 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**

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

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**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**

**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 where required in the specifications, shop drawings bearing stamp and signature of qualified 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 days for Departmental Representative's review of each submission.

- .5 Adjustments made on shop drawings by Departmental Representative are not intended to change Contract Price. If adjustments affect value of Work, state such in writing to Departmental Representative prior to proceeding with Work.
- .6 Make changes in shop drawings as Departmental Representative may require, consistent with Contract Documents. When resubmitting, notify Departmental Representative in writing of revisions other than those requested.
- .7 Accompany submissions with transmittal letter, containing:
  - .1 Date.
  - .2 Project title and number.
  - .3 Contractor's name and address.
  - .4 Identification and quantity of each shop drawing, product data and sample.
  - .5 Other pertinent data.
- .8 Submissions include:
  - .1 Date and revision dates.
  - .2 Project title and number.
  - .3 Name and address of:
    - .1 Subcontractor.
    - .2 Supplier.
    - .3 Manufacturer.
  - .4 Contractor's stamp, signed by Contractor's authorized representative certifying approval of submissions, verification of field measurements and compliance with Contract Documents.
  - .5 Details of appropriate portions of Work as applicable:
    - .1 Fabrication.
    - .2 Layout, showing dimensions, including identified field dimensions, and clearances.
    - .3 Setting or erection details.
    - .4 Capacities.
    - .5 Performance characteristics.
    - .6 Standards.
    - .7 Operating weight.
    - .8 Wiring diagrams.
    - .9 Single line and schematic diagrams.
    - .10 Relationship to adjacent work.
- .9 After Departmental Representative's review, distribute copies.
- .10 Submit 6 hard copies or one electronic copy of shop drawings for each requirement requested in specification Sections and as Departmental Representative may reasonably request.
- .11 Submit 6 hard copies or one 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 6 hard copies or one 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 6 hard copies or one 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 6 hard copies of one 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 6 hard copies or one electronic copy of manufacturer's Field Reports for requirements requested in specification Sections and as requested by Departmental Representative.
  - .1 Documentation of the testing and verification actions taken by manufacturer's representative to confirm compliance with manufacturer's standards or instructions.
- .16 Submit 6 hard copies or one electronic copy of Operation and Maintenance Data for requirements requested in specification Sections and as requested by Departmental Representative.
- .17 Delete information not applicable to project.
- .18 Supplement standard information to provide details applicable to project.
- .19 If upon review by Departmental Representative, no errors or omissions are discovered or if only minor corrections are made, copies will be returned and fabrication and installation of Work may proceed. If shop drawings are rejected, noted copy will be returned and resubmission of corrected shop drawings, through same procedure indicated above, must be performed before fabrication and installation of Work may proceed.
- .20 The review of shop drawings by Departmental Representative is for sole purpose of ascertaining conformance with general concept.
  - .1 This review shall not mean that 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.
- .21 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 and as specified in each applicable Section.



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**1.5 PROGRESS PHOTOGRAPHS**

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Project identification: name and number of project and date of exposure indicated.
- .3 Submit construction progress photographs as work proceeds. 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 Digital photographs stored on CD-ROM or DVD, shall be submitted with the Operation and Maintenance Manuals. Digital photographs shall be in jpg format.

**END OF SECTION**

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

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**1.3 FILING OF NOTICE**

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

**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 Through the course of the renovation process, should any on-site contractor encounter any item suspected of being lead-contaminated they should suspend work activity and contact the project manager for further instruction on how to proceed. Every effort will be made to ensure that all lead-contaminated materials have been removed from the work area prior to contractor access. .

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**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**

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**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        Lead: The Owner will complete a lead abatement of the space prior to the contractor taking the space over for construction. Though every attempt will be made to remove the lead dust from the space, it is possible that lead dust may still be found once the contractor takes over the work area. For this reason the contractor will include basic lead safety within their safety plan for the site.
- .3        PCB: Polychlorinated Biphenyl: stop work immediately when material resembling Polychlorinated Biphenyl is encountered during demolition work. Notify Departmental Representative.
- .4        Mould: stop work immediately when material resembling mould is encountered during demolition work. Notify Departmental Representative.
- .5        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**

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**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, Owner will deduct from Contract Price difference in value between Work performed and that called for by Contract Documents, amount of which will be determined by Departmental Representative.

## **1.5 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.

**END OF SECTION**



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**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 in order to execute work expeditiously.
- .2        Remove from site all such work after use.

**1.3                WATER SUPPLY**

- .1        Departmental Representative will make available a continuous supply of potable water for construction use.

**1.4                TEMPORARY HEATING AND VENTILATION**

- .1        Maintain temperatures of minimum 10 degrees C in areas where construction is in progress.
- .2        Ventilating:
  - .1        Prevent accumulations of dust, fumes, mists, vapours or gases in areas occupied during construction.
  - .2        Provide local exhaust ventilation to prevent harmful accumulation of hazardous substances into atmosphere of occupied areas.
  - .3        Dispose of exhaust materials in manner that will not result in harmful exposure to persons.
  - .4        Ventilate storage spaces containing hazardous or volatile materials.
  - .5        Continue operation of ventilation and exhaust system for time after cessation of work process to assure removal of harmful contaminants.
- .3        Permanent heating system of building, to be used when available. Be responsible for damage to heating system if use is permitted.
- .4        On completion of Work for which permanent heating system is used, provide service maintenance to system at discretion of the Departmental Representative.
- .5        Pay costs for maintaining temporary heat, when not using permanent heating system. Owner will pay utility charges when temporary heat source is existing building equipment.
- .6        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.

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

**1.5 TEMPORARY POWER AND LIGHT**

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

**1.6 TEMPORARY COMMUNICATION FACILITIES**

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

**1.7 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.

**END OF SECTION**

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**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 INFORMATIONAL SUBMITTALS**

- .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. 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.

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**1.7 CONSTRUCTION PARKING**

- .1 Parking will be permitted on site but may be limited. Parking arrangements will be provided by 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 Provide sanitary facilities for work force in accordance with governing regulations and ordinances.
- .2 Post notices and take precautions as required by local health authorities. Keep area and premises in sanitary condition.
- .3 Contractor shall be responsible for cleaning and maintenance of designated facilities.

**1.11 CONSTRUCTION SIGNAGE**

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

**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 Do not disrupt training on site around building.

- .5 Do not block roads without obtaining approval to do so from the Departmental Representative.
- .6 Contractor's traffic on roads selected for hauling material shall not interfere with on-going training on site.
- .7 Verify adequacy of existing roads and allowable load limit on these roads. Contractor: responsible for repair of damage to roads caused by construction operations.
- .8 Provide necessary lighting, signs, barricades, and distinctive markings for safe movement of traffic.
- .9 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**

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**Part 1            General**

**1.1                INSTALLATION AND REMOVAL**

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

**1.2                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.
- .3    Provide Roof Construction Zone warning and extent or work signage.

**1.3                HOARDING**

- .1    Erect temporary site enclosure using 1.8 m high chainlink fence with steel posts spaced at maximum 2.4 m on centre. Maintain fence in good repair.
- .2    Provide one lockable truck entrance gate, one lockable aircraft 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.
- .3    Erect and maintain pedestrian walkways including roof and side covers, complete with signs and electrical lighting as required by law.
- .4    Provide barriers around trees and plants designated to remain. Protect from damage by equipment and construction procedures.

**1.1                GUARD RAILS AND BARRICADES**

- .1    Provide secure, rigid guard rails and barricades around deep excavations, open shafts, open stair wells, open edges of floors and roofs.
- .2    Provide as required by governing authorities.

**1.2                WEATHER ENCLOSURES**

- .1    Provide weather tight closures and structures to protect interior when roof is removed and to all openings required.
- .2    Provide necessary materials, equipment, and procedures for protecting openings from ingress of rain, snow, and all moisture producing weather.
- .3    Protect the existing building and its contents from weather related risks.
- .4    Mitigate and control water due to weather to protect interior from water damage.

- .5 All new and temporary construction, including equipment and accessories, shall be secured in such a manner as to preclude wind blow-off and subsequent roof, equipment, and building damage.
- .6 Close off floor areas where walls are not finished; seal off other openings; enclose building interior work for temporary heat.
- .7 Design enclosures to withstand wind pressure and snow loading.

**1.3 DUST TIGHT SCREENS**

- .1 Provide dust tight screens or insulated partitions to localize dust generating activities, and for protection of workers, finished areas of Work and public.
- .2 Maintain and relocate protection until such work is complete.
- .3 Maintain negative pressure in area of dust generating work. Exhaust directly to the exterior through hepa filter.

**1.4 ACCESS TO SITE**

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

**1.5 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.

**1.6 FIRE ROUTES**

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

**1.7 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.

**1.8 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, enclosures, 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.

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**1.9 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**



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**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. Make reasonable efforts to use recycled and recovered materials and in otherwise utilizing recycled and recovered materials in execution of work.
- .3        Defective products, whenever identified prior to completion of Work, will be rejected, regardless of previous inspections. Inspection does not relieve responsibility, but is precaution against oversight or error. Remove and replace defective products at own expense and be responsible for delays and expenses caused by rejection.
- .4        Should disputes arise as to quality or fitness of products, decision rests strictly with Departmental Representative based upon requirements of Contract Documents.
- .5        Unless otherwise indicated in specifications, maintain uniformity of manufacture for any particular or like item throughout building.
- .6        Permanent labels, trademarks and nameplates on products are not acceptable in prominent locations, except where required for operating instructions, or when located in mechanical or electrical rooms.

**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.

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**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 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.

**1.15 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 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**

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

**1.2            FORMS**

- .1            Special forms required during the course of this Work include the following;
  - .1            Building Permit
  - .2            Hot work.
  - .3            Confined space entry.
  - .4            Site steam protocol.
  - .5            Ground disturbance.
  - .6            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, sleeves, 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**

**Part 1            General**

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

**1.2                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. Remove debris and surplus materials from accessible concealed spaces.
- .3        Prior to final review remove surplus products, tools, construction machinery and equipment.
- .4        Remove waste products and debris other than that caused by Owner or other Contractors.

- .5 Remove waste materials from site at regularly scheduled times or dispose of as directed by Departmental Representative. Do not burn waste materials on site.
- .6 Make arrangements with and obtain permits from authorities having jurisdiction for disposal of waste and debris.
- .7 Clean and polish glass, hardware, wall surfaces, and mechanical and electrical fixtures. Replace broken, scratched or disfigured glass.
- .8 Remove stains, spots, marks and dirt from decorative work, electrical and mechanical fixtures, walls, and floors.
- .9 Clean lighting reflectors, lenses, and other lighting surfaces.
- .10 Vacuum clean and dust building interiors, behind grilles, louvres and screens.
- .11 Inspect finishes, fitments and equipment and ensure specified workmanship and operation.
- .12 Broom clean and wash exterior walks, steps and surfaces; rake clean other surfaces of grounds.
- .13 Remove dirt and other disfiguration from exterior surfaces.
- .14 Clean and sweep roofs, gutters, areaways, and sunken wells.
- .15 Sweep and wash clean paved areas.
- .16 Clean equipment and fixtures to sanitary condition; clean or replace filters of mechanical equipment.
- .17 Clean roofs, downspouts, and drainage systems.
- .18 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 ACTION AND INFORMATIONAL SUBMITTALS**

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

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**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**

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**Part 1            General**

**1.1                ADMINISTRATIVE REQUIREMENTS**

- .1    Acceptance of Work Procedures:
  - .1    Contractor's Inspection: Contractor and Subcontractors: 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's inspection.
  - .2    Departmental Representative's Inspection:
    - .1    Departmental Representative, Consultant, and Contractor to inspect 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, adjusted, balanced and fully operational.
    - .4    Certificates required by Boiler Inspection Branch, Fire Commissioner, and Utility companies: submitted.
    - .5    Operation of systems: demonstrated to Owner's personnel.
    - .6    Work: complete and ready for final inspection.
  - .4    Final Inspection:
    - .1    When completion tasks are done, request final inspection of Work by Departmental Representative, Consultant, and Contractor.
    - .2    When Work incomplete according to Departmental Representative and Consultant, complete outstanding items and request re-inspection.
  - .5    Declaration of Substantial Performance: when Departmental Representative and Consultant considers deficiencies and defects corrected and requirements of Contract substantially performed, make application for Certificate of Substantial Performance.
  - .6    Final Payment:
    - .1    When Departmental Representative and Consultant considers final deficiencies and defects corrected and requirements of Contract met, make application for final payment.
  - .7    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        Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .2        Prepare instructions and data using personnel experienced in maintenance and operation of described products.
- .3        Copy will be returned after final inspection, with Departmental Representative's comments.
- .4        Revise content of documents as required prior to final submittal.
- .5        Two weeks prior to Substantial Performance of the Work, submit to the Departmental Representative, four final copies of operating and maintenance manuals in English.
- .6        Ensure spare parts, maintenance materials and special tools provided are new, undamaged or defective, and of same quality and manufacture as products provided in Work.
- .7        Furnish evidence, if requested, for type, source and quality of products provided.
- .8        Defective products will be rejected, regardless of previous inspections. Replace products at own expense.
- .9        Pay costs of transportation.

**1.2                FORMAT**

- .1        Organize data as instructional manual.
- .2        Provide one (1) bound copy and two (2) PDF copies on 2 DVD or 2 CD.
- .3        Binders: cloth, hard covered, expandable, loose leaf paper size 219 x 279. Colour "black" Provide two (2) copies.
- .4        CD or DVD: closed session format, write protected and free from errors and viruses.
- .5        When multiple binders and discs are used correlate data into related consistent groupings. Identify contents of each binder on spine.
- .6        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.
- .7        Provide printed title on DVD/CD version to coincide with title on bound version.
- .8        Arrange content by systems, under Section numbers and sequence of Table of Contents.
- .9        Provide tabbed fly leaf for each separate product and system, with typed description of product and major component parts of equipment.
- .10      Text: manufacturer's printed data, or typewritten data.

- .11 Drawings: provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.

### **1.3 CONTENTS – PROJECT RECORD DOCUMENTS**

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

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

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



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

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

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

## **1.6 EQUIPMENT AND SYSTEMS**

- .1 Each Item of Equipment and Each System: include description of unit or system, and component parts. Give function, normal operation characteristics, and limiting conditions. Include performance curves, with engineering data and tests, and complete nomenclature and commercial number of replaceable parts.
- .2 Panel board circuit directories: provide electrical service characteristics, controls, and communications.
- .3 Include installed colour coded wiring diagrams.
- .4 Operating Procedures: include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter, and any special operating instructions.

- .5 Maintenance Requirements: include routine procedures and guide for trouble-shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.
- .6 Provide servicing and lubrication schedule, and list of lubricants required.
- .7 Include manufacturer's printed operation and maintenance instructions.
- .8 Include sequence of operation by controls manufacturer.
- .9 Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.
- .10 Provide installed control diagrams by controls manufacturer.
- .11 Provide Contractor's co-ordination drawings, with installed colour coded piping diagrams.
- .12 Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.
- .13 Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.
- .14 Include test and balancing reports as specified in Section 01 45 00 - Quality Control.
- .15 Additional requirements: as specified in individual specification sections.

## **1.7 MATERIALS AND FINISHES**

- .1 Building Products, Applied Materials, and Finishes: include product data, with catalogue number, size, composition, and colour and texture designations. Provide information for re-ordering custom manufactured products.
- .2 Instructions for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.
- .3 Moisture-Protection and Weather-Exposed Products: include manufacturer's recommendations for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.
- .4 Additional Requirements: as specified in individual specifications sections.

## **1.8 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) DVD or CD.
- .2 DVD or CD: closed session format, write protected and free from errors and viruses.
- .3 Provide printed title on DVD/CD version to coincide with title on Operation and maintenance manuals.
- .4 Digital photographs shall be in jpg format.
- .5 Arrange contents chronologically by date photographs were taken.
- .6 Digital photographs stored on CD-ROM or DVD, 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 to satisfaction of Departmental Representative.

**1.11 WARRANTIES AND BONDS**

- .1 Submit, warranty information made available during construction phase, to Departmental Representative for approval prior to each monthly pay estimate.
- .2 Assemble approved information in binder and submit upon acceptance of work. Organize binder as follows:
  - .1 Separate each warranty or bond with index tab sheets keyed to Table of Contents listing.
  - .2 List subcontractor, supplier, and manufacturer, with name, address, and telephone number of responsible principal.
  - .3 Obtain warranties and bonds, executed in duplicate by subcontractors, suppliers, and manufacturers, within ten days after completion of applicable item of work.
  - .4 Verify that documents are in proper form, contain full information, and are notarized.
  - .5 Co-execute submittals when required.
  - .6 Retain warranties and bonds until time specified for submittal.
- .3 Except for items put into use with Owner's permission, leave date of beginning of time of warranty until Date of Substantial Performance is determined.
- .4 Conduct joint 10 month warranty inspection, measured from time of acceptance, by Departmental Representative.
- .5 Include information contained in warranty management plan as follows:
  - .1 Roles and responsibilities of personnel associated with warranty process, including points of contact and telephone numbers within the organizations of Contractors, subcontractors, manufacturers or suppliers involved.
  - .2 Listing and status of delivery of Certificates of Warranty for extended warranty items, to include hangar doors.
  - .3 Provide list for each warranted equipment, item, feature of construction or system.
  - .4 Post copies of instructions near selected pieces of equipment where operation is critical for warranty and/or safety reasons.
- .6 Respond in a timely manner to oral or written notification of required construction warranty repair work.
- .7 Written verification will follow oral instructions. Failure to respond will be cause for the Departmental Representative to proceed with action against Contractor.

**1.12 PRE-WARRANTY CONFERENCE**

- .1 Meet with Departmental Representative, to develop understanding of requirements of this section. Schedule meeting prior to contract completion, and at time designated by Departmental Representative.
- .2 Departmental Representative will establish communication procedures for:
  - .1 Notification of construction warranty defects.
  - .2 Determine priorities for type of defect.

- .3 Determine reasonable time for response.
- .3 Provide name, telephone number and address of licensed and bonded company that is authorized to initiate and pursue construction warranty work action.
- .4 Ensure contact is located within local service area of warranted construction, is continuously available, and is responsive to inquiries for warranty work action.

**END OF SECTION**

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**Part 1            General**

**1.1                ADMINISTRATIVE REQUIREMENTS**

- .1     Demonstrate operation and maintenance of equipment and systems to Owner's personnel two weeks prior to date of substantial performance.
- .2     Owner: provide list of personnel to receive instructions, and co-ordinate their attendance at agreed-upon times.
- .3     Preparation:
  - .1     Verify conditions for demonstration and instructions comply with requirements.
  - .2     Verify designated personnel are present.
  - .3     Ensure 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 sufficient 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 Owner's personnel.

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

**END OF SECTION**

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**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 is complete.
  - .3 Fully understand Cx requirements and procedures.
  - .4 Have Cx documentation shelf-ready.

- .5 Understand completely design criteria and intent and special features.
- .6 Submit complete start-up documentation to Departmental Representative.
- .7 Have Cx schedules up-to-date.
- .8 Ensure systems have been cleaned thoroughly.
- .9 Complete TAB procedures on systems; submit TAB reports to Departmental Representative 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.
  - .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.

## **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.

- .2 Refer to requirements of ES/SOW-0101 Statement of Work for Procurement and Installation of Electronic Security Systems (CSC) and ES/SOW-0102 Statement of Work for Quality Control for Procurement and Installation of Electronic Security Systems (CSC).

**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 Schedules**

**2.1 SCHEDULE OF ARCHITECTURAL SYSTEMS**

- .1 N/A



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**2.2 CX 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 N/A
- .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 Hydronic systems:
  - .1 N/A.
- .9 HVAC and related hydronic systems:
  - .1 Test in conjunction with EMCS, and fire and smoke detection systems.
- .10 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.
- .11 Vibration isolation and seismic control measures:

- .1 Test these measures at same time as connected system.
- .12 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. Consultant to witness tests as part of Quality Assurance role.
- .13 EMCS:
  - .1 Testing and Cx to verify original performance and any modifications under this work.
- .14 Commission mechanical systems and associated equipment as follows:
  - .1 HVAC and exhaust systems:
    - .1 HVAC systems
    - .2 Exhaust systems.
  - .2 Fire and life safety systems:
    - .1 Wet pipe sprinkler systems.
  - .3 EMCS (Energy Management Control System):
    - .1 Entire EMCS system from graphic to device (point-to-point) performance verification.
- .15 Product Information forms and Performance Verification will be carried out on the following mechanical systems:
  - .1 Supply air system – 100% to be reviewed with Cx Agent after commissioning is complete.
  - .2 Exhaust air system 100% to be reviewed with Cx Agent after commissioning is complete.
  - .3 Testing and Air Balancing Report: 30% to be reviewed with Cx Agent after commissioning is complete.

## **2.3 SCHEDULE OF ELECTRICAL SYSTEMS**

- .1 The following is a listing of the building electrical systems to be commissioned:
  - .1 Low Voltage Lighting Systems
  - .2 Low Voltage Switchboards
  - .3 Lighting
  - .4 Emergency Lighting
  - .5 Exit Signs
  - .6 Fire Alarm Systems
  - .7 Communication Cable Inside Building

**2.4 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**

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**Part 1            General**

**1.1                SUMMARY**

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

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

- .1    Include the following data:
  - .1        Product manufacturer's installation instructions and recommended checks.
  - .2        Special procedures as specified in relevant technical sections.
  - .3        Items considered good installation and engineering industry practices deemed appropriate for proper and efficient operation.
- .2    Equipment manufacturer's installation/start-up check lists are acceptable for use. As deemed necessary by Departmental Representative supplemental additional data lists 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.

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

- .1    Product Information (PI) forms compiles gathered data on items of equipment produced by equipment manufacturer, includes nameplate information, parts list, operating instructions, maintenance guidelines and pertinent technical data and recommended checks that is necessary to prepare for start-up and functional testing and used during operation and maintenance of equipment. This documentation is included in the 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.

**1.4                PERFORMANCE VERIFICATION (PV) FORMS**

- .1    PV forms to be used for checks, running dynamic tests and adjustments carried out on equipment and systems to ensure correct operation, efficiently and function independently and interactively with other systems as intended with project requirements.

- .2 PV report forms include those developed by Contractor, 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.

## **1.5 COMMISSIONING FORMS**

- .1 The Consultant will develop and provide the Contractor with final project-specific Commissioning forms in hard-copy format complete with specification data.
- .2 Revise items on Commissioning forms to suit project requirements.

## **1.6 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**

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**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 Content includes:
  - .1 Review of facility and occupancy profile.
  - .2 Functional requirements.
  - .3 System philosophy, limitations of systems and emergency procedures.
  - .4 Review of system layout, equipment, components and controls.

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

**END OF SECTION**



**Part 1 General**

**1.1 REFERENCES**

- .1 Definitions:
  - .1 Hazardous Materials: dangerous substances, dangerous goods, hazardous commodities and hazardous products, include but not limited to: poisons, corrosive agents, flammable substances, ammunition, explosives, radioactive substances, or materials that endanger human health or environment if handled improperly.
  - .2 Waste Management Co-ordinator (WMC): contractor representative responsible for supervising waste management activities as well as co-ordinating related, required submittal and reporting requirements.
  - .3 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.
  - .4 Waste Reduction Workplan (WRW): written report which addresses opportunities for reduction, reuse, or recycling of materials. WRW is based on information acquired from WA.
- .2 Reference Standards:
  - .1 CSA International
    - .1 CSA S350-M1980(R2003), Code of Practice for Safety in Demolition of Structures.
  - .2 Department of Justice Canada (Jus)
    - .1 Canadian Environmental Assessment Act (CEAA), 1995, c. 37.
    - .2 Canadian Environmental Protection Act (CEPA), 1999, c. 33.
      - .1 SOR/2003-2, On-Road Vehicle and Engine Emission Regulations.
      - .2 SOR/2006-268, Regulations Amending the On-Road Vehicle and Engine Emission Regulations.
      - .3 Transportation of Dangerous Goods Act (TDGA), 1992, c. 34.
  - .3 U.S. Environmental Protection Agency (EPA)
    - .1 EPA CFR 86.098-10, Emission standards for 1998 and later model year Otto-cycle heavy-duty engines and vehicles.
    - .2 EPA CFR 86.098-11, Emission standards for 1998 and later model year diesel heavy-duty engines and vehicles.

**1.2 ADMINISTRATIVE REQUIREMENTS**

- .1 Pre-Installation Meeting:
  - .1 Convene pre-installation meeting 1 week prior to beginning work of this Section, with Contractor's Representative, Departmental Representative, and Consultants in accordance with Section 01 31 19 - Project Meetings to:

- .1 Verify project requirements.
  - .2 Verify existing site conditions adjacent to demolition work.
  - .3 Co-ordination with other construction subtrades.
- .2 Scheduling:
- .1 Employ necessary means to meet project time lines without compromising specified minimum rates of material diversion.
    - .1 In event of unforeseen delay notify Departmental Representative in writing.

### **1.3 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures and Section 01 74 21 - Construction/Demolition Waste Management Disposal.
- .2 Prior to beginning of Work on site submit detailed Waste Reduction Workplan in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal and indicate:
  - .1 Descriptions of and anticipated quantities of materials to be salvaged reused, recycled and landfilled.
  - .2 Schedule of selective demolition.
  - .3 Number and location of dumpsters.
  - .4 Anticipated frequency of tippage.
- .3 Shop Drawings:
  - .1 Submit for review and approval demolition drawings, diagrams or details showing sequence of demolition work and supporting structures and underpinning.
  - .2 Submit demolition drawings stamped and signed by professional engineer registered or licensed in Province of Saskatchewan, Canada.
- .4 Sustainable Design Submittals:
  - .1 Construction Waste Management:
    - .1 Submit project Waste Reduction Workplan highlighting recycling and salvage requirements.

### **1.4 QUALITY ASSURANCE**

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

### **1.5 SITE CONDITIONS**

- .1 Environmental protection:
  - .1 Ensure Work does not adversely affect adjacent watercourses, groundwater and wildlife, or contribute to excess air and noise pollution.
  - .2 Fires and burning of waste or materials is not permitted on site.
  - .3 Do not bury rubbish waste materials.

- .4 Do not dispose of waste or volatile materials including but not limited to: mineral spirits, oil, petroleum based lubricants, or toxic cleaning solutions into watercourses, storm or sanitary sewers.
  - .1 Ensure proper disposal procedures are maintained throughout project.
- .5 Do not pump water containing suspended materials into watercourses, storm or sanitary sewers, or onto adjacent properties.
- .6 Control disposal or runoff of water containing suspended materials or other harmful substances in accordance with authorities having jurisdiction as directed by Departmental Representative.
- .7 Protect trees, plants and foliage on site and adjacent properties where indicated.
- .8 Prevent extraneous materials from contaminating air beyond application area, by providing temporary enclosures during demolition work.
- .9 Cover or wet down dry materials and waste to prevent blowing dust and debris. Control dust on all temporary roads.

**1.6 EXISTING CONDITIONS**

- .1 If material resembling spray or trowel applied asbestos or other designated substance listed as hazardous be encountered in course of demolition, stop work, take preventative measures, and notify Departmental Representative immediately. Proceed only after receipt of written instructions have been received from Departmental Representative.
- .2 Structures to be demolished are based on their condition at time of examination prior to tendering.
  - .1 Remove, protect and store salvaged items as directed by Departmental Representative. Salvage items as identified by Departmental Representative. Deliver to Departmental Representative as directed.

**Part 2 Products**

**2.1 EQUIPMENT**

- .1 Equipment and heavy machinery:
  - .1 On-road vehicles to: CEPA-SOR/2003-2, On-Road Vehicle and Engine Emission Regulations.
  - .2 Off-road vehicles to: EPA CFR 86.098-10 and EPA CFR 86.098-11.
- .2 Leave machinery running only while in use, except where extreme temperatures prohibit shutting machinery down.

**Part 3 Execution**

**3.1 PREPARATION**

- .1 Temporary Erosion and Sedimentation Control:
  - .1 Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent

- properties and walkways, according to: requirements of authorities having jurisdiction.
- .2 Inspect, repair, and maintain erosion and sedimentation control measures during demolition.
- .3 Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal after completion of demolition work.
- .2 Protection of in-place conditions:
  - .1 Prevent movement, settlement or damage of adjacent structures, services, walks, paving, trees, landscaping, adjacent grades, and parts of existing building to remain.
    - .1 Provide bracing, shoring and underpinning as required.
    - .2 Repair damage caused by demolition as directed by Departmental Representative.
  - .2 Support affected structures and, if safety of structure being demolished, adjacent structures, or services appears to be endangered, take preventative measures, stop Work and immediately notify Departmental Representative.
  - .3 Prevent debris from blocking surface drainage system, elevators, mechanical and electrical systems which must remain in operation.
- .3 Surface Preparation:
  - .1 Disconnect and re-route electrical and telephone service lines entering portions of building to be demolished.
    - .1 Post warning signs on electrical lines and equipment which must remain energized to serve other properties during period of demolition.
  - .2 Disconnect and cap mechanical services within building where demolition to occur.
    - .1 Natural gas supply lines: remove in accordance with gas company requirements.
    - .2 Sewer and water lines: remove in accordance with authority having jurisdiction and as directed by Departmental Representative.
    - .3 Other underground services: remove and dispose of as directed by Departmental Representative.
  - .3 Do not disrupt active or energized utilities designated to remain undisturbed.

### 3.2 DEMOLITION

- .1 Do demolition work in accordance with Section 01 56 00 - Temporary Barriers and Enclosures.
- .2 Blasting operations not permitted during demolition.
- .3 Remove contaminated or dangerous materials as defined by authorities having jurisdiction, relating to environmental protection, from site and dispose of in safe manner to minimize danger at site or during disposal.
- .4 Prior to start of Work remove contaminated or hazardous materials listed as hazardous from site and dispose of in safe manner and in accordance with TDGA and other applicable requirements.

- .5 Demolish parts of structure.
- .6 To permit construction of roof structure as indicated.
- .7 Remove existing equipment, services, and obstacles where required for refinishing or making good of existing surfaces, and replace as work progresses.
- .8 At end of each day's work, leave Work in safe and stable condition.
  - .1 Protect interiors of parts not to be demolished from exterior elements at all times.
- .9 Demolish to minimize dusting. Keep materials wetted as directed by Departmental Representative.
- .10 Demolish masonry and concrete walls.
- .11 Remove structural framing.
- .12 Contain fibrous materials to minimize release of airborne fibres while being transported within facility.
- .13 Remove and dispose of demolished materials except where noted otherwise and in accordance with authorities having jurisdiction.
- .14 Use natural lighting to do Work where possible.
  - .1 Shut off lighting except those required for security purposes at end of each day.

### **3.3 CLEANING**

- .1 Develop Waste Reduction Workplan related to Work of this Section.
- .2 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
  - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.
- .3 Stockpile materials designated for alternate disposal in location which facilitates removal from site and examination by potential end markets, and which does not impede disassembly, processing, or hauling procedures.
  - .1 Label stockpiles, indicating material type and quantity.
- .4 Remove stockpiled material as directed by Departmental Representative, when it interferes with operations of project construction.

**END OF SECTION**

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**Part 1          General**

**1.1          GENERAL CONDITIONS**

- .1          The General Conditions of the Contract, Supplementary General Conditions and General Requirements are hereby made part of this section.

**1.2          WORK INCLUDED**

- .1          Form for all cast-in-place concrete indicated on drawings and subsequently remove all such forms.

**1.3          RELATED WORK**

- |    |                                |                  |
|----|--------------------------------|------------------|
| .1 | Concrete Reinforcing           | Section 03 20 00 |
| .2 | Cast-in-Place Concrete         | Section 03 30 00 |
| .3 | Concrete Finishing             | Section 03 35 00 |
| .4 | Structural Steel for Buildings | Section 05 12 23 |

**1.4          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 (R2013) and CAN/CSA-A23.1-14 as applicable to the work.
- .2          Assume full responsibility for the design and for the adequacy and safety of all formwork and falsework.
- .3          Retain a professional engineer to design falsework which consists of shoring more than one tier in height or which is a framed structure.
- .4          The design and erection of formwork and related supporting works shall comply with construction safety legislation and regulations.

**1.5          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.

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**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 A23.1-14.

**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 (R2013). 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 (R2014) 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 Waterstops: Purpose made polyvinyl chloride; 12 MPa minimum tensile strength, -46<sup>0</sup> C. to +70<sup>0</sup> C working temperature range, conforming to CGSB 41 GP 35M, Type 2.
- .6 Pre-moulded joint fillers:
  - .1 Bituminous impregnated fibreboard: ASTM D1751-04 (2013).
  - .2 Vinyl Foam: to ASTM D1752-04a (2013) Type I, flexible grade.
  - .3 Standard Cork: to ASTM D1752-04a (2013) Type II.

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**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.
- .6 Obtain Consultant's approval for use of earth forms.



### **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 Obtain Consultant's approval before framing openings in concrete beams or columns not specifically detailed on structural drawings.
- .3 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.
- .4 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.
- .5 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 WINTER CONSTRUCTION**

- .1 Remove ice and snow from within the forms.
- .2 The use of de-icing salts will not be permitted.
- .3 Unless formwork and concrete construction proceed within a heated enclosure, do not use water to clean out completed forms. Use compressed air or other means to remove foreign matter.

### **3.10 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 Grade beams - 4 days.
  - .2 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 A23.1-14.

**END OF SECTION**

**Part 1 General**

**1.1 GENERAL CONDITIONS**

- .1 The General Conditions of the Contract, Supplementary General Conditions and General Requirements are hereby made a part of this section.

**1.2 WORK INCLUDED**

- .1 Furnish and install all bonded reinforcement and associated items required and/or indicated on the Drawings for all cast-in-place concrete and reinforced masonry work.

**1.3 RELATED WORK**

- |    |                                  |                  |
|----|----------------------------------|------------------|
| .1 | Concrete Forming and Accessories | Section 03 10 00 |
| .2 | Cast-in-Place Concrete           | Section 03 30 00 |
| .3 | Concrete Finishing               | Section 03 35 00 |

**1.4 INSPECTION AND TESTING**

- .1 Upon request, provide certified copy of mill test report of steel supplied, showing physical and chemical analysis.

**1.5 REFERENCE STANDARDS**

- .1 Do reinforcing work in accordance with CAN/CSA A23.1-14 and welding of reinforcement with CSA W186-M1990 (R2012).

**1.6 SUBMITTALS**

- .1 Prepare, check and submit reinforcing steel and mesh placing drawings and bar bending and cutting schedules for all steel reinforcement shown or specified in accordance with Submittal Procedures Section 01 33 00.
- .2 All drawings and schedules shall be prepared and checked under the direct supervision of a qualified professional engineer who is experienced in this work.
- .3 Clearly indicate bar sizes, spacing, location and quantities of reinforcement, mesh, chairs, spacers and hangers with identifying code marks to permit correct placement without reference to structural drawings; to ACI - 315 Manual of Standard Practice and Metric Supplement 1977 by Reinforcing Steel Institute of Ontario.
- .4 Design and detail lap lengths and bar development lengths to CAN3 A23.3-14, unless specified on drawings.
- .5 Review of shop drawings for size and arrangement of principal and auxiliary members only. Such review will not relieve the Contractor of responsibility for general and detail dimension and fit, or any errors or omissions.

**1.7 SUBSTITUTES**

- .1 Substitution of different size bars permitted only upon written approval of the Consultant.

**1.8 DELIVERY AND STORAGE**

- .1 Reinforcing steel, welded wire fabric and accessories shall be delivered, handled and stored in a manner which prevents contamination from bond reducing or foreign matter and damage to its fabricated form.

**Part 2 Products**

**2.1 MATERIALS**

- .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 (R2014) 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 (R2014), Grade 400.
- .3 *Column ties and beam stirrups:* shall conform to the current CAN/CSA G30.18-09 (R2014), Grade 300.
- .4 *Welded wire fabric:* to CSA G30.5-M1983 (R1998). 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.

**2.2 FABRICATION**

- .1 Fabricate bends, splices and ties and supply bar supports and accessories in accordance with the requirements of CAN-A23.3-14. 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.

- .5 *Welding of reinforcing bars:* use only weldable bars, preheat and weld to CSA W186-1990 (R2012).

**Part 3 Execution**

**3.1 EXAMINATION**

- .1 Examine the work upon which this section depends and report any discrepancies to the Consultant.
- .2 Commencement of the work shall imply acceptance of conditions.

**3.2 PLACING**

- .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 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 structural 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.

The foregoing clear covers shall be maintained within 5 mm.

- .5 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.
- .6 For slabs on grade, footings or similar construction, concrete blocks may be used in place of metal chairs.
- .7 Unless detailed otherwise, all exterior slabs, walks and pads abutting building foundations to be dowelled with 15 M at 400 on centre, extending minimum 750 into slab.
- .8 Review with the Consultant, placement of reinforcement prior to concreting.
- .9 Notify the Consultant twenty-four (24) hours prior to placing concrete.

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**3.3 CLEANING**

- .1 All materials shall be clean and free of all form oil or deleterious materials.
- .2 All deleterious material shall be removed from the surface of the reinforcing steel in a manner acceptable to the Consultant.

**3.4 WELDING**

- .1 Do welding to meet requirements of CSA W186-M1990 (R2012). Have welding performed by workmen qualified under CSA W47.1-09 (2014). Welding only by written authority of the Consultant.

**END OF SECTION**

---

**Part 1      General**

**1.1          GENERAL CONDITIONS**

- .1      The General Conditions of the Contract, Supplementary General Conditions and General Requirements are hereby made part of this section.

**1.2          WORK INCLUDED**

- .1      Cast-in-Place Concrete required for this work is indicated on drawing and includes, but is not necessarily limited to:
- .1      Concrete Beams
  - .2      Concrete Slabs
  - .3      Concrete Toppings
  - .4      Finishing of all Formed Concrete Surfaces.

**1.3          RELATED WORK**

- |    |                                  |                  |
|----|----------------------------------|------------------|
| .1 | Concrete Forming and Accessories | Section 03 10 00 |
| .2 | Concrete Reinforcing             | Section 03 20 00 |
| .3 | Concrete Finishing               | Section 03 35 00 |
| .4 | Structural Steel for Buildings   | Section 05 12 23 |

**1.4          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 CAN/CSA-A23.1-14 - "Concrete Materials and Methods of Concrete Construction".

**1.5          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 Consultant and at no additional cost to the Owner.

**1.6          INSPECTION AND TESTING**

- .1      Inspection and testing will be performed by a firm approved by the Consultant 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 Consultant for approval 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 CAN/CSA-A23.2-14 "Method of Test for Concrete".
- .9 Test results will be issued to the Contractor, Consultant and Owner. Test reports are to be numbered consecutively beginning with number one.
- .10 Required retesting will be paid for by the Contractor.
- .11 The Consultant may order additional testing any time even though the required tests indicate the strength requirements have been met. In this instance, the Owner 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 CAN/CSA A23.2-14.

## **1.7 SHOP DRAWINGS**

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

## **Part 2 Products**

### **2.1 CONCRETE MATERIALS**

- .1 *Cement:* Normal - Symbol 10 and Sulphate Resistant - Symbol 50 Portland Type, to CSA A3000-13 - "Portland Cements".
- .2 *Fine and Coarse Aggregates:* conforming to CAN/CSA-A23.1-14 - "Concrete Material and Methods of Concrete Construction".
- .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 C260-10 - "Air-Entraining Admixtures for Concrete".

- .2 *Chemical:* to ASTM C494-15a - "Chemical Admixtures for Concrete"; water reducing, strength increasing type WN - normal setting.
- .3 *Pozzolanic Mineral:* to CSA A3000-13 "Supplementary Cementing Materials and Their Use in Concrete Construction", fly ash permitted only as approved by Consultant.

### 2.3 ACCESSORIES

- .1 *Vapour Barrier:* 6 mil polyethylene film, to 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 equivalents.
- .4 *Void Form: to comply with either of the following:*
  - .1 Biodegradable Void Form: biodegradable, 150 mm deep, structurally sufficient to support weight of wet concrete and other superimposed loads without collapsing until concrete has gained sufficient strength to support these loads after which time the form must promptly degrade. Do not wrap void form. Do not place void form on poly ground sheet. The onus is entirely on the Contractor and Supplier to ensure that the void form is installed to perform as intended.
  - .2 Compressible Void Form: GeoVoid (below slabs) or Geospan (below grade beams) compressible void form by Plasti-Fab designed for 150 mm soil heave, installed to supplier's specifications.
- .5 *Joint Filler:* pre moulded bituminous impregnated cane fibre board Flexcell as manufactured by Sternson or approved equal.
- .6 *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.
- .7 *Horizontal Joint Sealant:* three component chemically curing, self-levelling, polyurethane joint sealant, THC-900 as manufactured by Tremco. Colour selection by Consultant. Install strictly in accordance with manufacturer's recommendations.
- .8 *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.
- .9 *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.

- .10 *Concrete Patching Material:* pre-packaged, polymer modified, cementitious product containing graded natural aggregate, Planitop X rapid setting mortar as manufactured by Mapei Inc.
- .11 *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 a 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.
- .12 *Cement Grout Capsules:* reinforcing steel detailed to be installed in pre-placed concrete to be anchored using Lafarge Fondu Cement Grout Capsules M3RR.

**2.4 CONCRETE MIXES**

- .1 Mechanical mix concrete in accordance with the requirements of CAN/CSA A23.1-14.
- .2 All concrete shall have the following minimum properties.

Based on 2010 National Building Code

Location	Exposure Class	Comp. Strength (MPa) and Age	Aggregate	Air Entrainment	Slump
1. Piling	S-2	32 @ 56 d	40	3 – 6	80 + 30
2. Grade Beams/Curbs	S-2	32 @ 56 d	20	4 – 7	80 + 30
3. Structural Slabs	N	25 @ 28 d	20	0	80 + 30
4. Interior Topping	N	25 @ 28 d	10	0	80 + 30
5. Exterior Grade Supported Slabs	C-2	32 @ 28 d	20	5 – 8	80 + 30

Minimum cement content for Type 50 cement to be 280 kg/m<sup>3</sup>.  
Maximum free water/cement ratio for Type 50 cement to be 0.5.

Semi-lightweight concrete to have unit weight of 2075 ± 75kg/m<sup>3</sup>.  
Lightweight concrete to have unit weight of 1850 ± 75 kg/m<sup>3</sup>.

All slabs finished with dry shake hardener to contain no artificially entrained air.

- .3 Submit proposed mix design to Inspection and Testing Firm and to Consultant 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 CAN/CSA A23.1-14.
- .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 Consultant. If approved, the use of admixture will not relax cold weather placement requirements. Use calcium chloride only as approved by the Consultant.
- .6 Use set-retarding admixtures during hot weather only when approved by the Consultant.
- .7 Use of plasticizers only when approved by Consultant.

### **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 Consultant.
- .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 CONCRETE**

- .1 Place concrete in accordance with requirements of CAN/CSA A23.1-14 and as indicated on Drawings.

- .2 Notify Consultant and Inspection and Testing Firm a minimum of twenty-four (24) 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 Consultant.
- .8 Approval to place concrete shall be contingent on the formwork and reinforcing steel placement and evidence that the Contractor can place the planned casting without stopping.
- .9 Pour slabs on grade in checkerboard pattern or saw cut, as indicated on Drawings. Saw cut control joints within twenty-four (24) hours after finishing. Use 6 mm thick blades, cutting 20 mm into depth of slab thickness. Vacuum clean saw cut prior to installation of sealant.
- .10 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.

### **3.5 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 Consultant. 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 CAN/CSA A23.1-14.
- .6 Accelerator or so-called anti-freeze compounds shall *not* be permitted unless otherwise approved in writing by the Consultant.
- .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.

### **3.6 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°.
- .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 Consultant.
- .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 Consultant when hot weather conditions prevail.

### **3.7 CONSTRUCTION JOINTS AND WATERSTOPS**

- .1 The location and detail of all construction joints not detailed on the structural drawings shall be approved by the Consultant.
- .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.

### **3.8 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 Consultant. 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 Consultant.
- .4 Concrete of insufficient strength or improper consistency shall be, as required by the Consultant, 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 Consultant and in accordance with CAN/CSA A23.2-14. The test results shall be indicative of the in-place concrete.
  - .3 Load testing of the structural elements in accordance with CAN3 A23.3-14.
  - .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 Consultant.

### **3.9 PATCHING CONCRETE**

- .1 After the removal of the forms concrete surfaces may be subject to inspection by the Consultant.
- .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 Consultant.

### **3.10 ANCHOR BOLTS AND WELDMENTS**

- .1 Set anchor bolts and weldments to the following tolerances:
  - .1 Alignment:  $\pm$  3mm of location, plumb and true.
  - .2 Projection:  $\pm$  6mm of elevations called for.

### **3.11 BASE PLATES GROUTING**

- .1 Mix and place as per Manufacturer's specifications. Pack grout tightly under plates and leave no voids. Neatly finish edges.

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**3.12 CONCRETE TOPPING**

- .1 All concrete toppings indicated on drawings are to be bonded toppings.
- .2 Concrete toppings are to be bonded by either of the following methods unless specifically directed:
  - .1 Application of cement/bonding agent/sand grout to prepared base course in accordance with CAN/CSA A23.1-14, Clause 7.8.3.2.
  - .2 Application of approved bonding agent to prepared base course.
- .3 The following toppings are to be bonded specifically by application of approved bonding agent:
  - .1 All toppings cast over existing slabs.
  - .2 All interior toppings.
- .4 All existing concrete surfaces shall be cleaned and roughened in accordance with approved bonding agent manufacturer's recommendations/specifications.

**END OF SECTION**



**Part 1 General**

**1.1 GENERAL CONDITIONS**

- .1 The General Conditions of the Contract, Supplementary General Conditions and General Requirements are hereby made part of this section.

**1.2 WORK INCLUDED**

- .1 Finish separate floor toppings, slabs on fill and monolithic floor slabs.
- .2 Apply concrete hardener, sealer.
- .3 Cure finished surfaces.

**1.3 RELATED WORK**

- .1 Cast-in-Place Concrete Section 03 30 00

**Part 2 Products**

**2.1 COMPOUNDS/HARDENERS/SEALERS**

- .1 *Curing Compound:* chlorinated liquid rubber to CGSB 90-GP-1a, Type 1.
- .2 *Non-metallic Surface Sealer:* premixed natural mineral type; "Eurocure 700, by Elstro Ltd., "Flor Seal" by Sternson Ltd., "Master Seal" by Master Builders, "Sealtight CS-309" by W. R. Meadows or approved equal.
- .3 *Horizontal Joint Sealer:* three component, chemically curing, self-levelling polyurethane joint sealant. THC-900 as manufactured by Tremco. Color selection by Consultant. Install strictly in accordance with manufacturer's recommendations.
- .4 *Bonding Agent:* Approved high polymere polyvinyl acetate emulsion applied in strict accordance with manufacturer's recommendations for proposed application. Daraweld - C or approved equal.

**Part 3 Execution**

**3.1 FLOOR FINISHING**

- .1 Finish concrete floor surfaces in accordance with CAN/CSA A23.1-14.
- .2 Uniformly spread, screed and float concrete. Do not use grate tampers or mesh rollers. Do not spread concrete by vibration. Bring surfaces to levels indicated on Drawings.

- .3 Unless otherwise noted, all concrete floors which are noted in Architect's Room Finish Schedule as exposed concrete, or as receiving carpeting, resilient flooring or hardener are to be final finished to a hard, smooth dense trowelled surface free from blemishes. Final finish to achieve a "flat" floor in accordance with CAN3 A23.1-14, Table 21 Class A straight edge method to produce floor surface of pleasing characteristics.

### **3.2 TOPPINGS**

- .1 All new concrete slabs which are to receive topping or thick set tile finish are to be screeded and mechanically floated to achieve surface flatness with maximum variation of 8 mm in 3 M. Depress slabs to accommodate finish where required. Provide a scratch finish in accordance with CAN/CSA A23.1-14, Clause 7.8 to all concrete slabs receiving topping or thickset tile finish.
- .2 All concrete slabs which are to receive a concrete topping shall be cleaned free of oil and loose material.
- .3 Place dividers, edge strips, reinforcing, expansion joint assemblies and other cast-in items shown.
- .4 Just prior to placing topping, apply cement bonding agent slurry coat in accordance with CAN/CSA A23.1-09, Clause 7.8 or approved bonding agent to base slab.
- .5 Apply bonded concrete topping over prepared concrete base slab to CAN/CSA A23.1-14.
- .6 All concrete toppings to receive insulation or roofing system shall be final finished by hand or mechanical floating to within a tolerance of 8 mm in 3 M.
- .7 All concrete toppings to serve as floor surfaces are to be final finished in accordance with Item 3.1 Floor Finishing.

### **3.3 CURING AND PROTECTION**

- .1 All equipment needed for the curing and protection of the concrete shall be on hand and ready for use before actual placing is started.
- .2 All exposed non-formed surfaces shall be kept continuously moist for a minimum of seven consecutive days after placement of the concrete. The water for curing shall be clean and free from any materials that will cause staining or discolouration of the concrete. A liquid, membrane forming, curing compound shall be used under circumstances where the application of moisture is impracticable and where such compounds will not jeopardize the appearance of the concrete nor the bonding of future floor finishes.
- .3 Special curing techniques shall be employed when the concrete is subject to drying conditions such as high temperatures, low relative humidity and high winds. Concrete wall and column forms shall be kept continuously moist.
- .4 Freshly placed concrete shall be protected from the effects of direct sunshine, drying winds, cold, excessive heat and running water by the use of adequate tarpaulins or other suitable material to cover completely or enclose all freshly finished surfaces until the end of the curing period specified.

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCES**

- .1 CSA Group
  - .1 CAN/CSA-A165 Series-04(R2009), CSA Standards on Concrete Masonry Units (Consists of A165.1, A165.2 and A165.3).
  - .2 CAN/CSA-A179-04(R2009), Mortar and Grout for Unit Masonry.
  - .3 CAN/CSA-A371-04(R2009), Masonry Construction for Buildings.
- .2 International Masonry Industry All-Weather Council (IMIAC)
  - .1 Recommended Practices and Guide Specification for Cold Weather Masonry Construction.

**1.2 ADMINISTRATIVE REQUIREMENTS**

- .1 Sequencing: sequence with other work in accordance with Section 01 32 16.07 - Construction Progress Schedules - Bar (GANTT) Chart. Comply with manufacturer's written recommendations for sequencing construction operations.
- .2 Scheduling: schedule with other work in accordance with Section 01 32 16.07 - Construction Progress Schedules - Bar (GANTT) Chart.

**1.3 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for masonry and include product characteristics, performance criteria, physical size, finish and limitations.
  - .2 Submit 2 copies of WHMIS MSDS in accordance with Section 01 35 29.06 - Health and Safety Requirements.
- .3 Shop Drawings:
  - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Saskatchewan, Canada.
  - .2 Submit shop drawings detailing temporary bracing required, designed to resist wind pressure and lateral forces during installation.
- .4 Samples:
  - .1 Provide samples as follows:
    - .1 6 of each type of brick specified, including special shapes, supplemented with specific requirements in Sections.
    - .2 2 cured, coloured samples of mortar, illustrating mortar colour and colour range, supplemented with specific requirements in Section 04 05 12 - Masonry Mortar and Grout.

- .3 2 of each type of masonry accessory and flashing specified, supplemented by specific requirements in Section 04 05 23 - Masonry Accessories.
- .4 2 of each type of masonry anchorage, reinforcement and connector proposed for use, supplemented by specific requirements in Section 04 05 19 - Masonry Anchorage and Reinforcing.
- .5 Samples: used for testing and when accepted become standard for material used.
- .5 Certificates: submit manufacturer's product certificates certifying materials.
- .6 Installer Instructions: provide manufacturer's installation instructions, including storage, handling, safety, and cleaning.
- .7 Sustainable Design Submittals:
  - .1 Construction Waste Management:
    - .1 Submit project Waste Reduction Workplan highlighting recycling and salvage requirements.

#### **1.4 CLOSEOUT SUBMITTALS**

- .1 Submit manufacturer's instructions for care, cleaning and maintenance of prefaced masonry units for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

#### **1.5 QUALITY ASSURANCE**

- .1 Mock-ups:
  - .1 Construct mock-ups in accordance with Section 01 45 00 - Quality Control.
  - .2 Construct mock-up panel of exterior masonry wall construction 1200 x 1800 mm showing masonry colours and textures, use of reinforcement, ties, through-wall flashing, weep holes, jointing, pointing, coursing, mortar and quality of work.
  - .3 Mock-up used:
    - .1 To judge quality of work, substrate preparation, operation of equipment and material application.
  - .4 Construct mock-up where directed by Departmental Representative.
  - .5 Allow 48 hours for inspection of mock-up by Departmental Representative before proceeding with work.
  - .6 When accepted by Departmental Representative, mock-up will demonstrate minimum standard for this work. Mock-up may remain as part of finished work.
  - .7 Start work only upon receipt of written acceptance of mock-up by Departmental Representative.

#### **1.6 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 and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect material from damage.
  - .3 Keep materials dry until use except where wetting of bricks is specified.
  - .4 Store under waterproof cover on pallets or plank platforms held off ground by means of plank or timber skids.
  - .5 Replace defective or damaged materials with new.
- .4 Develop Waste Reduction Workplan related to Work of this Section .

## **1.7 SITE CONDITIONS**

- .1 Weather Requirements: to CAN/CSA-A371 and to IMIAC - Recommended Practices and Guide Specifications for Cold Weather Masonry Construction.
- .2 Cold weather requirements:
  - .1 To CAN/CSA-A371 with following requirements.
    - .1 Maintain temperature of mortar between 5 degrees C and 50 degrees C until batch is used or becomes stable.
    - .2 Maintain ambient temperature of masonry work and it's constituent materials between 5 degrees C and 50 degrees C and protect site from windchill.
    - .3 Maintain temperature of masonry above 0 degrees C for minimum of 28 days, after mortar is installed.
    - .4 Preheat unheated wall sections in enclosure for minimum 72 hours above 10 degrees C, before applying mortar.
  - .2 Hot weather requirements:
    - .1 Protect freshly laid masonry from drying too rapidly, by means of waterproof, non-staining coverings.
    - .2 Keep masonry dry using waterproof, non-staining coverings that extend over walls and down sides sufficient to protect walls from wind driven rain, until masonry work is completed and protected by flashings or other permanent construction.
  - .3 Spray mortar surface at intervals and keep moist for maximum of 3 days after installation.

## **1.8 WARRANTY**

- .1 For Work in this Section, 12 months warranty period is extended to 24 months.

## **Part 2 Products**

### **2.1 MATERIALS**

- .1 Masonry materials are specified in related Sections.

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**Part 3 Execution**

**3.1 INSTALLERS**

- .1 Experienced and qualified masons to carry out erection, assembly and installation of masonry work.

**3.2 EXAMINATION**

- .1 Examine conditions, substrates and work to receive work of this Section.
- .2 Examine openings to receive masonry units. Verify opening size, location, and that opening is square and plumb, and ready to receive work of this Section.
  - .1 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
  - .2 Proceed with installation after unacceptable conditions have been remedied and after receipt of written approval from Departmental Representative.
- .3 Verification of Conditions:
  - .1 Verify that:
    - .1 Substrate conditions which have been previously installed under other sections or contracts, are acceptable for product installation in accordance with manufacturer's instructions prior to installation of brick and concrete block.
    - .2 Field conditions are acceptable and are ready to receive work.
    - .3 Built-in items are in proper location, and ready for roughing into masonry work.
  - .2 Commencing installation means acceptance of existing substrates.

**3.3 PREPARATION**

- .1 Surface Preparation: prepare surface in accordance with manufacturer's written recommendations.
- .2 Establish and protect lines, levels, and coursing.
- .3 Protect adjacent materials from damage and disfiguration.

**3.4 INSTALLATION**

- .1 Do masonry work in accordance with CAN/CSA-A371 except where specified otherwise.
- .2 Build masonry plumb, level, and true to line, with vertical joints in alignment, respecting construction tolerances permitted by CAN/CSA-A371.
- .3 Layout coursing and bond to achieve correct coursing heights, and continuity of bond above and below openings, with minimum of cutting.

**3.5 CONSTRUCTION**

- .1 Exposed masonry:
  - .1 Remove chipped, cracked, and otherwise damaged units, in accordance with CAN/CSA-A165, in exposed masonry and replace with undamaged units.

- .2 Jointing:
  - .1 Allow joints to set just enough to remove excess water, then tool with round jointer to provide smooth, joints true to line, compressed, uniformly concave joints where concave joints are indicated.
  - .2 Strike flush joints concealed in walls and joints in walls to receive plaster, tile, insulation, or other applied material except paint or similar thin finish coating.
- .3 Cutting:
  - .1 Cut out for electrical switches, outlet boxes, and other recessed or built-in objects.
  - .2 Make cuts straight, clean, and free from uneven edges.
- .4 Building-In:
  - .1 Build in items required to be built into masonry.
  - .2 Prevent displacement of built-in items during construction. Check plumb, location and alignment frequently, as work progresses.
  - .3 Brace door jambs to maintain plumb. Fill spaces between jambs and masonry with mortar.
- .5 Support of loads:
  - .1 Use 32 MPa concrete to Section 03 30 00 - Cast-in-Place Concrete, where concrete fill is used in lieu of solid units.
  - .2 Use grout to CAN/CSA-A179 where grout is used in lieu of solid units.
  - .3 Install building paper below voids to be filled with concrete or grout; keep paper 25 mm back from faces of units.
- .6 Provision for movement:
  - .1 Leave 5 mm space below shelf angles.
  - .2 Leave 6 mm space between top of non-load bearing walls and partitions and structural elements. Do not use wedges.
  - .3 Built masonry to tie in with stabilizers, with provision for vertical movement.
- .7 Loose steel lintels:
  - .1 Install loose steel lintels. Center over opening width.
- .8 Control joints:
  - .1 Construct continuous control joints as indicated.
- .9 Movement joints:
  - .1 Build-in continuous movement joints as indicated.
- .10 Interface with other work:
  - .1 Cut openings in existing work as indicated.
  - .2 Openings in walls: reviewed by Consultant.
  - .3 Make good existing work. Use materials to match existing.

**3.6 SITE TOLERANCES**

- .1 Tolerances in notes to CAN/CSA-A371 apply.

**3.7 FIELD QUALITY CONTROL**

- .1 Site Tests, Inspection:
  - .1 Perform field inspection and testing in accordance with Section 01 45 00 - Quality Control.

**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 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
  - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

**3.9 PROTECTION**

- .1 Temporary Bracing:
  - .1 Provide temporary bracing of masonry work during and after erection until permanent lateral support is in place.
  - .2 Bracing approved by Departmental Representative and Consultant.
  - .3 Brace masonry walls as necessary to resist wind pressure and lateral forces during construction.
- .2 Moisture Protection:
  - .1 Keep masonry dry using waterproof, non staining coverings that extend over walls and down sides sufficient to protect walls from wind driven rain, until completed and protected by flashing or other permanent construction.
  - .2 Cover completed and partially completed work not enclosed or sheltered with waterproof covering at end of each work day. Anchor securely in position.
  - .3 Air Temperature Protection: protect completed masonry as recommended in 1.7, SITE CONDITIONS.

**END OF SECTION**



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**Part 1            General**

**1.1                REFERENCES**

- .1    CSA Group
  - .1    CSA A23.1/A23.2-09, Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete.
  - .2    CAN/CSA-A179-04(R2009), Mortar and Grout for Unit Masonry.
  - .3    CAN/CSA-A371-04(R2009), Masonry Construction for Buildings.
  - .4    CAN/CSA-A3000-08, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).
- .2    International Masonry Industry All-Weather Council (IMIAC)
  - .1    Recommended Practices and Guide Specifications for Cold Weather Masonry 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 masonry mortar and grout and include product characteristics, performance criteria, physical size, finish and limitations.
  - .2    Submit 2 copies of WHMIS MSDS in accordance with Section 01 35 29.06 - Health and Safety Requirements. Indicate VOC's mortar, grout, parging, colour additives and admixtures. Expressed as grams per litre (g/L).
- .3    Samples:
  - .1    Samples: submit unit samples in accordance with Section 04 05 00 - Common Work Results for Masonry, supplemented as follows:
    - .1    Submit two samples of coloured mortar.
    - .2    Submit samples and confirmation of source or product data sheet, prior to mixing or preparation of mortars, to Departmental Representative of:
      - .1    Aggregate: sand.
      - .2    Cement.
      - .3    Lime.
      - .4    Colour pigment samples.
- .4    Manufacturers' Instructions: submit manufacturer's installation instructions.
- .5    Sustainable Design Submittals:
  - .1    Construction Waste Management:
    - .1    Submit project Waste Reduction Workplan highlighting recycling and salvage requirements.

### **1.3 QUALITY ASSURANCE**

- .1 Test Reports: submit certified test reports including sand gradation tests in accordance with CAN/CSA-A179 showing compliance with specified performance characteristics and physical properties, and in accordance with Section 04 05 00 - Common Work Results for Masonry.
- .2 Certificates: submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.
- .3 Mock-ups:
  - .1 Construct mock-ups in accordance with Section 04 05 00 - Common Work Results for Masonry.

### **1.4 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials off ground, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect masonry mortar and grout.
  - .3 Replace defective or damaged materials with new.
- .4 Develop Waste Reduction Workplan related to Work of this.

### **1.5 SITE CONDITIONS**

- .1 Ambient Conditions: maintain materials and surrounding air temperature to:
  - .1 Minimum 5 degrees C prior to, during, and 48 hours after completion of masonry work.
  - .2 Maximum 32 degrees C prior to, during, and 48 hours after completion of masonry work.
- .2 Weather Requirements: CAN/CSA-A371 and International Masonry Industry All-Weather Council (IMIAC) - Recommended Practices and Guide Specifications for Cold Weather Masonry Construction.

## **Part 2 Products**

### **2.1 MATERIALS**

- .1 Use same brands of materials and source of aggregate for entire project.
- .2 Cement:
  - .1 Portland Cement: to CAN/CSA-A3000, Type GU - General use hydraulic cement (Type 10) white colour.
    - .1 Use low VOC products.

- .2 Masonry Cement: to CAN/CSA-A3002 and CAN/CSA-A179, Type S.
- .3 Mortar Cement: to CAN/CSA-A3002 and CAN/CSA-A179, Type S.
- .4 Packaged Dry Combined Materials for mortar: to CAN/CSA-A179, Type S, using white colour cement.
- .3 Aggregate: supplied by one supplier.
  - .1 Fine Aggregate: to CAN/CSA-A179, natural sand.
  - .2 Course Aggregate: to CAN/CSA-A179.
- .4 Water: clean and potable.
- .5 Bonding Agent: latex type.
- .6 Polymer Latex: organic polymer latex admixture of butadiene-styrene type non-emulsifiable bonding admixture.

## **2.2 COLOUR ADDITIVES**

- .1 Use colouring admixture not exceeding 10% of cement content by mass, or integrally coloured masonry cement, to produce coloured mortar to match approved sample. Admixtures to be approved prior to use. Use in accordance with the specific manufacturer's recommendations.
- .2 White mortar: to produce mortar type specified.
- .3 Powder: inorganic mineral oxide pigment; colour to match existing.

## **2.3 MORTAR MIXES**

- .1 Mortar for exterior masonry above grade:
  - .1 Load Bearing: type S based on property specifications.
  - .2 Non-Load Bearing: S based on property specifications.
- .2 Mortar for interior masonry:
  - .1 Load Bearing: type S based on property specifications.
  - .2 Non-Load Bearing: N based on property specifications.
- .3 Mortar for Parapet walls, chimneys, unprotected walls: type S based on property specifications, CAN/CSA-A179.
- .4 Pointing Mortar: CAN/CSA-A179, Type S using property specification with maximum 2 percent ammonium stearate or calcium stearate per cement weight.
- .5 Parging Mortar: type S to CAN/CSA-A179.
- .6 Following applies regardless of mortar types and uses specified above:
  - .1 Mortar for calcium silicate brick and concrete brick: type O based on proportion specifications.
  - .2 Mortar for stonework: type N based on property specifications.
  - .3 Mortar for grouted reinforced masonry: type S based on property specifications.

## **2.4 MORTAR MIXING**

- .1 Use pre-blended, pre-coloured mortar prepackaged under controlled factory conditions. Ingredients batching limitations to be within 1% accuracy.
- .2 Mix mortar ingredients in accordance with CAN/CSA-A179 in quantities needed for immediate use.
- .3 Maintain sand uniformly damp immediately before mixing process.
- .4 Add mortar colour in accordance with manufacturer's instructions. Provide uniformity of mix and colouration.
- .5 Do not use anti-freeze compounds including calcium chloride or chloride based compounds.
- .6 Do not add air entraining admixture to mortar mix.
- .7 Use a batch type mixer in accordance with CAN/CSA-A179.
- .8 Pointing mortar: prehydrate pointing mortar by mixing ingredients dry, then mix again adding just enough water to produce damp unworkable mix that will retain its form when pressed into ball. Allow to stand for not less than 1 hour no more than 2 hours then remix with sufficient water to produce mortar of proper consistency for pointing.
- .9 Re-temper mortar only within two hours of mixing, when water is lost by evaporation.
- .10 Use mortar within 2 hours after mixing at temperatures of 32 degrees C, or 2-1/2 hours at temperatures under 5 degrees C.

## **2.5 GROUT MIXES**

- .1 Bond Beams: grout mix 10 to 12.5 MPa strength at 28 days; 200-250 mm slump; premixed type in accordance with CSA A23.1/A23.2 or mixed in accordance with CAN/CSA-A179 course grout.
- .2 Lintels: grout mix 10 to 12.5 MPa strength at 28 days; 200-250 mm slump; premixed type in accordance with CSA A23.1/A23.2 or mixed in accordance with CAN/CSA-A179 coarse grout.
- .3 Grout: Minimum compressive strength of 12.5 MPa at 28 days. Maximum aggregate size and grout slump: CAN/CSA-A179.

## **2.6 GROUT MIXING**

- .1 Mix batched and delivered grout in accordance with CSA A23.1/A23.2 transit mixed.
- .2 Mix grout ingredients in quantities needed for immediate use in accordance with CAN/CSA-A179 fine and coarse grout.
- .3 Add admixtures in accordance with manufacturer's instructions; mix uniformly.
- .4 Do not use calcium chloride or chloride based admixtures.

## **2.7 MIX TESTS**

- .1 Testing Mortar Mix:

- .1 Test mortar to requirements of Section 01 45 00 - Quality Control, and in accordance with CAN/CSA-A179, for mortar based on property specification. Test prior to construction and during construction for:
  - .1 Compressive strength.
  - .2 Consistency.
  - .3 Mortar aggregate ratio.
  - .4 Sand/cement ratio.
  - .5 Water content and water/cement ratio.
  - .6 Air content.
  - .7 Splitting tensile strength.
- .2 Testing Grout Mix:
  - .1 Test grout to requirements of Section 01 45 00 - Quality Control, and in accordance with CAN/CSA-A179, for grout based on property specification. Test prior to construction and during construction for:
    - .1 Compressive strength.
    - .2 Sand/cement ratio.
    - .3 Water content and water/cement ratio.
    - .4 Slump.

### **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 masonry 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 Apply bonding agent to existing concrete surfaces.
- .2 Plug clean-out holes with brick and block masonry units. Brace masonry for wet grout pressure.

#### **3.3 CONSTRUCTION**

- .1 Do masonry mortar and grout work in accordance with CAN/CSA-A179 except where specified otherwise.
- .2 Apply parging in uniform coating not less than 10 mm thick.

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**3.4 MIXING**

- .1 All pointing mortar can be mixed using a regular paddle mixer. Only electric motor mixers are permissible. Mixers run on hydrocarbons are not permitted, due to fumes. Mixing by hand must be pre-approved by the Departmental Representative.
- .2 Clean all mixing boards and mechanical mixing machine between batches.
- .3 Mortar must be weaker than the units it is binding.
- .4 Contractor to appoint one individual to mix mortar, for duration of project. In the event that this individual must be changed, mortar mixing must cease until the new individual is trained, and mortar mix is tested.

**3.5 MORTAR PLACEMENT**

- .1 Install mortar to manufacturer's instructions.
- .2 Install mortar to requirements of CAN/CSA-A179.
- .3 Remove excess mortar from grout spaces.

**3.6 GROUT PLACEMENT**

- .1 Install grout in accordance with manufacturer's instructions.
- .2 Install grout in accordance with CAN/CSA-A179.
- .3 Work grout into masonry cores and cavities to eliminate voids.
- .4 Do not install grout in lifts greater than 400 mm, without consolidating grout by rodding.
- .5 Do not displace reinforcement while placing grout.

**3.7 FIELD QUALITY CONTROL**

- .1 Site Tests, Inspection: in accordance with Section 04 05 00 - Common Work Results for Masonry supplemented as follows:
  - .1 Test and evaluate mortar prior to construction and during construction in accordance with CAN/CSA-A179.
  - .2 Test and evaluate grout prior to construction and during construction to CAN/CSA-A179; test in conjunction with masonry unit sections specified.

**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 Remove droppings and splashings using clean sponge and water.
- .3 Clean masonry with low pressure clean water and soft natural bristle brush.
- .4 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.
- .5 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

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

**3.9 PROTECTION**

- .1 Cover completed and partially completed work not enclosed or sheltered with waterproof covering at end of each work day. Anchor securely in position.
  - .1 Mortar:
    - .1 Brick Masonry.
    - .2 Concrete Masonry Units.

**3.10 SCHEDULE**

- .1 Use white mortar for interior block walls.
- .2 Use coloured mortar for exterior masonry walls.

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCES**

- .1 ASTM International
  - .1 ASTM A36/A36M-12, Standard Specification for Carbon Structural Steel.
  - .2 ASTM A82/A82M-07, Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.
  - .3 ASTM A167-99(R2009), Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
  - .4 ASTM A307-12, Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength.
  - .5 ASTM A580/A580M-13a, Standard Specification for Stainless Steel Wire.
  - .6 ASTM A641/A641M-09a, Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire.
- .2 CSA Group
  - .1 CSA A23.1/A23.2-09, Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete.
  - .2 CAN/CSA-A179-04(R2009), Mortar and Grout for Unit Masonry.
  - .3 CAN/CSA-A370-04(R2009), Connectors for Masonry.
  - .4 CAN/CSA-A371-04(R2009), Masonry Construction for Buildings.
  - .5 CSA G30.18-09, Carbon Steel Bars for Concrete Reinforcement.
  - .6 CSA S304.1-04(R2010), Design of Masonry Structures.
  - .7 CSA W186-M1990(R2012), Welding of Reinforcing Bars in Reinforced Concrete Construction.
- .3 Reinforcing Steel Institute of Canada (RSIC)
  - .1 Reinforcing Steel Manual of Standard Practice, 2004.

**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 anchorage and reinforcing materials and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
  - .1 Submit drawings detailing bar bending details, anchorage details lists and placement drawings
  - .2 On placement drawings, indicate sizes, spacing, location and quantities of reinforcement and connectors.
- .4 Manufacturers' Instructions: submit manufacturer's installation instructions.



- .5 Sustainable Design Submittals:
  - .1 Construction Waste Management:
    - .1 Submit project Waste Reduction Workplan highlighting recycling and salvage requirements.

### **1.3 QUALITY ASSURANCE**

- .1 Test Reports: submit certified test reports including sand gradation tests in accordance with CAN/CSA-A179 showing compliance with specified performance characteristics and physical properties, and in accordance with Section 04 05 00 - Common Work Results for Masonry.
- .2 Certificates: submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.
- .3 Mock-ups:
  - .1 Construct mock-ups in accordance with Section 01 45 00 - Quality Control and requirements of Section 04 05 00 - Common Work Results for Masonry.

### **1.4 SITE MEASUREMENTS**

- .1 Make site measurements necessary to ensure proper fit of members.

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

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials off ground and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect anchorage and reinforcing materials.
  - .3 Replace defective or damaged materials with new.
- .4 Develop Waste Reduction Workplan related to Work of this.

## **Part 2 Products**

### **2.1 MATERIALS**

- .1 Bar reinforcement: Steel to CAN/CSA-A371 and CSA G30.18, Grade stainless steel to ASTM A167.
- .2 Connectors: to CAN/CSA-A370 and CSA S304.1.
- .3 Corrosion protection: to CSA S304.1, galvanized to CSA S304.1 and CAN/CSA-A370.
- .4 Ties: hot dip galvanized to CAN/CSA-A370 Table 5.2, steel finish.
  - .1 Corrugated to: CAN/CSA-A370.

- .2 Unit ties, to CAN/CSA-A370: Z style, fabricated from cold-drawn steel, size to suit application.
- .3 Adjustable Unit Ties: to CAN/CSA-A370: proprietary type ties, type, style and size to suit application in accordance with manufacturer's recommendations.
- .4 Joint Reinforcement Ties: to CAN/CSA-A370:
  - .1 Single Wythe Joint Reinforcement: ladder or truss type:
    - .1 Steel wire, hot dip galvanized: to ASTM A641, Class 1 after fabrication.
    - .2 Cold drawn steel wire conforming to ASTM A82.
  - .2 Multiple Wythe Joint Reinforcement: ladder or truss type: without moisture drip; adjustable:
    - .1 Steel wire, hot dip galvanized: to ASTM A641 Class 1 after fabrication.
    - .2 Cold drawn steel wire conforming to ASTM A82.
- .5 Anchors: to CAN/CSA-A370:
  - .1 Conventional Anchors: type steel bolts with bent bar anchors, sized to suit application.
  - .2 Wedge Anchors: expansion anchors type wedge and bolt, sized to suit application.
  - .3 Sleeve Anchors: type sleeve and bolt, sized to suit application.
  - .4 Self-Contained Anchors: type double-glass/plastic vial system, with epoxy resin and hardener.
  - .5 Dovetail Anchors: bent steel strap, galvanized to CAN/CSA-A370 Table 5.2 coated finish.
  - .6 Anchor Bolts: proprietary (patented) anchors, stainless steel.
- .6 Conventional Bolts:
  - .1 Bolts: to ASTM A36, bar stock shop threaded.
  - .2 Plate anchors: steel to ASTM A36, weld square of circular steel plate perpendicular to axis of steel bar threaded on opposite end.
  - .3 Through bolt rods: to ASTM A307 threaded rod or threaded ASTM A36 bar stock.
- .7 Adhesive Anchors: proprietary systems, pre-mixed, self-contained system with double glass vial system to contain epoxy, consisting of resin, hardener and aggregate.

## 2.2 FABRICATION

- .1 Fabricate reinforcing in accordance with CSA A23.1/A23.2 and Reinforcing Steel Manual of Standard Practice by the Reinforcing Steel Institute of Canada.
- .2 Fabricate connectors in accordance with CAN/CSA-A370.
- .3 Obtain Departmental Representative's approval for locations of reinforcement splices other than shown on placing drawings.
- .4 Upon approval of Departmental Representative, weld reinforcement in accordance with CSA W186.

- .5 Ship reinforcement and connectors, clearly identified in accordance with drawings.

### **2.3 SOURCE QUALITY CONTROL**

- .1 Upon request, provide Departmental Representative with certified copy of mill test report of reinforcement steel and connectors, showing physical and chemical analysis, minimum 5 weeks prior to commencing reinforcement work.
- .2 Upon request inform Departmental Representative of proposed source of material to be supplied.

## **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 anchorage and reinforcing 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.

### **3.2 PREPARATION**

- .1 Direct and coordinate placement of metal anchors for masonry supplied to other Sections.

### **3.3 INSTALLATION**

- .1 Supply and install masonry connectors and reinforcement in accordance with CAN/CSA-A370, CAN/CSA-A371, CSA A23.1/A23.2 and CSA S304.1 unless indicated otherwise.
- .2 Prior to placing mortar, and grout, obtain Departmental Representative's approval of placement of reinforcement and connectors.
- .3 Supply and install additional reinforcement to masonry as indicated.

### **3.4 BONDING AND TYING**

- .1 Bond walls of two or more wythes using metal connectors in accordance with CSA S304.1, CAN/CSA-A371 and as indicated.
- .2 Tie masonry veneer to backing in accordance with NBC, CSA S304.1, CAN/CSA-A371 and as indicated.
- .3 Install unit, adjustable, single wythe and multiple wythe joint reinforcement where indicated and in accordance with CAN/CSA-A370 and CAN/CSA-A371 and manufacturer's instructions.
  - .1 Bond walls of two or more wythes using metal connectors in accordance with CAN/CSA-A371 and as indicated.

- .2 Install horizontal joint reinforcement 400 mm on centre.
- .3 Place masonry joint reinforcement in first and second horizontal joints above and below openings. Extend minimum 400 mm each side of opening.
- .4 Place joint reinforcement continuous in first and second joint below top of walls.
- .5 Lap joint reinforcement ends minimum 150 mm.
- .6 Connect stack bonded unit joint corners and intersections with strap anchors 400 mm on centre.

### **3.5 REINFORCED LINTELS AND BOND BEAMS**

- .1 Reinforce masonry beams, masonry lintels and bond beams as indicated.
- .2 Place and grout reinforcement in accordance with CSA S304.1, CAN/CSA-A371, and CAN/CSA-A179.
- .3 Support and position reinforcing bars in accordance with CAN/CSA-A371.

### **3.6 GROUTING**

- .1 Grout masonry in accordance with CSA S304.1, CAN/CSA-A371 and CAN/CSA-A179 and as indicated.

### **3.7 ANCHORS**

- .1 Supply and install metal anchors in accordance with CAN/CSA-A370 and CAN/CSA-A371.

### **3.8 LATERAL SUPPORT AND ANCHORAGE**

- .1 Supply and install lateral support and anchorage in accordance with CSA S304.1 and as indicated.

### **3.9 MOVEMENT JOINTS**

- .1 Reinforcement will not be continuous across movement joints unless otherwise indicated.

### **3.10 FIELD BENDING**

- .1 Do not field bend reinforcement and connectors except where indicated or authorized by Departmental Representative.
- .2 When field bending is authorized, bend without heat, applying a slow and steady pressure.
- .3 Replace bars and connectors which develop cracks or splits.

### **3.11 FIELD QUALITY CONTROL**

- .1 Site inspections in accordance with Section 04 05 00 - Common Work Results for Masonry.
- .2 Obtain Departmental Representative approval of placement of reinforcement and connectors, prior to placing mortar and grout.

**3.12 FIELD TOUCH-UP**

- .1 Touch up damaged and cut ends of epoxy coated or galvanized reinforcement steel and connectors with compatible finish to provide continuous coating.

**3.13 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.
  - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

**END OF SECTION**

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**Part 1            General**

**1.1                REFERENCES**

- .1     Brick Industry Association (BIA)
  - .1        Technical Note No. 20-2006, Cleaning Brick Work.
- .2     CSA Group
  - .1        CAN/CSA-A82-06(R2011), Fired Masonry Brick Made From Clay or Shale.
  - .2        CAN/CSA-A165 Series-04(R2009), CSA Standards on Concrete Masonry Units (Consists of A165.1, A165.2 and A165.3).
  - .3        CAN/CSA-A371-04(R2009), Masonry Construction for Buildings.

**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 brick masonry and include product characteristics, performance criteria, physical size, finish and limitations.
- .3     Sustainable Design Submittals:
  - .1        Construction Waste Management:
    - .1            Submit project Waste Reduction Workplan highlighting recycling and salvage requirements.

**1.3                QUALITY ASSURANCE**

- .1     Test Reports: submit certified test reports including sand gradation tests in accordance with CAN/CSA-A179 showing compliance with specified performance characteristics and physical properties, and in accordance with Section 04 05 00 - Common Work Results for Masonry.
- .2     Certificates: submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.
- .3     Mock-ups:
  - .1        Construct mock-ups in accordance with Section 01 45 00 - Quality Control and requirements of Section 04 05 00 - Common Work Results for Masonry.
    - .1            Construct mock-up panel of exterior brick construction 1200 x 1800 mm.

**1.4                DELIVERY, STORAGE AND HANDLING**

- .1     Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2     Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

- .3 Storage and Handling Requirements:
  - .1 Store materials off ground and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect brick masonry from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.
- .4 Develop Waste Reduction Workplan related to Work of this Section.

## **1.5 SITE CONDITIONS**

- .1 Ambient Conditions: assemble and erect components only when temperature is above 4 degrees C.

## **Part 2 Products**

### **2.1 MANUFACTURED UNITS**

- .1 Face brick:
  - .1 Fired clay brick: to CAN/CSA-A82.
    - .1 Type: FBX.
    - .2 Grade: SW.
    - .3 Size: 90 x 57 x 190 mm to match existing.
    - .4 Blended, multi-colour configuration.
    - .5 Colours and texture: to match existing face brick on building.
    - .6 Colours and texture selected by Departmental Representative from manufacturer's complete range.
- .2 Reinforcement:
  - .1 Reinforcement in accordance with Section 04 05 19 - Masonry Anchorage and Reinforcing.
- .3 Connectors:
  - .1 Connectors in accordance with Section 04 05 19 - Masonry Anchorage and Reinforcing.
- .4 Flashings:
  - .1 Flashing: in accordance with Section 07 62 00 – Sheet Metal Flashing and Trim.
- .5 Mortar Mixes:
  - .1 Mortar and mortar mixes in accordance with Section 04 05 12 - Masonry Mortar and Grout.
- .6 Grout Mixes:
  - .1 Grout and grout mixes in accordance with Section 04 05 12 - Masonry Mortar and Grout.
- .7 Cleaning Compounds:
  - .1 Use low VOC products.

- .2 Compatible with substrate and acceptable to masonry manufacturer for use on products.
- .3 Cleaning compounds compatible with brick masonry units and in accordance with manufacturer's written recommendations and instructions.

## **2.2 EXISTING FACE BRICK**

- .1 Use hard, sound, and clean salvaged bricks only. Use only bricks without evidence of soluble salts, compatible in appearance and performance with existing.
- .2 Contractor will be responsible for carefully removing existing bricks in area of walls to be rebuilt.
- .3 Contractor will be responsible for carefully cleaning mortar off salvaged bricks and to palletize bricks in a protected area.

## **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 brick masonry 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 Protect adjacent finished materials from damage due to masonry work.

### **3.3 INSTALLATION**

- .1 Construction to conform to CAN/CSA-A371.
- .2 Bond: stretcher.
- .3 Coursing height: 200 mm for three/two bricks and three/two joints.
- .4 Jointing: concave where exposed or where paint or similar thin finish coating is specified.
  - .1 Mixing and blending: mix units within each pallet and with other pallets to ensure uniform blend of colour and texture.
  - .2 Clean unglazed clay masonry as work progresses.
  - .3 Reinforcement:
    - .1 Install reinforcing in accordance with Section 04 05 19 - Masonry Anchorage and Reinforcing.
  - .4 Connectors:



- .1 Install connectors in accordance with Section 04 05 19 - Masonry Anchorage and Reinforcing.
- .5 Flashings:
  - .1 Install flashings in accordance with Section 07 62 00 – Sheet Metal Flashing and Trim.
- .6 Mortar Placement:
  - .1 Place mortar in accordance with Section 04 05 12 - Masonry Mortar and Grout.
- .7 Grout Placement:
  - .1 Place grout in accordance with Section 04 05 12 - Masonry Mortar and Grout.
- .8 Repair/Restoration:
  - .1 Upon completion of masonry, fill holes and cracks, remove loose mortar and repair defective work.
- .9 Tolerances:
  - .1 To CAN/CSA-A371 unless noted below.

### **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 Perform cleaning as soon as possible after installation to remove construction and accumulated environmental dirt.
  - .1 Remove large particles with wood paddles without damaging surface. Saturate masonry with clean water and flush off loose mortar and dirt.
  - .2 Scrub with solution of 25 ml trisodium phosphate and 25 ml household detergent dissolved in 1 L of clean water using stiff fibre brushes, then clean off immediately with clean water using hose. Alternatively, use proprietary compound recommended by brick masonry manufacturer in accordance with manufacturer's directions.
  - .3 Repeat cleaning process as often as necessary to remove mortar and other stains.
  - .4 Use acid solution treatment for difficult to clean masonry as described in Technical Note No.20 by the Brick Industry Association.
- .3 Clean concrete brick masonry as work progresses.
  - .1 Allow mortar droppings on masonry to partially dry then remove by means of trowel, followed by rubbing lightly with small piece of brick and finally by brushing.
- .4 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.
- .5 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
  - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

**3.5 PROTECTION**

- .1 Brace and protect brick masonry in accordance with Section 04 05 00 - Common Work Results for Masonry.

**3.6 REFERENCE**



**END OF SECTION**

**Part 1 General**

**1.1 REFERENCES**

- .1 CSA Group
  - .1 CAN/CSA-A165 Series-04(R2009), CSA Standards on Concrete Masonry Units consists: A165.1, A165.2, A165.3.

**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 concrete masonry units and include product characteristics, performance criteria, physical size, finish and limitations.

**1.3 QUALITY ASSURANCE**

- .1 Certificates: submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.
- .2 Mock-ups:
  - .1 Construct mock-ups in accordance with Section 01 45 00 - Quality Control and requirements of Section 04 05 00 - Common Work Results for Masonry supplemented as follows:
    - .1 Construct mock-up panel of interior concrete unit masonry construction 1200 x 1800 mm.

**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.
  - .1 Offload concrete unit masonry packages using equipment that will not damage the surfaces.
  - .2 Do not use brick tongs to move or handle masonry.
- .3 Storage and Handling Requirements:
  - .1 Store materials in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Do not double stack cubes of concrete unit masonry.
  - .3 Cover masonry units with non-staining waterproof membrane covering.
  - .4 Allow air circulation around units.
  - .5 Installation of wet or stained masonry units is prohibited.

- .6 Keep concrete unit masonry in individual cardboard packaging provided by manufacturer until units are ready to be installed.
- .7 Store and protect concrete unit masonry from damage.
- .8 Replace defective or damaged materials with new.
- .4 Develop Waste Reduction Workplan related to Work of this.

**Part 2 Products**

**2.1 MATERIALS**

- .1 Standard concrete block units: to CAN/CSA-A165 Series (CAN/CSA-A165.1).
  - .1 Classification: H/15/A/M
  - .2 Dimensions Nominal: 200 mm wide x 200 mm high x 400 mm long and 250 mm wide x 200 mm high x 400 mm long.
  - .3 Special shapes: provide bull-nosed units for exposed corners. Provide purpose-made shapes for lintels, beams and bond beams. Provide additional special shapes as indicated.

**2.2 REINFORCEMENT**

- .1 Reinforcement in accordance with Section 04 05 19 - Masonry Anchorage and Reinforcing.

**2.3 CONNECTORS**

- .1 Connectors in accordance with Section 04 05 19 - Masonry Anchorage and Reinforcing.

**2.4 MORTAR MIXES**

- .1 Mortar and mortar mixes in accordance with Section 04 05 12 - Masonry Mortar and Grout.

**2.5 GROUT MIXES**

- .1 Grout and grout mixes in accordance with Section 04 05 12 - Masonry Mortar and Grout.

**2.6 CLEANING COMPOUNDS**

- .1 Use low VOC products.
- .2 Compatible with substrate and acceptable to masonry manufacturer for use on products.
- .3 Cleaning compounds compatible with concrete unit masonry and in accordance with manufacturer's written recommendations and instructions.

**2.7 TOLERANCES**

- .1 Tolerances for standard concrete unit masonry tolerances in accordance with CAN/CSA-A165.1, supplemented as follows:
  - .1 Maximum variation between units within specific job lot not to exceed 2 mm.

- .2 No parallel edge length, width or height dimension for individual unit to differ by more than 2 mm.
- .3 Out of square tolerance not to exceed 2 mm.

**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 concrete unit masonry installation in accordance with manufacturer's written instructions.
  - .1 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
  - .2 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

**3.2 PREPARATION**

- .1 Protect adjacent finished materials from damage due to masonry work.

**3.3 INSTALLATION**

- .1 Concrete block units:
  - .1 Bond: running.
  - .2 Coursing height: 200 mm for one block and one joint.
  - .3 Jointing: concave where exposed or where paint or other finish coating is specified.
- .2 Special Shapes:
  - .1 Install special units to form corners, returns, offsets, reveals and indents without cut ends being exposed and without losing bond or module.
  - .2 Install reinforced concrete block lintels over openings in masonry where steel or reinforced concrete lintels are not indicated.
  - .3 End bearing: not less than 200 mm.
  - .4 Install special site cut shaped units.

**3.4 REINFORCEMENT**

- .1 Install reinforcing in accordance with Section 04 05 19 - Masonry Anchorage and Reinforcing.

**3.5 CONNECTORS**

- .1 Install connectors in accordance with Section 04 05 19 - Masonry Anchorage and Reinforcing.

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**3.6 MORTAR PLACEMENT**

- .1 Place mortar in accordance with Section 04 05 12 - Masonry Mortar and Grout.

**3.7 GROUT PLACEMENT**

- .1 Place grout in accordance with Section 04 05 12 - Masonry Mortar and Grout.

**3.8 CONSTRUCTION**

- .1 Cull out masonry units, in accordance with CAN/CSA-A165 and reviewed and approved range of colour samples, with chips, cracks, broken corners, excessive colour and texture variation.
- .2 Build in miscellaneous items such as bearing plates, steel angles, bolts, anchors, inserts, sleeves and conduits.
- .3 Construct masonry walls using running bond unless otherwise noted.
- .4 Build around frames previously set and braced. Fill behind hollow frames within masonry walls with mortar or grout and embed anchors.
- .5 Fit masonry closely against electrical and plumbing outlets so collars, plates and covers overlap and conceal cuts.
- .6 Install movement joints and keep free of mortar where indicated.
- .7 Hollow Units: spread mortar setting bed from outside edge of face shells. Gauge amount of mortar on top and end of unit to create full joints, equivalent to shell thickness. Avoid excess mortar.
- .8 Solid Units: apply mortar over entire vertical and horizontal surfaces. Avoid bridging of airspace between brick veneer and backup wall with mortar.
- .9 Ensure compacted head joints. Use full or face-shell joint as indicated.
- .10 Tamp units firmly into place.
- .11 Do not adjust masonry units after mortar has set. Where resetting of masonry is required, remove, clean and reset units in new mortar.
- .12 Tool exposed joints concave; strike concealed joints flush.
- .13 After mortar has achieved initial set up, tool joints.
- .14 Do not interrupt bond below or above openings.

**3.9 REPAIR/RESTORATION**

- .1 Upon completion of masonry, fill holes and cracks, remove loose mortar and repair defective work.

**3.10 FIELD QUALITY CONTROL**

- .1 Site Tests, Inspection: in accordance with Section 04 05 00 - Common Work Results for Masonry supplemented as follows:
- .2 Manufacturer's Field Services: in accordance with Section 04 05 00 - Common Work Results for Masonry.

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**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 Standard Concrete Unit Masonry:
    - .1 Allow mortar droppings on masonry to partially dry then remove by means of trowel, followed by rubbing lightly with small piece of block. Clean wall surface with suitable brush or burlap.
  - .3 Architectural Concrete Unit Masonry:
    - .1 Allow mortar droppings on masonry to partially dry then remove by means of trowel, followed by rubbing lightly with small piece of block. Clean wall surface with suitable brush or burlap.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
  - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

**3.12 PROTECTION**

- .1 Brace and protect concrete unit masonry in accordance with Section 04 05 00 - Common Work Results for Masonry.

**END OF SECTION**

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**Part 1           General**

**1.1               GENERAL CONDITIONS**

- .1       The General Conditions of the Contract, Supplementary General Conditions and General Requirements are hereby made part of this Section.

**1.2               WORK INCLUDED**

- .1       Structural steel framing members, structural steel support members, struts, complete with required bracing, welds, washers, nuts, shims, anchor plates and bolts.
- .2       Baseplates, connectors and bearing plates.
- .3       Field and shop welded composite beam studs shall be supplied and installed under this section.
- .4       Erection.

**1.3               RELATED WORK**

- |    |                                   |                  |
|----|-----------------------------------|------------------|
| .1 | Cast-in-Place Concrete            | Section 03 30 00 |
| .2 | Concrete Unit Masonry             | Section 04 22 00 |
| .3 | Steel Joist Framing               | Section 05 21 00 |
| .4 | Steel Decking                     | Section 05 31 00 |
| .5 | Structural Glued-Laminated Timber | Section 06 18 00 |
| .6 | Painting and Finishing            | Section 09 90 00 |

**1.4               QUALITY ASSURANCE**

- .1       Structural steel fabricator to be certified as minimum Division 2 Company under CSA W47.1-09 (R2014) - "Certification of Companies for Fusion Welding of Steel Structures" or CSA Standard W55.3-08 (R2013) "Resistance Welding Qualification Code for Fabricators of Structural Members" or both, as applicable.
- .2       Design to strictly adhere to all codes and standards as enumerated under Section 1.5 Reference Standards.
- .3       In the event of conflict between pertinent codes, standards and/or regulations, most stringent shall govern.
- .4       Composite steel studs attached to structural steel beams or girders and installed in either the fabricator's plant or in the field shall be supplied and installed by the Structural Steel Subcontractor who shall be a company certified as a Division 2 fabricator by the Canadian Welding Bureau under CSA Standard W47.1 "Certification of Companies for Fusion Welding of Steel Structures". This certification to be in effect prior to date of tender closing. This condition is a mandatory condition of the Contract Documents and shall not be waived regardless of Saskatchewan Bid Depository Rules or practices.



## **1.5 REFERENCE STANDARDS**

- .1 CSA Standard CAN/CSA-S16-14 - "Limit States Design of Structural Steel Buildings".
- .2 CSA G40.21-13 - "Structural Quality Steel".
- .3 ASTM Standard A325M - "High Strength Bolts for Structural Steel Joints including Suitable Nuts and Plane Hardened Washers".
- .4 CSA Standard W59-13 - "Welded Steel Construction".
- .5 CSA Standard W47.1-09 (R2014) - "Certification of Companies for Fusion Welding of Steel Structures".
- .6 ASTM Standard A53 - "Welded and Seamless Steel Pipe".

## **1.6 SHOP DRAWINGS**

- .1 Submit shop drawings in accordance with General Conditions.
- .2 Clearly indicate sizes, spacing and locations of structural members, connections, attachments, anchorages, framed openings and size and type of fasteners and welds.
- .3 Indicate all shop and erection details including cuts, copes, connections, holes, threaded fasteners and welds.
- .4 Show all welds, both shop and field, by the currently recommended symbols of the Canadian Welding Bureau.
- .5 Provide drawings stamped and signed by a Professional Engineer registered in the Province of Saskatchewan.
- .6 Review of shop drawings for size and arrangement of principal and auxiliary members only. Such review will not relieve the Contractor of responsibility for general and detail dimension and fit, or any errors or omissions.

## **1.7 INSPECTION AND TESTING**

- .1 Materials and workmanship subject to inspection on behalf of Owner.
- .2 Report failure of material to fit together properly to Consultant. No corrective measures permitted unless approved by Consultant in writing.

## **Part 2 Products**

### **2.1 MATERIALS/COMPONENTS**

- .1 *Standard Rolled Sections*: new material conforming to CSA G40.21-13, Grade 350W.

- .2 *Hollow Structural Sections*: new material conforming to CSA G40.21-13, Grade 350W, Class C.
- .3 *Steel Pipe Sections*: new material conforming to ASTM Standard A53, Grade 241.
- .4 *Base and Cap Plates*: new material conforming to CSA G40.21-13, Grade 300W.
- .5 *Beam End Plates, Ledger Angles and Miscellaneous Steel*: new material conforming to CSA G40.21-13, Grade 300W.
- .6 *Anchor Bolts*: new material conforming to CSA G40.21-13, Grade 260W.
- .7 *Bolts, Nuts and Washers*: high strength type recommended for structural steel joints, conforming to requirements of ASTM A325-14.
- .8 *Paint for Primer*: shall be grey (unless approved otherwise) and meet requirements of one of the following:
  - .1 CGSB 1-GP-40d, Primer, Structural Steel, oil alkyd type.
  - .2 CISC/CPMA Standard 1-73a, quick drying one-coat paint for use on structural steel.
- .9 *Shop and Field Studs*: shall be Nelson headed anchors to ASTM A108-13 or approved equivalent. Sizes as detailed on drawings.

## 2.2 FABRICATION

- .1 Fabricate structural steel members in accordance with building design drawings and all requirements of CAN/CSA S16-14. Welding to conform to CSA W59-13 “Welded Steel Construction”. Verify all dimensions prior to fabrication.
- .2 No cutting of openings in structural members except as shown on structural drawings. Reinforce openings to maintain required design strength.
- .3 Accurately cut and mill column ends to assure full contact of bearing surfaces.
- .4 Camber horizontal members as specified on drawings. Mill camber up where not specifically detailed.
- .5 All bolted connections to be “bearing” type connections except where subject to stress reversal which are to be “slip resistant” type connections.
- .6 All connections showing combined axial load (tension or compression) across the joint to be designed for loads shown. Such connection to be bolted through columns only.
- .7 All beams to be connected for the greater of the following conditions.
  - .1 Loads shown on drawings.
  - .2 50% of the total uniformly distributed load resistance of the member.
  - .3 Half depth of the connected member using M20 bolts (minimum two bolts) in double shear.

- .8 Shop installed shear studs to be installed in strict conformance with requirements of CSA Standard W59. Refer to Part 3 Execution for additional requirements.
- .9 Fabricate all glued-laminated timber brackets supported directly from structural steel. Coordinate design and details of connections with glulam supplier.
- .10 Masonry Ledgers
  - .1 All masonry ledgers supplied by structural steel shall be fabricated with connections to provide for full site adjustment.
- .11 Tolerances
  - .1 All masonry ledgers exposed to view are to be fabricated straight with no discernible kinks, bends or sweep. Maintain straightness to within tolerance of 1 in 500 with maximum deviation of  $\pm 3$ mm.
  - .2 Tolerances of all other structural steel shall be maintained strictly in accordance with CAN/CSA S16-14.
- .12 All exposed steel and all related bridging and bracing shall be fabricated with clean, neat fitting welded connections.

### 2.3 PAINTING

- .1 All steel in contact with concrete and all faying surfaces of high strength bolted slip-resistant connections shall not be primed.
- .2 Top flange of steel beams that have shop or field installed shear studs shall not be painted.
- .3 All exposed steel ledgers, lintels and glulam connections shall be prepared and painted as follows:
  - (I) Blast clean steel to SSPC Standard SP6 “Commercial Blast Cleaning”. Apply one coat of General Paint 06-134 Q.D. Shop Primer.
  - (II) Apply one coat of General Paint 17-Line Q.D. Industrial Enamel. Color section by Consultant.
- .4 All exposed steel and all related bridging and bracing shall be prepared and painted as follows:
  - (I) Blast clean steel to SSPC Standard SP6 “Commercial Blast Cleaning”. Apply one coat of specified shop primer.
- .5 All other structural steel shall be prepared in accordance with SSPC Standard SP2 “Hand Tool Cleaning” and have one coat of specified shop applied primer.
- .6 Hot dipped galvanizing zinc coating. 600 grams/m<sup>2</sup> to ASTM A653.

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**Part 3 Execution**

**3.1 ERECTION**

- .1 Erect structural steel in accordance with building design drawings and all requirements on CAN/CSA S16-14.
- .2 Make adequate provision for all erection loads and for sufficient temporary bracing to maintain structure safe, plumb and in true alignment until completion of erection. Leave such bracing in place as long as required for safety and integrity of the structure.
- .3 As erection progresses, securely bolt work to take care of full design loads and to provide structural integrity as required.
- .4 Use high tensile bolts for field connections unless otherwise noted on building design drawings.
- .5 Set all baseplates which are shop welded to columns to proper elevation on steel shims. Maximum tolerance from stated elevations to be  $\pm 2$ mm.
- .6 Masonry Ledgers
  - .1 All masonry ledgers shall be erected with provision for full site adjustment. Position ledgers accurately to correct elevations and plan location and field weld in place prior to laying up masonry.
7. Tolerances
  - .1 All masonry ledgers are to be erected straight, level and plumb with no discernible kinks, bends or sweep. All masonry support members are to be erected such that the masonry can be laid up in its correct location, fully supported, straight and plumb.
  - .2 All masonry support members exposed to view are to be erected to comply with the following tolerances:
    - .1 Straight to within tolerance of 1 in 500 with maximum deviation of  $\pm 3$  mm from established location.
    - .2 Level to within tolerance of 1 in 1000 with maximum deviation of  $\pm 3$  mm from established location.
    - .3 Plumb to within tolerance of 1 in 500 with maximum deviation of  $\pm 3$  mm .
    - .4 Adjoining ends of these members shall be aligned vertically within 2 mm.
    - .5 The location of these members vertically and horizontally shall be within 10 mm of the location established on the drawings.

- .6 Splices between ledgers shall have the toe of the exposed flanges flush. The ledgers are to be fully welded together at all splice locations and all exposed portions are to be continuous with all welds ground smooth and flush.
- .7 Exposed portions of all ledgers are to be finished smooth ready for finish painting. All irregularities and surface defects are to be removed.
- .3 Tolerance of all other structural steel shall be maintained strictly in accordance with CAN/CSA S16-14.
- .8 After erection, prime all welds, abrasions, bolted connections and all other surfaces not shop primed, except surfaces to be in contact with concrete.
- .9 Obtain written permission of Consultant prior to altering or field welding of structural members.

**END OF SECTION**

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**Part 1 General**

**1.1 GENERAL CONDITIONS**

- .1 The General Conditions of the Contract, Supplementary General Conditions and General Requirements are hereby made part of the Section.

**1.2 WORK INCLUDED**

- .1 Open web steel joists, with required anchorages, bridging, bracing and bearing plates.

**1.3 RELATED WORK**

- .1 Cast-in-Place Concrete Section 03 30 00
- .2 Concrete Unit Masonry Section 04 22 00
- .3 Structural Steel for Buildings Section 05 12 23
- .4 Steel Decking Section 05 31 00
- .5 Metal Fabrications Section 05 50 00

**1.4 QUALITY ASSURANCE**

- .1 Steel joist fabricator to be certified as a Division 1 or 2 Company under CSA W47.1-09 (R2014) - "Certification of Companies for Fusion Welding of Steel Structure".

**1.5 DESIGN OF STEEL JOISTS**

- .1 Unless detailed otherwise all floor joists to be designed to support all applicable dead loads, partition loads, and all live loads for designated occupancies in accordance with current NBC. Unless noted otherwise, all joists to be designed for maximum live load deflection of  $L/360$ .
- .2 Unless specifically detailed otherwise, provide additional steel floor joists below all concrete masonry partition walls running parallel to direction of joists. Design joists to support tributary floor loads plus applicable wall loads. Design floor joists for applicable point load from concrete masonry running perpendicular to joists.
- .3 In the event of conflict between pertinent codes, standards and/or regulations, most stringent shall govern.

**1.6 REFERENCE STANDARDS**

- .1 CAN/CSA G40.21-13 - "Structural Quality Steel".
- .2 CAN/CSA S16-14 - "Steel Structures for Buildings".
- .3 CSA Standard W59-13 - "Welded Steel Construction".
- .4 CSA Standard W55.3-08 (R2013) - "Resistance Welding Qualification Code".
- .5 ASTM Standard A325M - "High Strength Bolts for Structural Steel Joints including Suitable Nuts and Plane Hardened Washers".

## **1.7 SHOP DRAWINGS**

- .1 Submit shop drawings in accordance with General Conditions.
- .2 Clearly indicate material specification and profile of web and chord sections, location and spacing of joists, end connections, size and location of bridging.
- .3 Indicate load capacity for all simply supported joists in kN/metre. Clearly note that magnitude and locations of all point loads for which joists have been designed. Indicate shear capacity of all joists subject to built up or point loading resulting in unequal shears at joist ends.
- .4 Consider cantilever joists, continuous joists or joists having special support conditions as "Special Joists". Design these joists as per Clause 16.5.1 CSA S16-14 - "Loading for Open-Web Steel Joists". Indicate design loading on shop drawings.
- .5 Prepare shop drawings under the direction of a Professional Engineer registered in the Province of Saskatchewan.
- .6 Review of shop drawings for size and arrangement of principal and auxiliary members only. Such review will not relieve the Contractor of responsibility for general and detail dimension and fit, or any errors or omissions.
- .7 Submit shop drawings stamped and signed by qualified professional engineer registered in Province of Saskatchewan, Canada.

## **Part 2 Products**

### **2.1 MATERIALS/COMPONENTS**

- .1 *Joist Members:* of type W - Weldable steel, conforming to requirements of CSA G40.21-13; with minimum yield strength of 300 Mpa.
- .2 *Bridging and Bearing Plates/Angles:* of type W - Weldable steel conforming to requirements of CSA G40.21-13; with minimum yield strength of 260 MPa.
- .3 *Anchor Bolts for Required Nuts and Washers:* high strength type recommended for structural steel joints conforming to requirements of ASTM A325 M-83C.
- .4 *Paint for primer* shall be grey (unless approved otherwise) and meet requirements of one of the following:
  - .1 CGSB 1-GP-40d, Primer, Structural Steel, oil alkyd type.
  - .2 CISC/CPMA Standard 1-73a, quick drying one-coat paint for use on structural steel.

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**2.2 FABRICATION**

- .1 Fabricate steel joists in accordance with building design drawings and all requirements of CAN/CSA S16-14. Verify all drawing dimensions and conditions prior to commencing fabrication.
- .2 Fabricate joists to adhere to Clause 16.10 CSA S16-14 "Manufacturing Tolerances".
- .3 Provide top and bottom chord extensions where indicated.
- .4 Camber joists to accommodate for dead load deflection.
- .5 Surface Preparation: shall conform to SSPC-SP2 "Hand Tool Cleaning".
- .6 Apply 1 coat of specified shop primer.

**Part 3 Execution**

**3.1 Erection**

- .1 Erect joists in accordance with drawings and within tolerances specified by Clause 16.12.2 CSA S16-14 - "Erection Tolerances".
- .2 Allow minimum 100 mm bearing when supported by masonry. Allow minimum 65 mm bearing when supported by structural steel.
- .3 Extend joist legs to within 6 mm of centre line of beams when bearing on both sides and minimum 25 mm past centre line when bearing on one side only.
- .4 During erection, provide all temporary bracing required as a result of induced loads and stresses.
- .5 Co-ordinate the proper placement of anchor bolts in concrete and masonry construction as required for the support of bearing plates/angles.
- .6 Field weld joist seat to bearing plates/angles after alignment and angles.
- .7 Strut bottom chord where noted on drawings.
- .8 Do not permit erection of decking until joists are sufficiently braced.
- .9 Obtain Consultant's written permission prior to field cutting or altering of joists or bridging.
- .10 After erection, prime all welds, abrasions and surfaces not shop primed. Use a primer consistent with that used to provide shop coat.

**END OF SECTION**



**Part 1 General**

**1.1 GENERAL CONDITIONS**

- .1 The General Conditions of the Contract, Supplementary General Conditions and General Requirements are hereby made part of this Section.

**1.2 WORK INCLUDED**

- .1 Steel roof and floor deck, complete with cover plates, cell closures and flashings.
- .2 All closure angles, channels, plates, as well as supplementary deck support or anchorage where required to provide continuous deck membrane.
- .3 Contractor to study Contract Drawings and Specifications with regard to the work shown and required under this Section to ensure its completeness. Supplementary items necessary to complete the work although not specifically shown or specified shall be supplied and installed.
- .4 Steel roof deck designed as a structural diaphragm. Contractor to ensure all side lap fastening and welding is as per the Drawings and Specifications.
- .5 Field and shop welded composite beam studs are to be supplied and installed by the structural steel subcontractor.

**1.3 RELATED WORK**

- .1 Cast-in-Place Concrete Section 03 30 00
- .2 Concrete Unit Masonry Section 04 22 00
- .3 Structural Steel for Buildings Section 05 12 23
- .4 Steel Joist Framing Section 05 21 00
- .5 Metal Fabrications Section 05 50 00
- .6 Installation of acoustical deck insulation Section 07 50 00
- .7 Painting and Finishing Section 09 90 00

**1.4 REFERENCE STANDARDS**

- .1 Canadian Sheet Steel Building Institute (CSSBI) - "Standard Steel Roof Deck" and "Steel Roof Deck".
- .2 CSA S136-12 - "Cold Formed Steel Structural Members".
- .3 ASTM A653 - "Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process".
- .4 Welding to CSA W59-13 except where specified elsewhere.

## **1.5 SHOP DRAWINGS**

- .1 Submit shop drawings in accordance with General Conditions.
- .2 Clearly indicate decking plan, deck profile, dimensions, anchorage, supports, projects, openings and reinforcement, applicable details and accessories.
- .3 Clearly indicate position of temporary shoring of decking if required by design criteria.
- .4 Review of shop drawings will not relieve Contractor of responsibility for general and detail dimensions and fit, or any errors or omissions.
- .5 Prepare shop drawings under the direction of a professional engineer registered in the Province of Saskatchewan, Canada.
- .6 Submit shop drawings stamped and signed by qualified professional engineer registered in Province of Saskatchewan, Canada.

## **Part 2 Products**

### **2.1 MATERIALS/COMPONENTS**

- .1 *Sheet Steel:* Grade A or Grade B structural quality, conforming to ASTM A653.

### **2.2 DECKING/RELATED ACCESSORIES**

- .1 *Roof Decking:* RD938 Roof Deck - 38 mm deep by 914 mm wide sheets by 0.76 mm core thickness, as manufactured by VicWest or approved equivalent. Galvanized to Z275 (G90) standard or ZF075 (A25) wiped coat.
- .2 *Roof Decking:* RD36A Acoustic Roof Deck - 38 mm deep by 914 mm wide sheets by 0.91 mm core thickness as manufactured by Agway Metals or approved equivalent. Galvanized to Z275 (G90) Standard or ZF075 (A25) wiped coat.
- .3 *Floor Decking:* HB938 Hi-Bond Steel Floor Deck - 38 mm deep by 914 mm wide sheets by 0.76 mm core thickness as manufactured by VicWest or approved equivalent. Galvanized to ZF075 (Wipe Coat) Standard.
- .4 *Floor Decking:* HB308 Hi-Bond Floor Deck - 76 mm deep by 810 mm wide sheets by 0.91 mm core thickness as manufactured by Vic West or approved equivalent. Galvanized to Z275 (G90) Standard or ZF075 (A25) wiped coat.
- .5 *Ribbed Pans:* minimum (26 ga.) 0.5mm thick sheet steel. V-rib as manufactured by CAN-AM or approved equivalent.
- .6 Any substitution of specified material to be approved in writing by the Consultant.
- .7 *Closure Strips, Flashings, Cover Plates and Related Accessories:* minimum 1.6 mm (16 gauge) sheet steel.

- .8 *Acoustical Insulation:* fibrous glass 17.5 kg/M3 density; profiled to suit decking.
- .9 *Acoustical closures:* closed cell foam rubber profiled to deck corrugations, 25 mm thick.
- .10 *Primer:* Zinc rich, ready mix to CGSB-1-GP-181M.
- .11 *Closures to external walls:* neoprene as recommended by manufacturer.

## **2.3 FABRICATION**

- .1 Fabricate metal decking in accordance with Drawings and as recommended by the Canadian Sheet Steel Building Institute (CSSBI) Standards. Fabricate to accommodate maximum deflections of 1/360 span.
- .2 Supply steel fillers between decking and supporting members where required.
- .3 Deck units to be 3 span continuous where possible; under no circumstances should deck be less than 2 span continuous except where detailed.

## **Part 3 Execution**

### **3.1 INSTALLATION**

- .1 Erect metal decking in accordance with drawings and as recommended by the CSSBI. Properly align and level on structural supports.
- .2 Allow minimum 40 mm bearing when supported by structural steel and minimum 100 mm bearing when supported by masonry or concrete.
- .3 Mechanical fasten male/female side laps at maximum 300 mm.
- .4 Fasten deck to ALL supporting steel with 20 mm fusion welds at maximum 300 mm on centre. Secure "V" rib pans to structure with plug welds through 19 mm diameter steel washers at 300 mm on centre.
- .5 Reinforce openings 150 mm to 450 mm in size with L51 x 51 x 4.8 steel angles or as indicated on the Drawings. Place angles perpendicular to flutes, extended minimum two flutes each side of openings and weld to deck.
- .6 Reinforce openings over 450 mm in accordance with details indicated on Drawings.
- .7 Install minimum 150 mm cover plates where deck changes direction. Spot weld in place at maximum 300 mm on centre.
- .8 Install strip closures at slab edges to match thickness of slab, as required to contain poured concrete. Ensure closures are of sufficient strength to remain in place without distortion.
- .9 Install acoustical closures in locations above walls and partitions in areas where partitions butt to decking.

- .10 Immediately after installation, touch up welds, burned areas and damaged spots with prime paint. Use type of primer recommended for galvanized surfaces.

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCES**

- .1 ASTM International
  - .1 ASTM A53/A53M-07, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
  - .2 ASTM A276/A276M, Standard Specification for Stainless Steel Bars and Shapes.
  - .3 ASTM A307-07b, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
  - .4 ASTM A325-14, Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
  - .5 ASTM A635/A635M-14, Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Hot-Rolled, Alloy, Carbon, Structural, High-Strength Low-Alloy, and High-Strength Low-Alloy with Improved Formability, General Requirements for.
  - .6 ASTM A653/A653M-15, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- .2 CSA International
  - .1 CSA G40.20/G40.21-04(R2009), General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
  - .2 CAN/CSA G164-M92(R2003), Hot Dip Galvanizing of Irregularly Shaped Articles.
  - .3 CSA S16-09, Design of Steel Structures.
  - .4 CSA W48-06, Filler Metals and Allied Materials for Metal Arc Welding (Developed in co-operation with the Canadian Welding Bureau).
  - .5 CSA W59-M03(R2008), Welded Steel Construction (Metal Arc Welding) Metric.
- .3 Health Canada / Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (MSDS).
- .4 The Master Painters Institute (MPI)
  - .1 Architectural Painting Specification Manual - current edition.

**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 sections, plates, pipe, tubing, bolts and include product characteristics, performance criteria, physical size, finish and limitations.

- .2 Submit two copies of WHMIS MSDS in accordance with Section 01 35 29.06 - Health and Safety Requirements.
  - .1 For finishes, coatings, primers, and paints applied on site: indicate VOC concentration in g/L.
- .3 Shop Drawings:
  - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Saskatchewan, Canada.
  - .2 Indicate materials, core thicknesses, finishes, connections, joints, method of anchorage, number of anchors, supports, reinforcement, details, and accessories.
  - .3 Construction Waste Management:
    - .1 Submit project Waste Reduction Workplan highlighting recycling and salvage requirements.
  - .4 Low-Emitting Materials:
    - .1 Submit listing of paints and coatings used in building, comply with VOC and chemical component limits or restrictions requirements.

### **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.
- .4 Develop Waste Reduction Workplan related to Work of this.

## **Part 2 Products**

### **2.1 MATERIALS**

- .1 Refer to Section 13 54 00 - Firing Range Baffles, for special material specifications for steel baffles.
- .2 Steel sections and plates: to CSA G40.20/G40.21, Grade 350W.
- .3 Steel pipe: to ASTM A53/A53M extra strong, galvanized finish, Grade 241.
- .4 Welding materials: to CSA W59.

- .5 Welding electrodes: to CSA W48 Series. (low-hydrogen-producing electrodes for AR500)
- .6 Bolts, nuts and washers: high strength for structural requirements, conforming to ASTM A325.
- .7 Anchor bolts: new material conforming to CSA G40.21, Grade 260W.
- .8 Unistrut Metal Framing System: to ASTM A635 and ASTM A653.
- .9 Stainless steel: to ASTM A276, Type 302 commercial steel.

## **2.2 FABRICATION**

- .1 Fabricate work square, true, straight and accurate to required size, with joints closely fitted and properly secured.
- .2 Use self-tapping shake-proof flat headed screws on items requiring assembly by screws or as indicated.
- .3 Where possible, fit and shop assemble work, ready for erection.
- .4 Ensure exposed welds are continuous for length of each joint. File or grind exposed welds smooth and flush.

## **2.3 FINISHES**

- .1 Galvanizing: hot dipped galvanizing with zinc coating 600 g/m<sup>2</sup> to CAN/CSA-G164.
- .2 Shop coat primer: in accordance with chemical component limits and restrictions requirements and VOC limits.
- .3 Zinc primer: zinc rich, ready mix to MPI-EXT 5.2C and in accordance with chemical component limits and restrictions requirements and VOC limits.

## **2.4 ISOLATION COATING**

- .1 Isolate aluminum from following components, by means of bituminous paint:
  - .1 Dissimilar metals except stainless steel, zinc, or white bronze of small area.
  - .2 Concrete, mortar and masonry.
  - .3 Wood.

## **2.5 SHOP PAINTING**

- .1 Primer: VOC limit 250 g/L maximum.
- .2 Apply one shop coat of primer to metal items, with exception of galvanized or concrete encased items.
- .3 Use primer unadulterated, as prepared by manufacturer. Paint on dry surfaces, free from rust, scale, grease. Do not paint when temperature is lower than 7 degrees C.
- .4 Clean surfaces to be field welded; do not paint.

## **2.6 BAFFLE PLATE**

- .1 Refer to Section 13 54 00 - Firing Range Baffles.

**2.7 BAFFLE SUPPORT SYSTEM**

- .1 Steel angles: prime painted and sizes as indicated. Provide support as noted on drawings.
- .2 Steel threaded rods: galvanized, 12.5mm diameter.
- .3 Steel washers, nuts, locking nuts, and double nuts: hot dipped galvanized, sized to suit.
- .4 Finish: shop painted.
  - .1 Primer: VOC limit 250 g/L maximum.

**2.8 PIPE RAILINGS**

- .1 Steel pipe: nominal outside diameter as indicated, formed to shapes and sizes as indicated.
- .2 Galvanize exterior pipe railings after fabrication.

**2.9 SHIPS LADDERS**

- .1 Stringers: C150x16, steel channel.
- .2 Steel Rungs: 150mm wide, welded to stringers as indicated, slip resistant safety grating.
- .3 Brackets: sizes and shapes as indicated, weld to stringers, complete with fixing anchors.
- .4 Galvanize finish for exterior, prime paint for interior.
- .5 Galvanize exterior ladders after fabrication.

**2.10 PERFORATED PANELS**

- .1 Type 1
  - .1 Thickness: 1.3 mm (18ga)
  - .2 Pattern: staggered
  - .3 Hole size: 12.7 mm
  - .4 Opening percentage: 20.5% open area (150 holes per square foot)
- .2 Type 2
  - .1 Thickness: 1.3 mm (18ga)
  - .2 Pattern: staggered
  - .3 Hole size: 12.7 mm
  - .4 Opening percentage: 29.7% open area (217 holes per square foot)
- .3 Type 3
  - .1 Thickness: 1.3mm (18ga)
  - .2 Pattern: staggered
  - .3 Hole size: 12.7mm
  - .4 Opening percentage: 34.9% open area (255 holes per square foot)
- .4 Type 4
  - .1 Thickness: 1.3mm (18ga)
  - .2 Pattern: staggered



- .3 Hole size: 12.7mm
- .4 Opening percentage: 23.7% open area (174 holes per square foot)

### **2.11 FLOOR SLEEVE**

- .1 89 mm outside diameter pipe sleeve complete with top flange, spacers, hinged locking cover plate, and all accessories for a complete installation.
  - .1 Pipe sleeve: 6.4 mm thick aluminum or steel sleeve complete with mounting flange.
  - .2 Spacers: 13 x 25 mm
  - .3 Cover plate assembly: 190 diameter x 6.4 mm, brass or chrome plated steel, mounting ring and flip up type keyless locking cover.
  - .4 Fasteners: as recommended by manufacturer.

### **2.12 POST (FOR SWING OUT BARRIER)**

- .1 Aluminum pipe: high strength galvanized, nominal outside diameter as indicated, formed to shapes and sizes as indicated. Complete with aluminum cap.
- .2 Aluminum pipe to be mechanically fastened to swing out barrier. Refer to Section 11 67 23 Shooting Range Equipment for swing out barrier requirements.

### **2.13 CORNER GUARDS**

- .1 Stainless steel angle: 89 x 89 x 2 mm thick x 12200 mm high, with 6 anchors each guard.
- .2 Satin finish for all applications.

## **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 Make field connections with bolts to CSA S16.
- .7 Deliver items over for casting into concrete and building into masonry together with setting templates to appropriate location and construction personnel.
- .8 Touch-up rivets, field welds, bolts and burnt or scratched surfaces with primer after completion of:
  - .1 Primer: maximum VOC limit 250 g/L.
- .9 Touch-up galvanized surfaces with zinc rich primer where burned by field welding.
  - .1 Primer: maximum VOC limit 250 g/L.

**3.3 BAFFLE SUPPORT SYSTEM**

- .1 Install steel baffle support system as indicated. Drill plate and bottom chord of steel trusses for installation.
- .2 Coordinate spacing of system with Firing Range Baffle supplier.

**3.4 PIPE RAILINGS**

- .1 Install pipe railings as indicated.

**3.5 SHIPS LADDERS**

- .1 Install access ladders in locations as indicated.

**3.6 PERFORATED PANELS**

- .1 Install perforated panels in locations as indicated.

**3.7 FLOOR SLEEVE**

- .1 Install floor sleeves in locations as indicated.

**3.8 POST (FOR FLOOR SLEEVE)**

- .1 Install post in locations as indicated.

**3.9 CORNER GUARDS**

- .1 Install corner guards as indicated in drawings.

**3.10 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

- 
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
    - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

**3.11 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**

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**Part 1           General**

**1.1           REFERENCES**

- .1 American Wood-Preservers' Association (AWPA)
  - .1       AWPA M4-06, Standard for the Care of Preservative-Treated Wood Products.
- .2 Canadian Standards Association (CSA International)
  - .1       CSA O80 Series-97(R2002) - O80S2-05, Wood Preservation.
  - .2       CSA O80.20-1.1-M97(R2002), This Standard applies to the fire-retardant treatment of lumber by pressure processes..
  - .3       CSA O80.27-1.1-M97(R2002), This Standard covers the fire-retardant treatment of Douglas Fir, hardwood, softwood, and Poplar plywood by pressure processes.

**1.2           ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit Submittal submissions: in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Quality assurance submittals:
  - .1       Submit certificates in accordance with Section 01 33 00 - Submittal Procedures.
  - .2       For products treated with fire-retardant by pressure impregnation submit following information certified by authorized signing officer of treatment plant:
    - .1       Information listed in AWPA M2 and revisions specified in CSA O80 Series, Supplementary Requirement to AWPA M2 applicable to specified treatment.
    - .2       Moisture content after drying following treatment with fire-retardant.
    - .3       Acceptable types of paint, stain, and clear finishes that may be used over treated materials to be finished after treatment.

**1.3           QUALITY ASSURANCE**

- .1 Regulatory Requirements:
  - .1       Each board or bundle of fire-retardant treated material and panel to bear ULC label indicating Flame Spread Classification (FSC), and smoke developed.

**1.4           DELIVERY, STORAGE, AND HANDLING**

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

**Part 2           Products**

**2.1           MATERIALS**

- .1 Lumber treatment to CSA O80.20.

- .2 Plywood treatment to CSA O80.27.
- .3 Fire-Retardant: to CSA O80.20 and CSA O80.27, to provide:
  - .1 Flame Spread Classification: FSC 150.
  - .2 Smoke developed of not more than: 300.

**Part 3 Execution**

**3.1 APPLICATION: FIRE-RETARDANT**

- .1 Treat indicate material by pressure impregnation with fire-retardant chemicals in accordance with CSA O80.20 and CSA O80.27.
- .2 Following treatment, kiln-dry material to maximum moisture content of 15%.

**3.2 APPLICATION: FIELD TREATMENT**

- .1 Comply with AWPA M4 and revisions specified in CSA O80 Series, Supplementary Requirements to AWPA M2.
- .2 Remove chemical deposits on treated wood to receive applied finish.
- .3 Treat all cut edges of plywood.

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCES**

- .1 ASTM International
  - .1 ASTM C578-11a, Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation.
  - .2 ASTM C1289-11, Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board.
  - .3 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 CAN/CSA-A247-M86(R1996), Insulating Fiberboard.
  - .2 CSA B111-1974(R2003), Wire Nails, Spikes and Staples.
  - .3 CSA O112.9-10, Evaluation of Adhesives for Structural Wood Products (Exterior Exposure).
  - .4 CSA O141-05(R2009), Softwood Lumber.
  - .5 CSA O151-09, Canadian Softwood Plywood.
  - .6 CSA O325-07, Construction Sheathing.
  - .7 CAN/CSA-Z809-08, Sustainable Forest Management.
- .4 Forest Stewardship Council (FSC)
  - .1 FSC-STD-01-001-2004, FSC Principle and Criteria for Forest Stewardship.
- .5 National Lumber Grades Authority (NLGA)
  - .1 Standard Grading Rules for Canadian Lumber 2010.
- .6 Sustainable Forestry Initiative (SFI)
  - .1 SFI-2010-2014 Standard.
- .7 Underwriters' Laboratories of Canada (ULC)
  - .1 CAN/ULC-S706-09, Standard for Wood Fibre Insulating Boards for Buildings.

**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.
- .3 Shop Drawings:

- .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Saskatchewan, Canada.
- .4 Sustainable Design Submittals:
  - .1 Construction Waste Management:
    - .1 Submit project Waste Management Plan and Waste Reduction Workplan highlighting recycling and salvage requirements.
    - .2 Submit calculations on end-of-project recycling rates, salvage rates, and landfill rates demonstrating that 50% of construction wastes were recycled or salvaged.
  - .2 Wood Certification: submit manufacturer's Chain-of-Custody Certificate number for CAN/CSA-Z809 or FSC or SFI certified wood.
  - .3 Low-Emitting Materials:
    - .1 Submit listing of adhesives and sealants and paints and coatings used in building, showing compliance with VOC and chemical component limits or restriction requirements.
    - .2 Submit listing of composite wood products used in building, stating that they contain no added urea-formaldehyde resins, laminate adhesives used in building, stating that they contain no urea-formaldehyde.

### **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.
- .3 Sustainable Standards Certification:
  - .1 Certified Wood: submit listing of wood products and materials used in accordance with CAN/CSA-Z809 or FSC or SFI.

### **1.4 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials off ground, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect wood from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.
- .4 Develop Construction Waste Management Plan and Waste Reduction Workplan related to Work of this Section.
- .5 Packaging Waste Management: remove for reuse and return of pallets, crates, padding, packaging materials as specified in Construction Waste Management Plan and Waste

Reduction Workplan in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

**Part 2 Products**

**2.1 FRAMING STRUCTURAL AND PANEL MATERIALS**

- .1 Description:
  - .1 Sustainability Characteristics:
    - .1 Lumber, to CAN/CSA-Z809 or FSC or SFI certified.
    - .2 Plywood, particleboard, and OSB urea-formaldehyde free, CAN/CSA-Z809 or FSC or SFI certified.
  - .2 Lumber: softwood, S4S, moisture content 19% (S-dry) or less in accordance with following standards:
    - .1 CSA O141.
    - .2 NLGA Standard Grading Rules for Canadian Lumber.
  - .3 Framing and board lumber: in accordance with NBC.
  - .4 Furring, blocking, nailing strips, grounds, 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.
  - .5 Plywood, OSB and wood based composite panels: to CSA O325.
  - .6 Canadian softwood plywood (CSP): to CSA O151, standard construction.
  - .7 Insulating fiberboard sheathing: to CAN/CSA-A247 and CAN/ULC-S706.
  - .8 Glass fibre board sheathing: non-structural, rigid, faced, fiberglass, insulating exterior sheathing board.
  - .9 Isocyanurate sheathing: to ASTM C1289, faced.
  - .10 Expanded polystyrene sheathing: to ASTM C578.
  - .11 Gypsum sheathing: to ASTM C1396/C1396M.

**2.2 ACCESSORIES**

- .1 Polyethylene film: to CAN/CGSB-51.34, Type 1, 0.15 mm thick.
- .2 Air seal: closed cell polyurethane or polyethylene.
- .3 Sealants: in accordance with Section 07 92 00 - Joint Sealants.
  - .1 Sealants: VOC limit 250 g/L maximum.
- .4 General purpose adhesive: to CSA O112.9.
  - .1 VOC limit 200 g/L maximum.
- .5 Nails, spikes and staples: to CSA B111.



- .6 Bolts: 12.5 mm diameter unless indicated otherwise, complete with nuts and washers.
- .7 Proprietary fasteners: toggle bolts, expansion shields and lag bolts, screws and lead or inorganic fibre plugs, [explosive actuated fastening devices], recommended for purpose by manufacturer.
- .8 Fastener Finishes:
  - .1 Galvanizing: to ASTM A653, use galvanized fasteners for interior highly humid areas, pressure-preservative, fire-retardant, and treated lumber.
- .9 Wood Preservative:
  - .1 Preservative: in accordance with manufacturer's recommendations for surface conditions:
    - .1 Preservative: VOC limit 350 g/L maximum.

### **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.
- .4 Treat material as indicated:
  - .1 Wood furring on surface of exterior masonry and concrete walls.
  - .2 Plywood backing on baffle assemblies.

#### **3.3 MATERIAL USAGE**

- .1 Baffle Backing:
  - .1 Plywood, DFP or CSP, B or C grade, square edge, thickness as noted.
  - .2 Fasteners: Flathead, countersunk screws.

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**3.4           INSTALLATION**

- .1   Comply with requirements of NBC 2010 Part 9 supplemented by following paragraphs.
- .2   Install members true to line, levels and elevations, square and plumb.
- .3   Construct continuous members from pieces of longest practical length.
- .4   Install spanning members with "crown-edge" up.
- .5   Select exposed framing for appearance. Install lumber and panel materials so that grade-marks and other defacing marks are concealed or are removed by sanding where materials are left exposed.
- .6   Install furring and blocking as required to space-out and support wall and ceiling finishes, and other work as required.
- .7   Install rough bucks, nailers and linings to rough openings as required to provide backing for frames and other work.
- .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.

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

**3.6           PROTECTION**

- .1   Protect installed products and components from damage during construction.
- .2   Repair damage to adjacent materials caused by rough carpentry installation.

**END OF SECTION**

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**Part 1            General**

**1.1                REFERENCES**

- .1    American National Standards Institute (ANSI)
  - .1        ANSI/HPVA HP-1-2009, Standard for Hardwood and Decorative Plywood.
  - .2        ANSI/NPA A208.1-2009, Particleboard.
- .2    Architectural Woodwork Manufacturers Association of Canada (AWMAC) and Architectural Woodwork Institute (AWI)
  - .1        Architectural Woodwork Quality Standards Illustrated, 1st edition, 2009.
- .3    Canadian General Standards Board (CGSB)
  - .1        CAN/CGSB-71.20-M88, Adhesive, Contact, Brushable.
- .4    Canadian Standards Association (CSA International)
  - .1        CSA B111-74(R2003), Wire Nails, Spikes and Staples.
  - .2        CSA O112.4 Series-M1977(R2006), Standards for Wood Adhesives.
  - .3        CSA O121-08(R2013), Douglas Fir Plywood.
  - .4        CSA O141-05(R2009), Softwood Lumber.
- .5    National Electrical Manufacturers Association (NEMA)
  - .1        ANSI/NEMA LD-3-2005, High-Pressure Decorative Laminates (HPDL).
- .6    National Hardwood Lumber Association (NHLA)
  - .1        Rules for the Measurement and Inspection of Hardwood and Cypress 2011.
- .7    National Lumber Grades Authority (NLGA)
  - .1        Standard Grading Rules for Canadian Lumber 2010.

**1.2                PERFORMANCE REQUIREMENTS**

- .1    Perform architectural casework work in accordance with the recommendations of the "Architectural Woodwork Quality Standards Illustrated" of the Architectural Woodwork Institute and Architectural Woodwork Manufacturers Association of Canada (AWMAC), 2009 Edition, together with authorized additions and amendments, Custom Grade.
- .2    Where modifications to the AWMAC Quality Standards are included in this project specification, then such modifications shall govern in case of conflict.
- .3    Materials and installation shall be in metric measurement as specified.

**1.3                SUBMITTALS**

- .1    Provide Submittal submissions: in accordance with Section 01 33 00 - Submittal Procedures.
- .2    Provide shop drawings in accordance with Section 01 33 00 - Submittal Procedures.

- .1 Indicate details of construction, profiles, jointing, fastening and other related details.
  - .1 Scales: profiles full size, details half full size.
- .2 Indicate materials, thicknesses, finishes and hardware.
- .3 Indicate locations of service outlets in casework, typical and special installation conditions, and connections, attachments, anchorage and location of exposed fastenings.
- .3 Provide samples in accordance with Section 01 33 00 - Submittal Procedures.
  - .1 Provide duplicate samples: sample size 300 x 300 mm or 600 mm long unless specified otherwise.
  - .2 Provide two (2) samples of each wood species for review.
  - .3 Provide duplicate colour samples of laminated plastic for colour selection.
  - .4 Provide duplicate samples of laminated plastic joints, edging, cutouts and postformed profiles.
- .4 Quality assurance submittals:
  - .1 Manufacturer's Instructions: manufacturer's installation instructions.

#### **1.4 QUALITY ASSURANCE**

- .1 Lumber by grade stamp of an agency certified by Canadian Lumber Standards Accreditation Board.
- .2 Plywood, particleboard, OSB and wood based composite panels in accordance with CSA and ANSI standards.
- .3 Delivery, Storage, and Handling:
  - .1 Deliver, handle, store and protect materials of this section in accordance with Section 01 61 00 - Common Product Requirements.
    - .1 Protect millwork against dampness and damage during and after delivery.
    - .2 Store millwork in ventilated areas, protected from extreme changes of temperature or humidity.
- .4 Waste Management and Disposal:
  - .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

#### **Part 2 Products**

##### **2.1 MATERIALS**

- .1 Softwood lumber: unless specified otherwise, S4S, moisture content 19% or less in accordance with following standards:
  - .1 CSA O141.
  - .2 NLGA Standard Grading Rules for Canadian Lumber.

- .3 AWMAC custom grade, moisture content as specified.
- .2 Hardwood lumber: moisture content 6% or less in accordance with following standards:
  - .1 National Hardwood Lumber Association (NHLA).
  - .2 AWMAC custom grade, moisture content as specified.
- .3 Douglas fir plywood (DFP): to CSA O121, standard construction.
  - .1 Urea-formaldehyde free.
- .4 Hardwood plywood: to ANSI/HPVA HP-1.
  - .1 Urea-formaldehyde free.
- .5 Engineered Combination core – 5 ply veneer: to ANSI A208-1
  - .1 Urea-formaldehyde free.
- .6 Laminated plastic for flatwork: to NEMA LD3, Grade VGL, Type HD, 1.6 mm thick; based on solid, woodgrain, printed pattern, and metallic, colour range with satin, matt, textured, and embossed finish.
  - .1 Colour and finish: from manufacturer's complete range.
- .7 Laminated plastic backing sheet: Grade BK, Type HD not less than 0.5 mm thick or same thickness and colour as face laminate.
- .8 Thermofused Melamine: to NEMA LD3 Grade VGL.
  - .1 High wear resistant thermofused melamine: equal or exceed 400 cycles (Minimum standard for HPL abrasion test).
  - .2 Colour: from manufacturer's complete range.
- .9 Nails and staples: to CSA B111.
- .10 Wood screws: plain, type and size to suit application.
- .11 Splines: wood and metal.
- .12 Sealant: in accordance with Section 07 92 00 - Joint Sealants.
- .13 Laminated plastic adhesive:
  - .1 Adhesive: contact adhesive to CAN/CGSB-71.20.
    - .1 Maximum VOC limit 250 g/l.
    - .2 Adhesives urea-formaldehyde free.

## 2.2 **HARDWOOD TRIM**

- .1 Hardwood: Solid maple, clear finish. Refer to section 09 91 23 – Interior Painting

## 2.3 **MANUFACTURED UNITS**

- .1 Casework:
  - .1 Fabricate caseworks to AWMAC custom quality grade.
  - .2 Furring, blocking, nailing strips, grounds and rough bucks

- .1 S2S is acceptable for concealed products.
- .2 Board sizes: "standard" or better grade.
- .3 Dimension sizes: "standard" light framing or better grade.
- .4 Urea-formaldehyde free.
- .3 Case bodies (ends, divisions and bottoms).
  - .1 Particleboard, grade, square edge, 19mm thick. Laminated with high pressure laminate on exposed ends and thermofused melamine on concealed interiors.
- .4 Backs:
  - .1 Particleboard, grade, square edge, 19mm thick. Laminated with high pressure laminate on exposed ends and thermofused melamine on concealed interiors.
- .5 Shelving:
  - .1 Particleboard, laminated with thermofused melamine, 19 mm thick.
  - .2 Edge banding: provide matching colour PVC, 3 mm thickness.
- .2 Drawers:
  - .1 Fabricate drawers to AWMAC custom grade supplemented as follows:
  - .2 Sides and Backs.
    - .1 Thermofused melamine: 15 mm thick.
  - .3 Bottoms:
    - .1 Thermofused melamine: 15 mm thick.
  - .4 Fronts:
    - .1 Particleboard, 19 mm thick, laminated with high-pressure plastic laminate.
      - .1 Exposed finish: high-pressure plastic laminate
      - .2 Semi-exposed surface: plastic laminate.
      - .3 Edges: banded with 3 mm PVC edge, colour to match exposed faces.
- .3 Countertops
  - .1 High-pressure plastic laminate: edged with 3 mm PVC edge unless indicated otherwise on details. Backsplash and sidesplash to match countertop unless indicated otherwise on drawings.
  - .2 Solid wood nosing: Maple, semi-transparent stain with water-borne varnish, Semi-gloss finish.
    - .1 Finish: MPI INT 6.3W Premium Grade (stain with 3 coats of varnish)

## 2.4 FABRICATION

- .1 Assemble cabinets in flush overlay style.
- .2 Set nails and countersink screws apply plain wood filler to indentations, sand smooth and leave ready to receive finish.

- .3 Shop install cabinet hardware for doors, shelves and drawers. Recess shelf standards unless noted otherwise.
- .4 Shelving to cabinetwork to be adjustable unless otherwise noted.
- .5 Provide cutouts for plumbing fixtures, inserts, appliances, outlet boxes and other fixtures.
- .6 Shop assemble work for delivery to site in size easily handled and to ensure passage through building openings.
- .7 Obtain governing dimensions before fabricating items which are to accommodate or abut appliances, equipment and other materials.
- .8 Ensure adjacent parts of continuous laminate work match in colour and pattern.
- .9 Veneer laminated plastic to core material in accordance with adhesive manufacturer's instructions. Ensure core and laminate profiles coincide to provide continuous support and bond over entire surface. Use continuous lengths up to 2400 mm. Keep joints 600 mm from sink cutouts.
- .10 Use straight self-edging laminate strip for flatwork to cover exposed edge of core material. Chamfer exposed edges uniformly at approximately 20 degrees. Do not mitre laminate edges.
- .11 Apply laminate backing sheet to reverse side of core of plastic laminate work.

## **2.5 HARDWARE**

- .1 Hinges: European concealed hinges, 110 degree opening. Only screw fastened hardware will be accepted, no friction fit hardware will be accepted. Use plastic insertion dowels to receive screws of hinge baseplates.
  - .1 Acceptable manufacturers: Hettich, Blum, Hafele or Richelieu.
- .2 Drawer slides: full extension, bearing type, secured to sides of drawers and to gable, 45kg static load capacity, integral stop, self-closing
  - .1 Acceptable product: Accuride 3832, or Knappe & Vogt 8400.
- .3 Shelf standards: Safety shelf support pin for 5mm diameter holes, steel pin with mounded on clear plastic.
- .4 Cabinet locks: Cam type cylinder lock. Satin nickel finish. Install where shown on details. Key locks that are in the same room alike.
- .5 Clear plastic silencers to be installed on all cabinet doors.

## **Part 3 Execution**

### **3.1 INSTALLATION**

- .1 Do architectural woodwork to Quality Standards of the Architectural Woodwork Manufacturers Association of Canada (AWMAC), except where specified otherwise.

- .2 Install prefinished millwork at locations shown on drawings. Position accurately, level, plumb straight.
- .3 Fasten and anchor millwork securely. Provide heavy duty fixture attachments for wall mounted cabinets.
- .4 Use draw bolts in countertop joints.
- .5 Scribe and cut as required to fit abutting walls and to fit properly into recesses and to accommodate piping, columns, fixtures, outlets or other projecting, intersecting or penetrating objects.
- .6 At junction of plastic laminate counter back splash and adjacent wall finish, apply small bead of sealant.
- .7 Apply water resistant building paper over wood framing members in contact with masonry or cementitious construction.
- .8 Fit hardware accurately and securely in accordance with manufacturer's written instructions.
- .9 Site apply laminated plastic to units as indicated. Adhere laminated plastic over entire surface. Make corners with hairline joints. Use full sized laminate sheets. Make joints only where indicated or approved. Slightly bevel arises.
- .10 For site application, offset joints in plastic laminate facing from joints in core.
- .11 Install wood window sills as noted in drawing.
- .12 Coordinate installation of continuous wood blocking behind adjustable shelving units. Attach standards to studs at a maximum spacing of 400mm on centre. Adjustable shelf shall extend a maximum of 100mm beyond the final standard, install standard as required.

### **3.2 CLEANING**

- .1 Proceed in accordance with Section 01 74 11 - Cleaning.
- .2 Clean millwork and cabinet work, inside cupboards and drawers and outside surfaces.
- .3 Remove excess glue from surfaces.

### **3.3 PROTECTION**

- .1 Protect millwork and cabinet work from damage until final inspection.

**END OF SECTION**



**Part 1 General**

**1.1 REFERENCES**

- .1 ASTM International
  - .1 ASTM C423-09a, Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
  - .2 ASTM C612-14, Standard Specification for Mineral Fibre Block and Board Thermal Insulation.
  - .3 ASTM C1071-12, Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material).
  - .4 ASTM E84-15a, Standard Test Method for Surface Burning Characteristics of Building Materials.
  - .5 ASTM E90-09, Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
  - .6 ASTM E96/E96M-13, Standard Test Methods for Water Vapour Transmission of Materials.
  - .7 ASTM E413-10, Classification for Rating Sound Insulation.
  - .8 ASTM E1050-12, Standard Test Method for Impedance and Absorption of Acoustical Materials Using a Tube, Two Microphones and a Digital Frequency Analysis System.
- .2 CSA Group
  - .1 CSA B149 PACKAGE-10, Consists of B149.1, Natural Gas and Propane Installation Code and B149.2, Propane Storage and Handling Code.
- .3 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (MSDS).
- .4 Underwriters Laboratories of Canada (ULC)
  - .1 CAN/ULC-S102-10, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies
  - .2 CAN/ULC-S604-2012, Standard for Factory-Built Type A Chimneys.
  - .3 CAN/ULC-S702-2012, Standard for Mineral Fibre Insulation for Buildings.
  - .4 CAN/ULC-S114-05, Standard Method of Test For Determination of Non-Combustibility In Building Materials.

**1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for board insulation and include product characteristics, performance criteria, physical size, finish and limitations.

- .2 Submit 2 copies of WHMIS MSDS in accordance with Section 01 35 29.06 - Health and Safety Requirements. Indicate VOC's during application and curing.
- .3 Shop Drawings:
  - .1 Submit drawings in accordance with Section 01 33 00 – Submittal Procedures.
- .4 Samples:
  - .1 Submit 300 x 300 mm sample of board insulation.
- .5 Certificates:
  - .1 Submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.
- .6 Test Reports:
  - .1 Submit certified test reports showing compliance with specified performance characteristics and physical properties.
- .7 Manufacturer's Instructions:
  - .1 Submit manufacturer's installation instructions.
- .8 Sustainable Design Submittals:
  - .1 Construction Waste Management:
    - .1 Submit project Waste Reduction Workplan and Waste Management Plan highlighting recycling and salvage requirements.
    - .2 Submit calculations on end-of-project recycling rates, salvage rates, and landfill rates demonstrating that 50% of construction wastes were recycled or salvaged.
  - .2 Recycled Content:
    - .1 Submit listing of recycled content products used, including details of required percentages or recycled content materials and products, showing their costs and percentages of post-industrial and post-consumer content, and total cost of materials for project.

### **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 off ground, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect specified materials from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.
- .4 Develop Construction Waste Management Plan and Waste Reduction Workplan related to Work of this Section.

- .5 Packaging Waste Management: remove for reuse and return of packaging materials, pallets, padding, crates, as specified in Construction Waste Management Plan and Waste Reduction Workplan in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

**Part 2 Products**

**2.1 INSULATION**

- .1 Duct liner (for plenum):
  - .1 Faced semi-rigid non-combustible mineral fibre to ASTM C1071
  - .2 Type: 2
  - .3 Density: 48kg/m<sup>3</sup> minimum.
  - .4 Thickness as indicated.
  - .5 Noise Reduction Coefficient (NRC) designation of 0.95 at 50mm to ASTM C423
  - .6 Ksi value: 0.035 at 24 degrees C.
  - .7 Coated air side for maximum 20.3m/s air velocity.
  - .8 Fire and smoke rating in accordance with CAN/ULC-S102
    - .1 Maximum flame spread rating: 25.
    - .2 Maximum smoke developed rating: 50.
- .2 Acoustical treatment on underside of Firing Range Baffles: to ASTM C423 and ASTM E84.
  - .1 Open cell melamine acoustic foam
  - .2 Class: 1.
  - .3 Density: 0.7 lbs/ft<sup>3</sup>
  - .4 Thickness as indicated.
  - .5 Shape: wedge, pyramid, or baffle.
  - .6 Tensile strength: 8 PSA
  - .7 Noise Reduction Coefficient (NRC) designation of 0.80 at 50mm to ASTM C423
  - .8 Noise Reduction Coefficient (NRC) designation of 1.05 at 75mm to ASTM C423
  - .9 Fire and smoke rating in accordance with CAN/ULC-S102
    - .1 Maximum flame spread rating: 10.
    - .2 Maximum smoke developed rating: 50.
  - .10 Adhesive: as per manufacturer's recommendation.
- .3 Sound batt insulation above ceilings: to CAN/ULC-S702
  - .1 Mineral fibre batt.
  - .2 Type: 1.
  - .3 Thickness: 50mm.
  - .4 Non-combustible: to CAN/ULC S114
  - .5 Surface burning characteristics: to CAN /ULC S102
    - .1 Flame spread: 0 to 10

- .2 Smoke Development: 0 to 10
- .6 Zero formaldehyde content.
- .7 Acoustical performance:
  - .1 Airborne sound transmission loss: to ASTM E90
  - .2 Rating sound insulation: to ASTM E413
  - .3 Sound absorption coefficients: to ASTM C423 (NRC 0.95 for 50mm thickness)
  - .4 Impedance and absorption of acoustical materials: to ASTM E1050.
- .8 Density: to ASTM C612, 45 kg/m<sup>3</sup>.
- .4 Batt and blanket mineral fibre: to CAN/ULC-S702.
  - .1 Type: 1.
  - .2 Density 40kg/m<sup>3</sup>.
  - .3 Thickness: as indicated.
- .5 Rigid Cellular Polyisocyanurate.
  - .1 Exterior wall:
  - .2 Faced: to CAN/ULC-S704.
    - .1 Closed cell polyisocyanurate foam core bonded to inorganic glass fibre reinforced faces, 2 sides per ASTM C1289 Type II, Class 1, Grade 2.
    - .2 Shape: flat.
    - .3 Thickness: as indicated in drawings.
    - .4 RSI (R-value): as indicated in drawings.

## **2.2 ADHESIVE**

- .1 Adhesive: as recommended by manufacture.

## **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 board insulation application in accordance with manufacturer's written instructions.
  - .1 Visually inspect substrate in presence of Departmental Representative.
  - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
  - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

### **3.2 INSTALLATION**

- .1 Install insulation after building substrate materials are dry.
- .2 Install insulation to maintain continuity of acoustic protection to building spaces.

- .3 Fit insulation tight in all areas where installation occurs.
- .4 Keep insulation minimum 75 mm from heat emitting devices such as recessed light fixtures, and minimum 50 mm from sidewalls of CAN/ULC-S604 type A chimneys and CSA B149.1 and CSA B149.2 type B and L vents.
- .5 Cut and trim insulation neatly to fit spaces. Butt joints tightly, offset vertical joints. Use only insulation boards free from chipped or broken edges. Use largest possible dimensions to reduce number of joints.
- .6 Use mechanical fasteners (colour black) for installation of duct liner in plenum behind firing line.

### **3.3 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
  - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

**END OF SECTION**

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**Part 1            General**

**1.1                REFERENCES**

- .1    ASTM International
  - .1    ASTM E1677; Specification for Air Retarder Material or System for Framed Building Walls
- .2    Canadian General Standards Board (CGSB)
  - .1    CAN/CGSB-51.33-M89, Vapour Barrier Sheet, Excluding Polyethylene, for Use in Building Construction.
  - .2    CAN/CGSB-51.34-M86, Vapour Barrier, Polyethylene Sheet, for Use in Building Construction.

**1.2                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 datasheets.

**1.3                QUALITY ASSURANCE**

- .1    Mock-Ups:
  - .1    Submit mock-ups in accordance with Section 01 45 00 - Quality Control.
  - .2    Convene pre-installation meeting prior to construction of mock-up, include major sub-trades..
  - .3    Install mock-up using approved air barrier assemblies including fasteners, flashing, tape and related accessories per manufacturer's current printed instructions and recommendations.
    - .1    Mock-up size: approximately 4 meters by 4 meters including wall opening.
  - .4    Mock-up will be used to judge workmanship, substrate preparation, and material application.
- .2    When accepted, mock-up will demonstrate minimum standard of quality required for this work. Approved mock-up may remain as part of finished work.
- .3    Allow 48 h for inspection of mock-up by Consultant before proceeding with air/vapour barrier Work.

**1.4                SEQUENCING**

- .1    Sequence work to permit installation of materials in conjunction with related materials and seals.

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**Part 2            Products**

**2.1**            Air and Vapour Barrier membrane for Roofing is specified in Section 07 52 00 – Modified Bituminous Membrane Roofing and Section 07 61 00 – Sheet Metal Roofing

**2.2            POLY VAPOUR BARRIER**

.1            Polyethylene film: to CAN/CGSB-51.34, 0.15 mm thick.

**2.3            AIR VAPOUR BARRIER**

.1            Self-Adhesive SBS rubberized asphalt laminated to high-density polyethylene film, minimum nominal total thickness of 1.0 mm.

- .1            Soprema: Sopraseal Stick 1100T
- .2            IKO: Aquabarrier AVB
- .3            Carlisle: CCW 705 A/V Barrier
- .4            Approved equivalent

**2.4            VAPOUR PERMEABLE AIR BARRIER**

.1            Self-adhered water resistive, vapour permeable, air barrier membrane to ASTM E 2178. Consisting of tri-laminate of modified polyolefin with two layers of non-woven polyethylene, suitable for full wall assemblies. Permeable self-adhesive layer with release film. Refer to details on drawings for locations and assembly.

- .1            Henry Company: BlueskinVP 100
- .2            Approved equivalent

**2.5            ACCESSORIES – POLYETHYLENE VAPOUR BARRIER**

.1            Joint sealing tape: air resistant pressure sensitive adhesive tape, type recommended by vapour barrier manufacturer, 50 mm wide for lap joints and perimeter seals, 25 mm wide elsewhere.

.2            Sealant: compatible with vapour retarder materials, recommended by vapour retarder manufacturer. To Section 07 92 00 - Joint Sealing .

.3            Staples: minimum 6 mm leg.

.4            Moulded box vapour barrier: factory-moulded polyethylene box for use with recessed electric switch and outlet device boxes.

**2.6            ACCESSORIES-SHEET VAPOUR BARRIERS**

.1            Sealant: compatible with air barrier materials, recommended by air barrier manufacturer. Refer to Section 07 92 00 - Joint Sealing.

.2            Foam Seal: Spray-applied medium density spray polyurethane foam insulation/air/vapour barrier.

.3            Sheet steel: Galvanized steel, Z275 zinc coating; 0.8 mm thick core steel.

- .4 Attachments: Galvanized steel bars and anchors.
- .7 Primer: Appropriate to application.

**Part 3 Execution**

**3.1 EXAMINATION**

- .1 Verify substrate and surface conditions are in accordance with manufacturer recommended tolerances prior to installation of barrier and accessories.

**3.2 INSTALLATION - POLY VAPOUR BARRIER**

- .1 Refer to Wall Types and details on drawings for location and assembly.
- .2 Ensure services are installed and inspected prior to installation of retarder.
- .3 Install sheet vapour retarder on warm side of exterior wall and ceiling assemblies prior to installation of gypsum board to form continuous retarder.
- .4 Use sheets of largest practical size to minimize joints.
- .5 Inspect for continuity. Repair punctures and tears with sealing tape before work is concealed.
- .6 Exterior Surface Openings
  - .1 Cut sheet vapour retarder to form openings and ensure material is lapped and sealed to frame using sealant recommended by manufacturer.
- .7 Perimeter Seals
  - .1 Seal perimeter of sheet vapour barrier as follows:
    - .1 Apply continuous bead of sealant, minimum 6mm wide and high, to substrate at perimeter of sheets.
    - .2 Lap sheet over sealant and press into sealant bead.
    - .3 Install staples through lapped sheets at sealant bead into wood substrate.
    - .4 Ensure that no gaps exist in sealant bead. Smooth out folds and ripples occurring in sheet over sealant.
- .8 Lap Joint Seals
  - .1 Seal lap joints of sheet vapour barrier as follows:
    - .1 Attach first sheet to substrate.
    - .2 Apply continuous bead of sealant over solid backing at joint.
    - .3 Lap adjoining sheet minimum 150 mm and press into sealant bead.
    - .4 Install staples through lapped sheets at sealant bead into wood substrate.
    - .5 Ensure that no gaps exist in sealant bead. Smooth out folds and ripples occurring in sheet over sealant.
- .9 Electrical Boxes



- .1 Seal electrical switch and outlet device boxes that penetrate vapour barrier as follows:
  - .1 Install moulded box vapour barrier Wrap boxes with film sheet providing minimum 300 mm perimeter lap flange.
  - .2 Apply sealant to seal edges of flange to main vapour barrier and seal wiring penetrations through box cover.

### **3.3 INSTALLATION - AIR VAPOUR BARRIER AND VAPOUR PERMEABLE AIR BARRIER**

- .1 Refer to Wall Types and drawings for locations of air vapour barrier and vapour permeable air barrier.
- .2 Preparation
  - .1 Remove loose or foreign matter which might impair adhesion of materials.
  - .2 Ensure all substrates are clean of oil or excess dust; all masonry joints struck flush, and open joints filled; and all concrete surfaces free of large voids, spalled areas or sharp protrusions.
  - .3 Ensure all substrates are free of surface moisture prior to application of self-adhesive membrane and primer.
  - .4 Ensure metal closures are free of sharp edges and burrs.
  - .5 Prime substrate surfaces to receive adhesive in accordance with manufacturer's instructions.
- .3 Installation
  - .1 Install materials in accordance with manufacturer's instructions to create a continuous seal between all material junctions within the building envelope.
  - .2 Apply sealants and primers within recommended application temperature ranges. Consult manufacturer when products cannot be applied within these temperature ranges.
  - .3 Install membrane using a consecutive weatherboard method starting at base of wall and working upward, provide minimum 50mm side laps and 80mm end laps.
  - .4 Position membrane for alignment, remove protective film and firmly apply pressure to ensure adhesion. Eliminate all gaps and wrinkles.
  - .5 Roll entire membrane surface, including seams, to ensure full contact and adhesion.
  - .6 Seal membrane terminations, heads of mechanical fasteners, masonry tie fasteners, around penetrations, duct work, electrical and other apparatus extending through the water resistive air barrier membrane and around the perimeter edge of membrane terminations at window and door frames with manufacturer recommended sealant.

### **3.4 INSTALLATION – MASONRY CAVITY FLASHING**

- .1 Install masonry cavity flashing in a shingle style manner integrated with other air barrier membranes, as indicated in drawings. Coordinate work with adjacent work to ensure proper lapping of membranes.

**3.5**

**CLEANING**

- .1 Proceed in accordance with Section 01 74 11 – Cleaning.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCES**

- .1 American Society for Testing and Materials International, (ASTM).
  - .1 ASTM A653/A653M-10, Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
  - .2 ASTM A755/A755M-11, Standard Specification for Steel Sheet, Metallic Coated by the Hot-Dip Process and Prepainted by the Coil-Coating Process for Exterior Exposed Building Products.
  - .3 ASTM D523-14, Standard Test Method for Specular Gloss.
  - .4 ASTM D2247-11, Standard Practice for Testing Water Resistance of Coatings in 100% Relative Humidity
  - .5 ASTM D3363-05(2011), Standard Test Method for Film Hardness by Pencil Test.
- .2 Canadian General Standards Board (CGSB).
  - .1 CGSB 19-GP-14M-76 (R1984), Sealing Compound, One Component, Butyl Polyisobutylene Polymer Base, Solvent Curing.
  - .2 CGSB 93.5-92, Installation of Metal Residential Siding, Soffits and Fascia.

**1.2 DESIGN AND PERFORMANCE REQUIREMENTS**

- .1 Components: Design and size to withstand dead and live loads caused by positive and negative wind pressure acting normal to plane of panel as calculated in accordance with National Building Code of Canada.
- .2 Maximum Allowable Deflection of Panel: 1/180.
- .3 Movement: Accommodate movement within system without damage to system, components, or deterioration of seals; movement between system and perimeter components when subject to seasonal temperature cycling; dynamic loading and release of loads; deflection of structural support framing.
- .4 Tolerances: Accommodate tolerances of building structural framing.
- .5 Products: Provide continuity of thermal barrier at building enclosure elements.

**1.3 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for metal siding and include product characteristics, performance criteria, physical size, finish and limitations.
  - .2 Submit two copies of WHMIS MSDS - Material Safety Data Sheets in accordance with Section 01 33 00 - Submittal Procedures.

- .3 Shop Drawings:
  - .1 Indicate dimensions, profiles, attachment methods, schedule of wall elevations, trim and closure pieces, soffits, fascia, metal furring, fasteners, and related work.
- .4 Samples:
  - .1 Submit duplicate 300 x 300 mm samples of siding material, of colour and profile specified.
- .5 Manufacturer's Instructions:
  - .1 Submit manufacturer's installation instructions.

#### **1.4 QUALITY ASSURANCE**

- .1 Test Reports: certified test reports showing compliance with specified performance characteristics and physical properties.
- .2 Certificates: product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

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

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials off ground and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect metal siding from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove for reuse and return of pallets, crates, padding, and packaging materials as specified in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

### **Part 2 Products**

#### **2.1 STEEL CLADDING AND COMPONENTS**

- .1 Zinc coated steel sheet: 0.8 mm thickness, ASTM A792M minimum Grade 230, minimum aluminium-zinc alloy coating designation AZ180 (galvalume); or commercial quality to ASTM A653/A653M with Z275 (galvanized) designated zinc coating.
  - .1 Factory preformed steel sheet.
  - .2 Minimum 0.76mm (22ga) base steel thickness.
  - .3 Finish: factory prefinished 2 coat system.
    - .1 Base metal: ASTM A653 / ASTM A653M for Zinc coated steel (galvanized).

- .2 Film thickness: To ASTM A755/A755M and AAMA 621-02. Minimum topcoat dry film thickness of 18microns (0.7 mils) and 5microns (0.2 mils) primer.
- .3 Film hardness: to ASTM D3363.
- .4 Gloss: to ASTM D523
- .5 Humidity resistance: to ASTM D2247
- .6 Film integrity: no evidence of cracking, flacking, or checking that is apparent on ordinary outdoor observations for first 40 years.
- .7 Product Attributes: minimum of 70% Kynar 500 or Hylar 5000 PVDF resins, 10000 Series.
  - .1 Medium gloss.
  - .2 Colour to be selected from manufacturer's standard range of colours.
- .4 Profile: fluted smooth finish, 300mm x 37 mm deep with reveals at 150mm.
  - .1 Flynn 'S-12-R'
  - .2 VicWest 'AD300'
  - .3 Approved alternate.
- .2 Subgirts: gauge to suit intended application, profile as required and as indicated; to attach panel system to building structure.
- .3 Expansion Joints: As recommended by manufacturer.

## 2.2 FASTENERS

- .1 Nails: CSA B111. Screws: ASME B18.6.3. Purpose made stainless steel.
- .2 Manufacturer's standard type suitable for use with installation of hidden fastener system.

## 2.3 CAULKING

- .1 Sealants: as recommended by manufacturer and in accordance with Section 07 92 00 - Joint Sealants.
- .2 Concealed sealants: one component, butyl polyisobutylene polymer base, solvent curing to CGSB 19 GP 14M. Sealant Type 4.
- .3 Exposed sealants: one component, silicone base, solvent curing, colour to match panel. Sealant Type 3.

## 2.4 ACCESSORIES

- .1 Exposed trim: inside corners, outside corners, cap strip, drip cap, under sill trim, starter strip and window/door trim, brake or ben to shape, of same material, colour and gloss as cladding, with fastener holes pre-punched.
- .2 Insulation: Rigid Cellular Polyisocyanurate: thickness as indicated in drawings. Refer to Section 07 21 13 – Board Insulation.

- .3 Internal and External Corners: Same material, thickness, and finish as exterior sheets; profile to suit system; shop cut and factory mitered to required angles as recommended by manufacturer.
- .4 Include closures, gaskets, caulking, flashing and fasteners to effect weathertight installation. Cut ends of sheets square and clean.

**Part 3 Execution**

**3.1 EXAMINATION**

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable 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 MANUFACTURER'S INSTRUCTIONS**

- .1 Compliance: comply with manufacturer's written data, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, and data sheets.

**3.3 INSTALLATION**

- .1 Install cladding in accordance with CGSB 93.5, and manufacturer's written instructions
- .2 Install cladding in locations and orientations indicated in drawings.
- .3 Install continuous starter strips, inside and outside corners, edgings, drip, cap, sill and window/door opening flashings as indicated.
- .4 Install outside corners, fillers and closure strips with carefully formed and profiled work.
- .5 Install soffit and fascia cladding as indicated.
- .6 Maintain joints in exterior cladding, true to line, tight fitting, hairline joints.
- .7 Attach components in manner not restricting thermal movement.
- .8 Caulk junctions with adjoining work with sealant. Do work in accordance with Section 07 92 00 - Joint Sealants.

**3.4 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.

- .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
  - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

**3.5 PROTECTION**

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by preformed metal siding installation.

**END OF SECTION**

**Part 1 General**

**1.1 SECTION INCLUDES**

- .1 Materials and installation for modified bituminous roofing for conventional installation over sloped insulation and vapour retarder on metal deck.

**1.2 REFERENCES**

- .1 ASTM International Inc.
  - .1 ASTM C1177/C1177M-06, Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing.
  - .2 ASTM C1289-16, Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board.
  - .3 ASTM D5147/D5147M-14, Standard Test Methods for Sampling and Testing Modified Bituminous Sheet Material.
  - .4 ASTM D6164-05, Standard Specification for Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using Polyester Reinforcements.
  - .5 ASTM E96/E96M-14, Standard Test Methods for Water Vapor Transmission of Materials.
  - .6 ASTM E2853-12, Standard Test Method for Evaluating Emergency Response Robot Capabilities: Human-System Interaction (HSI): Search Tasks: Random Mazes with Complex Terrain.
- .2 Canadian General Standards Board (CGSB)
  - .1 CGSB 37-GP-9Ma-83, Primer, Asphalt, Unfilled, for Asphalt Roofing, Dampproofing and Waterproofing.
  - .2 CGSB 37-GP-56M-80b(A1985), Membrane, Modified, Bituminous, Prefabricated, and Reinforced for Roofing.
  - .3 CAN/CGSB-51.33-M89, Vapour Barrier Sheet, Excluding Polyethylene, for Use in Building Construction.
- .3 Canadian Roofing Contractors Association (CRCA)
  - .1 CRCA Roofing Specifications Manual-1997.
- .4 Canadian Standards Association (CSA International)
  - .1 CSA A123.21-04, Standard Test Method for the Dynamic Wind Uplift Resistance of Mechanically Attached Membrane-Roofing Systems
- .5 Health Canada / Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (MSDS).

**1.3 PERFORMANCE REQUIREMENTS**

- .1 Wind Uplift Resistance testing will be in accordance with CSA A123.21
- .2 Building parameters



- .1 Geometry: Low rise, low slope roof.
  - .2 Exposure: Open.
  - .3 Openings: Category 2
  - .4 Importance: High
- .3 Submit a report, issued by a certified materials testing laboratory, showing the roofing system offered was tested in accordance with CSA A123.21-10, Standard Test Method for the Dynamic Wind Uplift Resistance of Membrane Roofing Systems. Test results shall demonstrate the roofing system provides a Dynamic Uplift Resistance pressure for the field, edges and corners of the roof that satisfy the wind load requirements per the NBCC.
  - .4 Compatibility between components of roofing system is essential. Provide written declaration to Consultant stating that materials and components, as assembled in system, meet this requirement.

#### **1.4 ADMINISTRATIVE REQUIREMENTS**

- .1 Convene pre-installation meeting one week prior to beginning waterproofing Work, with roofing contractor's representative, Departmental Representative, and Consultant in accordance with Section 01 32 16.07 - Construction Progress Schedules - Bar (GANNT) Chart to:
  - .1 Verify project requirements.
  - .2 Review installation and substrate conditions.
  - .3 Co-ordination with other building subtrades.
  - .4 Review manufacturer's installation instructions and warranty requirements.

#### **1.5 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Provide two copies of most recent technical roofing components data sheets describing materials' physical properties and include product characteristics, performance criteria, physical size, finish and limitations.
  - .2 Provide two copies of WHMIS MSDS in accordance with Section 01 35 29.06 - Health and Safety Requirements, and indicate VOC content for:
    - .1 Primers.
    - .2 Asphalt.
    - .3 Sealers.
    - .4 Filter fabric.
- .3 Provide shop drawings:
  - .1 Indicate membrane flashing and tapered insulation details.
  - .2 Provide layout for tapered insulation.
- .4 Manufacturer's Certificate: certify that products meet or exceed specified requirements.

- .5 Test and Evaluation Reports: submit laboratory test reports certifying compliance of bitumens and membrane with specification requirements.
- .6 Manufacturer's Installation Instructions: indicate special precautions required for seaming the membrane.
- .7 Manufacturer's field report: in accordance with Section 01 45 00 - Quality Control.
- .8 Reports: indicate procedures followed, ambient temperatures and wind velocity during application.

## **1.6 QUALITY ASSURANCE**

- .1 Installer qualifications: company specializing in application of modified bituminous roofing systems approved by manufacturer with 5 years documented experience. Roofing contractor will supply and install materials to acceptance of manufacturer in order to qualify for manufacturer's warranty.

## **1.7 FIRE PROTECTION**

- .1 Fire Extinguishers:
  - .1 Maintain one stored pressure rechargeable type with hose and shut-off nozzle,
  - .2 ULC labelled for A, B and C class protection.
  - .3 Size 9 kg on roof per torch applicator, within 6 m of torch applicator.
- .2 Maintain fire watch for 1 hour after each day's roofing operations cease.

## **1.8 DELIVERY, STORAGE, AND HANDLING**

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions and Section 01 61 00 - Common Product Requirements.
- .2 Storage and Handling Requirements:
  - .1 Safety: comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage, and disposal of asphalt, sealing compounds, primers and caulking materials.
  - .2 Provide and maintain dry, off-ground weatherproof storage.
  - .3 Store rolls of felt and membrane in upright position. Store membrane rolls with salvage edge up.
  - .4 Remove only in quantities required for same day use.
  - .5 Place plywood runways over completed Work to enable movement of material and other traffic.
  - .6 Store sealants at +5 degrees C minimum.
  - .7 Store insulation protected from daylight, weather, and deleterious materials.

## **1.9 SITE CONDITIONS**

- .1 Ambient Conditions
  - .1 Do not install roofing when temperature remains below -18 degrees C for torch application, or to manufacturers' recommendations for mop application.
  - .2 Minimum temperature for solvent-based adhesive is -5 degrees C.

- .2 Install roofing on dry deck, free of snow and ice, use only dry materials and apply only during weather that will not introduce moisture into roofing system.

### **1.10 WARRANTY**

- .1 Contractor shall warrant that modified bituminous roofing and membrane flashings will stay in place and remain leakproof for 24 months.
- .2 Membrane manufacturer will issue a written and signed document in the Owner's name, valid for a 10-year period, stating it will repair all leaks in the roofing membrane to restore the roofing system to a dry and watertight condition should defects in either the membrane manufacturing or workmanship of the installation cause water infiltration. The warranty will cover the full cost of the repairs during the entire warranty period.

## **Part 2 Products**

### **2.1 PERFORMANCE CRITERIA**

- .1 Compatibility between components of roofing system is essential. Provide written declaration to Departmental Representative stating that materials and components, as assembled in system, meet this requirement and are eligible for system warranty.
- .2 Roofing System: to CSA A123.21 for wind uplift resistance.

### **2.2 DECK PRIMER**

- .1 Elastomeric bitumen and solvent based for self-adhesive waterproofing membranes as recommended by vapour retarder membrane manufacturer. Primer must be suitable for temperatures at which it will be installed.

### **2.3 ADHESIVES**

- .1 Dual component urethane, solvent free, cold process roofing adhesive as recommended by roof membrane manufacturer. Adhesive must be suitable for temperatures at which it will be installed.
  - .1 IKO Millennium: One Step Foamable Adhesive.
  - .2 Soprema: Duotack Adhesive.
  - .3 Approved alternate

### **2.4 VAPOUR RETARDER**

- .1 SBS Modified Bitumen to ASTM D5147.
- .2 SBS self-adhered modified bitumen. Top surface is a high-density polyethylene grid laminated between two layers of polyethylene film. Silicone release plastic film covers the self-adhesive back side.
- .3 Vapour retarder must be suitable for installation directly on metal deck.
  - .1 Thickness: min 0.8mm
  - .2 Air permeability: ASTM E2853 (75 Pa).
  - .3 Water vapour permeance: ASTM E96 (procedure B).

- .4 Top face: high density polyethylene grid laminated between two layers of polyethylene film.
- .5 Thickness: 0.8 mm.
- .6 Self-adhesive with silicone plastic release liner.
- .7 Acceptable Products:
  - .1 IKO: IKO- MVP
  - .2 Soprema – Sopravap'R
  - .3 Approved alternate.

## **2.5 PROTECTION PANELS**

- .1 Multi-ply, semi-rigid asphaltic roofing substrate board composed of a mineral fortified asphaltic core formed between two asphaltic saturated fibreglass liners.
  - .1 Insulation protection panels: 1220mm x 2440mm, minimum thickness 4.8mm.
  - .2 Acceptable products:
    - .1 IKO: Protectoboard
    - .2 Soprema: Sopraboard
    - .3 Approved alternate.

## **2.6 FIRE PROTECTION TAPE**

- .1 Self-adhesive membrane composed of a reinforced glass mat and SBS modified bitumen designed to prevent flames from penetrating into empty spaces and openings while installing heat-welded membranes.

## **2.7 BOARD INSULATION**

- .1 Faced: to CAN/ULC C-S704.
  - .1 Closed cell polyisocyanurate foam core bonded to inorganic glass fibre reinforced faces, 2 sides per ASTM C1289 Type II, Class 1, Grade 2.
  - .2 Shape: flat and tapered as required to suit roof drainage slopes and plan.
  - .3 Pre-manufactured tapered sump panels.
  - .4 Average RSI (R-Value): as noted in drawings
  - .5 Approved product:
    - .1 Compatible with roof membrane system and acceptable to membrane manufacturer as part of the specified extended warranty.
- .2 Adhere insulation to meet requirements of CSA 123.21 and in accordance with manufacturer's written instructions.

## **2.8 PREMANUFACTURED TAPERED SUMP PANEL**

- .1 Rigid cellular Polyisocyanurate, panels tapered to centre, size 2440 x 2440 mm, 172 KPa (25 PSI).
  - .1 Minimum thickness at roof drain: 25mm.
  - .2 Perimeter thickness: 50mm (approximately 2% slope to drain)

## 2.9 MEMBRANE

- .1 Base sheet membrane systems:
- .2 Factory laminated base sheet to asphaltic board or base membrane torched to protection panels on site are both acceptable systems for base sheet installation. Selection of either base sheet system is at the discretion of the Contractor.
- .3 To CGSB-37.56-M and ASTM D6164. Styrene Butadiene Styrene (SBS) elastomeric polymer prefabricated sheet, polyester reinforcement, having nominal weight of 180 g/m<sup>2</sup>.
  - .1 Factory-laminated Base Sheet Panel:
    - .1 SBS modified base sheet membrane factory-laminated on a semi-rigid asphaltic board. Top surface is covered with thermofusible plastic film. base sheet has a duo selvedge composed of both self-adhesive and thermofusible sections. Minimum panel thickness including membrane : 6.5 mm. Minimum membrane thickness 2.0 mm.
      - .1 Soprema: Soprasmart Board 180.
      - .2 Approved alternate.
    - .2 Fibre board panels are not acceptable.
  - .2 Base Sheet membrane (installed over protection panels):
    - .1 Non-woven reinforced polyester reinforcing mat coated and impregnated with SBS modified bitumen to a nominal thickness of 3.0 mm. Both sides covered with a thermofusible plastic film.
      - .1 IKO: Torchflex TP-180-FF-Base
      - .2 Soprema: Sopralene Flam 180
      - .3 Approved alternate.
- .4 Cap Sheet Membrane:
  - .1 To CGSB 37-GP-56M polyester fibres to ASTM D6164. Styrene Butadiene Styrene(SBS) elastomeric polymer prefabricated sheet, polyester reinforcement, having nominal weight of 250 g/m<sup>2</sup>. Top face is covered with coloured granules. underface is covered with a thermofusible plastic film.
  - .2 Colour for granular surface: white, minimum SRI 75.
    - .1 IKO: Armourcool HD TP
    - .2 Soprema: Soprastar Flam HD GR
    - .3 Approved alternate.
- .5 Flashing Membranes
  - .1 Base Sheet Flashing: to CGSB 37 GP 56M. Styrene Butadiene Styrene elastomeric polymer, prefabricated sheet, heavy duty reinforcement, self-adhesive underface, top surface torchable polyethylene
    - .1 IKO: Armour Bond Flash.
    - .2 Soprema: Sopraflash Flam Stick
    - .3 Approved alternate.

- .2 Cap Sheet Flashing: to CGSB 37 GP 56M. Styrene Butadiene Styrene (SBS) elastomeric polymer, prefabricated sheet, heavy duty reinforcement. Fully adhered torched on membrane. Cap sheet flashing underface is covered with a plastic thermofusible film. Top face is protected by coloured granules to match cap sheet.
  - .1 IKO: TP-250-CAP
  - .2 Soprema: Sopralene Flam 250
  - .3 Approved alternate.
- .6 Walkway
  - .1 Walkway to consist of one additional ply of cap sheet membrane.
    - .1 Colour: Grey.
- .7 Warning Strip
  - .1 Warning strip to consist of one additional ply of cap sheet membrane.
    - .1 Colour: red.
- .8 Perimeter Fastening Strip
  - .1 Prefinished metal angle 22ga, galvanized, 100mm x 100mm metal angle, fabricated with 90 degree bend to be used for mechanical attachment of roofing base sheet panels to parapet or area divider walls and curbs greater than 600mm in length.

## **2.10 ADHESIVE**

- .1 Adhesive for securing overlay board and insulation: [asphalt extended vulcanized adhesive, two component unit, consisting of two liquids mixed on site to produce pourable adhesive].

## **2.11 SEALERS**

- .1 Plastic cement: asphalt, to CAN/CGSB-37.5
- .2 Sealing compound: to CAN/CGSB-37.29, rubber asphalt type.
- .3 Sealants:
  - .1 Urethanes Two Part.
    - .1 Non-sag to CAN/CGSB-19.24, Type 2, Class B, colour to match adjacent surfaces.
  - .2 Silicones One part
    - .1 Mildew resistant.

## **2.12 FASTENERS**

- .1 As recommended by manufacturer.

## **2.13 CARPENTRY**

- .1 Refer to Section 06 10 00 - Rough Carpentry.

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**Part 3 Execution**

**3.1 QUALITY OF WORK**

- .1 Compliance: comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and datasheets.
- .2 Do examination, preparation and roofing Work in accordance with Roofing Manufacturer's Specification Manual, CRCA Roofing Specification Manual, and to FM Design No. as specified.
- .3 Do priming in accordance with manufacturers written recommendations.
- .4 The interface of the walls and roof assemblies will be fitted with durable rigid material [sheet metal] [plywood] providing connection point for continuity of air barrier.
- .5 Assembly, component and material connections will be made in consideration of appropriate design loads, [with reversible mechanical attachments].

**3.2 EXAMINATION OF ROOF DECKS**

- .1 Verification of Conditions:
  - .1 Inspect with Departmental Representative deck conditions including parapets, construction joints, roof drains, plumbing vents and ventilation outlets to determine readiness to proceed.
- .2 Prepare surfaces and complete waterproofing work in conformance with manufacturer's written instructions. Install roofing elements on clean and dry surfaces, in conformance with manufacturer's instructions and recommendations.
- .3 Evaluation and Assessment:
  - .1 Prior to beginning of work ensure:
    - .1 Decks are firm, straight, smooth, dry, free of snow, ice or frost, and swept clean of dust and debris. Do not use calcium or salt for ice or snow removal.
    - .2 Curbs have been built.
    - .3 Roof drains have been installed at proper elevations relative to finished roof surface.
    - .4 Plywood and lumber nailer plates have been installed to deck, walls and parapets as indicated.
- .4 Do not install roofing materials during rain or snowfall.

**3.3 PROTECTION OF IN-PLACE CONDITIONS**

- .1 Cover walls, walks and adjacent work where materials hoisted or used.
- .2 Use warning signs and barriers. Maintain in good order until completion of Work.
- .3 Clean off drips and smears of bituminous material immediately.
- .4 Dispose of rain water off roof and away from face of building until roof drains or hoppers installed and connected.

- .5 Protect new and existing roof membranes from traffic and damage. Comply with precautions deemed necessary by Departmental Representative.
- .6 At end of each day's work or when stoppage occurs due to inclement weather, provide protection for completed Work and materials out of storage.
- .7 Metal connectors and decking will be treated with rust proofing or galvanization.

### **3.4 VAPOUR RETARDER**

- .1 Install the self-adhesive vapour retarder membrane in conformance with the manufacturer's recommended methods.
- .2 Apply primer to roof substrates as recommended by membrane manufacturer. All surfaces to be primed must be free of rust, dust or any residue that may hinder adherence. Cover primed surfaces with roofing membrane as soon as possible.
- .3 Hold the membrane in place, remove the siliconized release film from the underside by pulling diagonally. Apply pressure with a roller to ensure positive adhesion to the surface. Install subsequent rolls in the same manner and overlap the side laps a minimum of 75 mm. Roll all laps for positive adhesion.
- .4 Ensure the membrane end lap is overlapped a minimum of 150mm (6") and roll the lap for positive adhesion.
- .5 Install vapour retarder membrane to vertical surfaces at perimeters, curbs, and other roof projections to permit a sealed connection with the base sheet layer. Vapour retarder extensions on vertical surfaces to be installed not more than 25mm above the level of the field base sheet membrane.
- .6 Metal Decking
  - .1 Unroll vapour retarder membrane directly onto metal decking, parallel with the direction of the flutes. Ensure the metal deck surface is clean, dry, and free of any loose material. Align the longitudinal edge of the membrane with the edge of the top flute.
  - .2 Affix a metal plate 150mm x 1066mm to support the membrane end lap between the flutes of the deck. Ensure the membrane end lap is overlapped a minimum of 150mm and roll the lap for positive adhesion.
  - .3 Roll two membrane end laps to ensure a complete end lap seal.

### **3.5 PRIMING PARAPET**

- .1 Apply deck primer to substrate at rate recommended by manufacturer for adherence of self-adhesive parapet base membranes.

### **3.6 PROTECTION PANELS**

- .1 Protection Panel is not required if factory-laminated base sheet panels are used.
- .2 Apply adhesive in strict conformance with manufacturer's written recommendations.
- .3 Measure and cut asphalt core panels to fit profile of curb or parapet. Cut sheets to proper length in maximum 1200mm widths.



- .4 Apply adhesive to substrate and carefully lay insulation protection panels onto adhesive. Avoid excessive sliding of boards and smearing of adhesive. Once panel is in place, use a 100lb steel roller over entire surface of panel to ensure complete contact with adhesive.
- .5 Measure and cut insulation protection panels to ensure minimum ½ size panels adjacent to parapets and roof dividers.
- .6 Install only as many panels as can be covered same day with waterproofing layer.

### **3.7 FIRE PROTECTION TAPE**

- .1 Apply fire protection tape according to manufacturer's written instructions.
- .2 Install prior to torch-applied vapour retarders, base sheets or stripping membranes. Install over substrate cracks, voids, vertical abutments, panel joints and any locations subject to back drafts or entrance of flame from torch.

### **3.8 PERIMETER FASTENING**

- .1 Prior to installation of base sheet panels, install the prefinished metal angle at all parapet and divider walls and curbs greater than 600mm in length.
- .2 Place the angle tight to the roof/wall connection and directly on top of the insulation panels. Mechanically attach the metal angle to the side walls @ 300mm o/c (or at stud spacing for gypsum substrates).

### **3.9 EXPOSED MEMBRANE ROOFING APPLICATION**

- .1 Insulation: fully adhered.
- .2 Factory-laminated Base Sheet Application:
  - .1 Fully adhere factory-laminated base sheet panel directly to insulation layer. Insulation Protection Panel is not required if factory-laminated base sheet panels are used.
  - .2 Apply adhesive in strict conformance with manufacturer's written recommendations.
  - .3 Starting at low point or roof drain, install base sheet panels over insulation layer, aligned with edge of roof. Panels must be snugly fitted, without any significant differences in level.
  - .4 Install factory-laminated base sheet panel in strict accordance with manufacturer's written instructions.
  - .5 All vertical joints between substrate and base sheet panels will be staggered.
  - .6 Application to be free of blisters, wrinkles and fishmouths.
- .3 Base Sheet Membrane application (when factory laminated base sheet is not used).
  - .1 Install torch applied base sheet in strict accordance with manufacturer's written instructions.
  - .2 Unroll base sheet at drain with side lap lined up with drain centre and ensure roll is parallel to roof edge.
  - .3 Torch apply base sheet directly to bituminous protection panels. Ensure adequate heat is used to liquefy bitumen and obtain positive adherence to substrate.

- .4 Ensure installation is free of wrinkles, air pockets, and fishmouths.
- .4 Cap Sheet Application:
  - .1 Install torch applied cap sheet in strict accordance with manufacturer's written instructions.
  - .2 Starting at low point on roof, perpendicular to slope, unroll cap sheet, align and reroll from both ends.
  - .3 Unroll and torch cap sheet onto base sheet taking care not to burn membrane or its reinforcement.
  - .4 Application to be free of blisters, fishmouths and wrinkles.
- .5 Membrane Flashings:
  - .1 Complete installation of flashing base sheet stripping prior to installing membrane cap sheet. Install flashing in strict accordance with manufacturer's written instructions.
  - .2 Lap flashing base sheet to membrane base sheet minimum 150 mm and seal torch welding.
  - .3 Lap flashing cap sheet to membrane cap sheet 250 mm minimum and torch weld.
  - .4 Provide 75 mm minimum side lap and seal.
  - .5 Properly secure flashings to their support, without sags, blisters, fishmouths, wrinkles or excessive bleed-out at joints.
- .6 Reinforced Gussets
  - .1 Install reinforcing gussets in all inside and outside corners in conformance to manufacturer's specifications.
  - .2 Install gussets after installation of base sheet membranes. Heat weld and butter gussets to provide a smooth finish.
- .7 Roof penetrations:
  - .1 Install roof drain pans, vent stack covers and other roof penetration flashings and seal to membrane in accordance with manufacturer's recommendations and details and as noted in drawings

**3.10 WALKWAY**

- .1 Install over cap sheet. Prepare cap sheet as required for additional walkway layer.
- .2 Refer to drawings for location.

**3.11 WARNING STRIP**

- .1 Install over cap sheet. Prepare cap sheet as required for additional warning strip layer.
- .2 Install walkway membrane in accordance with manufacturer's instructions.
- .3 Refer to drawings for location.

**3.12 PREMANUFACTURED TAPERED SUMP PANEL**

- .1 Install premanufactured tapered sump panels at each roof drain location.

- .2 Adhere tapered sump panel to roof deck according to manufacturer's written instructions.

**3.13 CLEANING**

- .1 Remove bituminous markings from finished surfaces.
- .2 In areas where finished surfaces are soiled caused by work of this section, consult manufacturer of surfaces for cleaning advice and complying with their [documented] instructions.
- .3 Repair or replace defaced or disfigured finishes caused by work of this section.
- .4 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
  - .1 Place materials defined as hazardous or toxic in designated containers.
  - .2 Clearly label location of salvaged material's storage areas and provide barriers and security devices.
  - .3 Ensure emptied containers are sealed and stored safely.
  - .4 Unused paint and coating material must be disposed of at official hazardous material collections.
  - .5 Unused adhesive, sealant and [asphalt] materials must not be disposed of into sewer system, into streams, lakes, onto ground or in other location where it will pose health or environmental hazard.
  - .6 Dispose of unused adhesive material at official hazardous material collections.
  - .7 Dispose of unused sealant material at official hazardous material collections site.
  - .8 Dispose of unused asphalt material at official hazardous material collections site.

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCES**

- .1 The Aluminum Association Inc. (AAI)
  - .1 AAI-Aluminum Sheet Metal Work in Building Construction-2002.
  - .2 AAI DAF45-03, Designation System for Aluminum Finishes.
- .2 American Society for Testing and Materials International (ASTM)
  - .1 ASTM A653/A653M-07, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
  - .2 ASTM B32-04, Standard Specification for Solder Metal.
  - .3 ASTM D523-89(1999), Standard Test Method for Specular Gloss.
  - .4 ASTM D822-01(2006), Standard Practice for Filtered Open-Flame Carbon-Arc Exposures of Paint and Related Coatings.
- .3 Canadian Roofing Contractors Association (CRCA)
  - .1 Roofing Specifications Manual 1997.
- .4 Canadian General Standards Board (CGSB)
  - .1 CAN/CGSB-51.32-M77, Sheathing, Membrane, Breather Type.
  - .2 CAN/CGSB-93.1-M85, Sheet Aluminum Alloy, Prefinished, Residential.
- .5 Canadian Standards Association (CSA International)
  - .1 CSA A123.3-05, Asphalt Saturated Organic Roofing Felt.
  - .2 CSA B111-1974(R2003), Wire Nails, Spikes and Staples.
- .6 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (MSDS).

**1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's printed product literature for sheet metal flashing systems materials, specifications 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 01 35 29.06 - Health and Safety Requirements.
- .3 Shop Drawings:
  - .1 Shop drawings: submit drawings showing locations, fastening and anchoring methods, details, materials, and finish.
- .4 Samples:

- .1 Submit duplicate 100 x 100 mm samples of each type of sheet metal material, finishes and colours.
- .5 Quality assurance 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, and cleaning procedures.

### **1.3 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Waste Management and Disposal:
  - .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

## **Part 2 Products**

### **2.1 SHEET METAL MATERIALS**

- .1 Zinc coated steel sheet: 0.8 mm thickness, commercial quality to ASTM A653/A653M, with Z275 designation zinc coating.

### **2.2 PREFINISHED STEEL SHEET**

- .1 Prefinished steel with factory applied polyvinylidene fluoride.
  - .1 Class F1S.
  - .2 Profile: match existing profiles.
  - .3 Colour: to match existing metal and cap flashings.
  - .4 Specular gloss: 30 units +/- in accordance with ASTM D523.
  - .5 Coating thickness: not less than 22 micrometres.
  - .6 Resistance to accelerated weathering for chalk rating of 8, colour fade 5 units or less and erosion rate less than 20% to ASTM D822 as follows:
    - .1 Outdoor exposure period 2500 hours.
    - .2 Humidity resistance exposure period 5000 hours.

### **2.3 ACCESSORIES**

- .1 Isolation coating: alkali resistant bituminous paint.
- .2 Underlay for metal flashing: No. 15 perforated asphalt felt to CSA A123.3.
- .3 Sealants: in accordance with Section 07 92 00 – Joint Sealants.
  - .1 Maximum VOC limit 50 g/L.
- .4 Cleats: of same material, and temper as sheet metal, minimum 50 mm wide. Thickness same as sheet metal being secured.

- .5 Fasteners: of same material as sheet metal, to CSA B111, ring thread flat head roofing nails of length and thickness suitable for metal flashing application.
- .6 Washers: of same material as sheet metal, 1 mm thick with rubber packings.
- .7 Solder: to ASTM B32, alloy composition.
- .8 Touch-up paint: as recommended by prefinished material manufacturer.

## **2.4 FABRICATION**

- .1 Fabricate metal flashings and other sheet metal work in accordance with applicable CRCA 'FL' series details and as indicated.
- .2 Fabricate aluminum flashings and other sheet aluminum work in accordance with AAI-Aluminum Sheet Metal Work in Building Construction.
- .3 Form pieces in 2400 mm maximum lengths.
  - .1 Make allowance for expansion at joints.
- .4 Hem exposed edges on underside 12 mm.
  - .1 Mitre and seal corners with sealant.
- .5 Form sections square, true and accurate to size, free from distortion and other defects detrimental to appearance or performance.
- .6 Apply isolation coating to metal surfaces to be embedded in concrete or mortar.

## **2.5 METAL FLASHINGS AND CAP FLASHINGS**

- .1 Form flashings, copings and fascia to profiles indicated of 0.8 mm thick prefinished steel.

## **2.6 SCUPPERS**

- .1 Form scuppers from 1.2 mm thick prefinished sheet metal.
- .2 Sizes and profiles as indicated in drawings.
- .3 Provide necessary fastenings.
- .4 Colour as selected from manufacture's standard range of colours.

## **Part 3 Execution**

### **3.1 MANUFACTURER'S INSTRUCTIONS**

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

### **3.2 INSTALLATION**

- .1 Install sheet metal work in accordance with CRCA FL series details, and as indicated.
- .2 Use concealed fastenings except where approved before installation.
- .3 Provide underlay under sheet metal.
  - .1 Secure in place and lap joints 100 mm.

- .4 Counterflash bituminous flashings at intersections of roof with vertical surfaces and curbs.
  - .1 Flash joints using S-lock forming tight fit over hook strips.
- .5 Lock end joints and caulk with sealant.
- .6 Install metal flashing under cap flashing to form weather tight junction.

### **3.3 SCUPPERS**

- .1 Form scuppers from 1.2 mm prefinished metal. Provide fasteners as required to secure scupper in wall. Scuppers shall be formed in a box shape and shall be continuous through entire depth of wall.
- .2 Install scuppers as indicated.

### **3.4 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 Leave work areas clean, free from grease, finger marks and stains.

**END OF SECTION**

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**Part 1            General**

**1.1                REFERENCES**

- .1        Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1        Material Safety Data Sheets (MSDS).
- .2        Underwriter's Laboratories of Canada (ULC)
  - .1        ULC-S115-1995, Fire Tests of Fire stop Systems.

**1.2                DEFINITIONS**

- .1        Fire Stop Material: device intended to close off opening or penetration during fire or materials that fill openings in wall or floor assembly where penetration is by cables, cable trays, conduits, ducts and pipes and poke-through termination devices, including electrical outlet boxes along with their means of support through wall or floor openings.
- .2        Single Component Fire Stop System: fire stop material that has Listed Systems Design and is used individually without use of high temperature insulation or other materials to create fire stop system.
- .3        Multiple Component Fire Stop System: exact group of fire stop materials that are identified within Listed Systems Design to create on site fire stop system.
- .4        Tightly Fitted; (ref: NBC Part 3.1.9.1.1 and 9.10.9.6.1): penetrating items that are cast in place in buildings of noncombustible construction or have "0" annular space in buildings of combustible construction.
  - .1        Words "tightly fitted" should ensure that integrity of fire separation is such that it prevents passage of smoke and hot gases to unexposed side of fire separation.

**1.3                ACTION AND INFORMATIONAL SUBMITTALS**

- .1        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 two copies of WHMIS MSDS - Material Safety Data Sheets in accordance with Section 02 81 01 - Hazardous Materials.
- .3        Shop Drawings:
  - .1        Submit shop drawings to show location, proposed material, reinforcement, anchorage, fastenings and method of installation.
  - .2        Construction details should accurately reflect actual job conditions.
- .4        Samples:
  - .1        Submit duplicate 300 x 300 mm samples showing actual fire stop material proposed for project.



- .5 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, cleaning procedures and [\_\_\_\_\_].

#### **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 indicated 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.
  - .1 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<sup>2</sup> : fire stopping to consist of bead of fire stopping material between retaining angle and fire separation and between retaining angle and duct, on each side of fire separation.

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCES**

- .1 ASTM International
  - .1 ASTM E814-13a, Standard Test Method for Fire Tests of Penetration Firestop Systems.
  - .2 ASTM E1966-15, Standard Test Method for Fire-Resistive Joint Systems.
- .2 Canadian General Standards Board (CGSB)
  - .1 CAN/CGSB-19.13-M87, Sealing Compound, One-component, Elastomeric, Chemical Curing.
  - .2 CAN/CGSB-19.17-M90, One-Component Acrylic Emulsion Base Sealing Compound.
  - .3 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 2 copies of WHMIS MSDS in accordance with Section 01 35 29.06 - Health and Safety Requirements.
- .3 Samples:
  - .1 Submit 2 samples of each type of material and colour.
  - .2 Cured samples of exposed sealants for each colour where required to match adjacent material.
- .4 Manufacturer's Instructions:
  - .1 Submit instructions to include installation instructions for each product used.
- .5 Sustainable Design Submittals:
  - .1 Construction Waste Management:

- .1 Submit project Waste Management Plan and Waste Reduction Workplan highlighting recycling and salvage requirements.
- .2 Submit calculations on end-of-project recycling rates, salvage rates, and landfill rates demonstrating that 50% of construction wastes were recycled or salvaged.

### **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 off ground, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Replace defective or damaged materials with new.
- .4 Develop Construction Waste Management Plan and Waste Reduction Workplan related to Work of this Section.
- .5 Packaging Waste Management: remove for reuse and return of pallets, crates, padding, packaging materials as specified in Construction Waste Management Plan and Waste Reduction Workplan in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

### **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 for application and curing of sealants including special conditions governing use.
- .3 Ventilate area of work 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 - Acrylic Latx One Part
  - .1 To CAN/CGSB-19.17.
- .2 Type 2 - 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
- .3 Type 3 – Acoustical Sealant and Firestopping
  - .1 To ASTM E-814 and ASTM E-1966
  - .2 Acceptable material: Metacaulk MC-150+.
- .4 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/m<sup>3</sup> density, or neoprene foam backer, size as recommended by manufacturer.

- .4 Bond breaker tape:
  - .1 Polyethylene bond breaker tape which will not bond to sealant.

### **2.3 SEALANT SELECTION**

- .1 Control and expansion joints on the interior of exterior poured-in place concrete walls: sealant type: 2.
- .2 Control and expansion joints on the interior of exterior surfaces of unit masonry walls: sealant type: 2.
- .3 Interior control and expansion joints in floor surfaces: sealant type: 2.
- .4 Perimeters of interior frames, as detailed and itemized: sealant type: 1.
- .5 Perimeter of millwork: sealant type: 1.
- .6 Perimeter of ductwork through gypsum board assembly: sealant type: 3.
- .7 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.
  - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

**3.8 PROTECTION**

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by joint sealants installation.

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCES**

- .1 American Society for Testing and Materials International (ASTM)
  - .1 ASTM A653/A653M-06a, Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- .2 Canadian General Standards Board (CGSB)
  - .1 CAN/CGSB-1.181-99, Ready-Mixed Organic Zinc-Rich Coating.
- .3 Canadian Standards Association (CSA International)
  - .1 CSA-G40.20-04/G40.21-04, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
  - .2 CSA W59-03, Welded Steel Construction (Metal Arc Welding).
- .4 Canadian Steel Door Manufacturers' Association (CSDMA)
  - .1 CSDMA, Recommended Specifications for Commercial Steel Doors and Frames, 2000.
  - .2 CSDMA, Selection and Usage Guide for Commercial Steel Doors, 1990.
- .5 National Fire Protection Association (NFPA)
  - .1 NFPA 80-99, Standard for Fire Doors and Fire Windows.
  - .2 NFPA 252-03, Standard Methods of Fire Tests of Door Assemblies.
- .6 Underwriters' Laboratories of Canada (ULC)
  - .1 CAN4-S104-M80, Standard Method for Fire Tests of Door Assemblies.
  - .2 CAN4-S105-M85, Standard Specification for Fire Door Frames Meeting the Performance Required by CAN4-S104.

**1.2 SYSTEM DESCRIPTION**

- .1 Design Requirements:
  - .1 Steel fire rated doors and frames: labelled and listed by an organization accredited by Standards Council of Canada in conformance with CAN4-S104 for ratings specified or indicated.
  - .2 Provide fire labelled frames for openings requiring fire protection ratings. Test products in conformance with CAN4-S104 or ASTM E152 and listed by nationally recognized agency having factory inspection services.

**1.3 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Provide product data: in accordance with Section 01 33 00 - Submittal Procedures.
- .3 Provide shop drawings: in accordance with Section 01 33 00 - Submittal Procedures.

- .1 Indicate each type of door, material, steel core thicknesses, mortises, reinforcements, location of exposed fasteners, openings, glazed, arrangement of hardware, fire rating, and finishes.
- .2 Indicate each type frame material, core thickness, reinforcements, glazing stops, location of anchors and exposed fastenings, reinforcing, fire rating, and finishes.
- .3 Include schedule identifying each unit, with door marks and numbers relating to numbering on drawings and door schedule.
- .4 Provide samples in accordance with Section 01 33 00 - Submittal Procedures.

#### **1.4 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Waste Management and Disposal:
  - .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

### **Part 2 Products**

#### **2.1 MATERIALS**

- .1 Hot dipped galvanized steel sheet: to ASTM A653M, ZF75, minimum base steel thickness in accordance with CSDMA Table 1 - Thickness for Component Parts.
- .2 Reinforcement: to CSA G40.20/G40.21, Type 44W, coating designation to ASTM A653M, ZF75.

#### **2.2 DOOR CORE MATERIALS**

- .1 Honeycomb construction:
  - .1 Structural small cell, 24.5 mm maximum kraft paper 'honeycomb', weight: 36.3 kg per ream minimum, density: 16.5 kg/m<sup>3</sup> minimum sanded to required thickness.
  - .2 Temperature rise rated (TRR): core composition to limit temperature rise on unexposed side of door to 250 degrees C at 60 minutes. Core to be tested as part of a complete door assembly, in accordance with CAN4-S104, ASTM E152, or NFPA 252, covering Standard Method of Tests of Door Assemblies and listed by nationally recognized testing agency having factory inspection service.

#### **2.3 ADHESIVES**

- .1 Honeycomb cores and steel components: heat resistant, spray grade, resin reinforced neoprene/rubber (polychloroprene) based, low viscosity, contact cement.
  - .1 Adhesive: maximum VOC content 50 g/L.
- .2 Polystyrene and polyurethane cores: heat resistant, epoxy resin based, low viscosity, contact cement.

- .3 Lock-seam doors: fire resistant, resin reinforced polychloroprene, high viscosity, sealant/adhesive.

## **2.4 PRIMER**

- .1 Touch-up prime CAN/CGSB-1.181.
  - .1 Maximum VOC limit 50 g/L.

## **2.5 PAINT**

- .1 Field paint steel doors and frames in accordance with Sections 09 91 23 - Interior Painting. Provide final finish free of scratches or other blemishes.
  - .1 Maximum VOC emission level 50 g/L.

## **2.6 ACCESSORIES**

- .1 Door silencers: single stud rubber/neoprene type.
- .2 Interior top and bottom caps: steel.
- .3 Fabricate glazing stops as formed channel, minimum 16 mm height, accurately fitted, butted at corners and fastened to frame sections with counter-sunk oval head sheet metal screws.
- .4 Metallic paste filler: to manufacturer's standard.
- .5 Fire labels: metal rivited.
- .6 Sealant: in accordance with Section 07 92 00 – Joint Sealants.
  - .1 Maximum VOC limit 250 g/L.
- .7 Glazing: in accordance with Section 08 80 50 – Glazing.
- .8 Make provisions for glazing as indicated and provide necessary glazing stops.
  - .1 Provide removable 0.9mm formed steel channels, 16 mm high, for use with glazing tapes and compounds and secured with countersunk stainless steel screws.

## **2.7 FRAMES FABRICATION GENERAL**

- .1 Fabricate frames in accordance with CSDMA specifications.
- .2 Fabricate frames to profiles and maximum face sizes as indicated.
- .3 Interior frames: 1.6 mm welded type construction.
- .4 Blank, reinforce, drill and tap frames for mortised, templated hardware, electronic hardware using templates provided by finish hardware supplier. Reinforce frames for surface mounted hardware.
- .5 Protect mortised cutouts with steel guard boxes.
- .6 Prepare frame for door silencers, 3 for single door, 2 at head for double door.
- .7 Manufacturer's nameplates on frames and screens are not permitted.
- .8 Conceal fastenings except where exposed fastenings are indicated.

- .9 Provide factory-applied touch up primer at areas where zinc coating has been removed during fabrication.

**2.8 FRAME ANCHORAGE**

- .1 Provide appropriate anchorage to floor and wall construction.
- .2 Locate each wall anchor immediately above or below each hinge reinforcement on hinge jamb and directly opposite on strike jamb.
- .3 Provide 2 anchors for rebate opening heights up to 1520 mm and 1 additional anchor for each additional 760 mm of height or fraction thereof.
- .4 Locate anchors for frames in existing openings not more than 150 mm from top and bottom of each jambs and intermediate at 660 mm on centre maximum.

**2.9 FRAMES: WELDED TYPE**

- .1 Welding in accordance with CSA W59.
- .2 Accurately mitre or mechanically joint frame product and securely weld on inside of profile.
- .3 Cope accurately and securely weld butt joints of mullions, transom bars, centre rails and sills.
- .4 Grind welded joints and corners to a flat plane, fill with metallic paste and sand to uniform smooth finish.
- .5 Securely attach floor anchors to inside of each jamb profile.
- .6 Weld in 2 temporary jamb spreaders per frame to maintain proper alignment during shipment.

**2.10 DOOR FABRICATION GENERAL**

- .1 Doors: swing type, flush, with provision for glass and/or louvre openings as indicated.
- .2 Fabricate doors with longitudinal edges welded. Seams: grind welded joints to a flat plane, fill with metallic paste filler and sand to a uniform smooth finish.
- .3 Blank, reinforce, drill doors and tap for mortised, templated hardware, and electronic hardware.
- .4 Factory prepare holes 12.7 mm diameter and larger except mounting and through-bolt holes, on site, at time of hardware installation.
- .5 Reinforce doors where required, for surface mounted hardware. Provide inverted, recessed, spot welded channels to top and bottom of interior doors.
- .6 Provide factory-applied touch-up primer at areas where zinc coating has been removed during fabrication.
- .7 Provide fire labelled doors for those openings requiring fire protection ratings, as scheduled. Test such products in conformance with CAN4-S104, ASTM E152, or NFPA 252 and list by nationally recognized agency having factory inspection service and construct as detailed in Follow-Up Service Procedures/Factory Inspection Manuals issued by listing agency to individual manufacturers.

- .8 Manufacturer's nameplates on doors are not permitted.

### **2.11 DOORS: HONEYCOMB CORE CONSTRUCTION**

- .1 Form face sheets for interior doors from 1.6 mm sheet steel with honeycomb core laminated under pressure to face sheets.

### **2.12 HOLLOW STEEL CONSTRUCTION**

- .1 Form face sheets for interior doors from 1.6 sheet steel.
- .2 Reinforce doors with vertical stiffeners, securely welded to face sheets at 150 mm on centre maximum.
- .3 Fill voids between stiffeners of interior doors with honeycomb core.

## **Part 3 Execution**

### **3.1 MANUFACTURER'S INSTRUCTIONS**

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

### **3.2 INSTALLATION GENERAL**

- .1 Install labelled steel fire rated doors and frames to NFPA 80 except where specified otherwise.
- .2 Install doors and frames to CSDMA Installation Guide.

### **3.3 FRAME INSTALLATION**

- .1 Set frames plumb, square, level and at correct elevation.
- .2 Secure anchorages and connections to adjacent construction.
- .3 Brace frames rigidly in position while building-in. Install temporary horizontal wood spreader at third points of door opening to maintain frame width. Provide vertical support at centre of head for openings over 1200 mm wide. Remove temporary spreaders after frames are built-in.
- .4 Make allowances for deflection of structure to ensure structural loads are not transmitted to frames.
- .5 Caulk perimeter of frames between frame and adjacent material.

### **3.4 DOOR INSTALLATION**

- .1 Install doors and hardware in accordance with hardware templates and manufacturer's instructions and Section 08 71 00 - Door Hardware.
- .2 Provide even margins between doors and jambs and doors and finished floor and thresholds as follows.
  - .1 Hinge side: 1.0 mm.

- .2 Latchside and head: 1.5 mm.
- .3 Finished floor and thresholds: 13 mm.
- .3 Adjust operable parts for correct function.
- .4 Install louvres.

**3.5 FINISH REPAIRS**

- .1 Touch up with primer finishes damaged during installation.
- .2 Fill exposed frame anchors and surfaces with imperfections with metallic paste filler and sand to a uniform smooth finish.

**3.6 GLAZING**

- .1 Install glazing for doors in accordance with Section 08 80 50 - Glazing.

**END OF SECTION**

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**Part 1           General**

**1.1               REFERENCES**

- .1   Architectural Woodwork Manufacturers Association of Canada (AWMAC).
  - .1       Quality Standards for Architectural Woodwork, 1<sup>st</sup> edition, 2009.
- .2   Canadian Standards Association (CSA International).
  - .1       CAN/CSA O132.2 Series-90(R1998), Wood Flush Doors.
  - .2       CAN/CSA-O132.5-M1992(R1998), Stile and Rail Wood Doors.

**1.2               SUBMITTALS**

- .1   Product Data:
  - .1       Submit manufacturer's printed product literature, specifications and data sheet in accordance with Section 01 33 00 - Submittal Procedures.
  - .2       Submit two copies of WHMIS MSDS - Material Safety Data Sheets in accordance with Section 01 33 00 - Submittal Procedures. Indicate VOC's:
    - .1           For caulking materials during application and curing.
    - .2           For door materials and adhesives.
- .2   Shop Drawings:
  - .1       Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
  - .2       Indicate door types and cutouts for lights and louvres, sizes, core construction, transom panel construction and cutouts.

**1.3               QUALITY ASSURANCE**

- .1   Certificates: product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

**1.4               DELIVERY, STORAGE, AND HANDLING**

- .1   Storage and Protection:
  - .1       Protect doors from dampness. Arrange for delivery after work causing abnormal humidity has been completed.
  - .2       Store doors in well ventilated room, off floor, in accordance with manufacturer's recommendations.
  - .3       Protect doors from scratches, handling marks and other damage. Wrap doors.
  - .4       Store doors away from direct sunlight.

**Part 2           Products**

**2.1               WOOD FLUSH DOORS**

- .1   Solid core: to CAN/CSA-O132.2.1.



- .2 Grade: AWMAC “Custom” grade unless otherwise noted.
- .3 Performance Duty Level: AWMAC “Extra Heavy Duty” level unless otherwise noted
  - .1 Construction:
    - .1 Solid particleboard core: grade LD-1 or LD-2, stile and rail frame bonded to particleboard core with wood lock blocks and top blocks, 5-ply construction, 45 mm thickness. Door core and all materials shall contain no urea formaldehyde.
  - .2 Face Panels:
    - .1 Hardwood; veneer grades: Grade I (Premium), flat sliced white birch species.
  - .3 Adhesive: Type II (water resistant) for interior doors.
  - .4 Finish: Stain and clear varnish finish on site. Refer to Section 09 91 23 – Interior Painting.

## **2.2 FABRICATION**

- .1 Vertical edge strips solid hardwood compatible with face veneer. AWMAC edge type 2.
- .2 Prepare doors for louvres and glazing. Provide hardwood species to match face veneer and glazing stops with mitred corners.
- .3 Bevel vertical edges of single acting doors 3 mm in 50 mm on lock side and 1.5 mm in 50 mm on hinge side.

## **Part 3 Execution**

### **3.1 MANUFACTURER'S INSTRUCTIONS**

- .1 Compliance: comply with manufacturer's written data, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, and data sheets.

### **3.2 INSTALLATION**

- .1 Unwrap and protect doors in accordance with CAN/CSA-O132.2 Series, Appendix A.
- .2 Install doors and hardware in accordance with manufacturer's printed.
- .3 Adjust hardware for correct function.
- .4 Install glazing in accordance with Section 08 80 50 - Glazing.
- .5 Install louvres and stops.

### **3.3 ADJUSTMENT**

- .1 Re-adjust doors and hardware just prior to completion of building to function freely and properly.

**3.4 CLEANING**

- .1 Perform cleaning as soon as possible after installation to remove construction and accumulated environmental dirt.
- .2 Remove traces of primer, caulking; clean doors and frames.
- .3 Clean glass and glazing materials with approved non-abrasive cleaner.
- .4 On completion of installation, remove surplus materials, rubbish, tools and equipment barriers.

**END OF SECTION**

**Part 1      General**

**1.1          REFERENCES**

- .1 American National Standards Institute / Steel Door Institute ANSI/SDI
  - .1 ANSI/SDI A115-13, Manufacturing Tolerances for Standard Steel Doors and Frames.
  - .2 ANSI/SDI A250.6-2003(R2009), Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames.
  - .3 ANSI/SDI A250.8-2003(R2008), Recommended Specifications for Standard Steel Doors and Frames.
- .2 American Society for Testing and Materials International (ASTM)
  - .1 ASTM A153/A153M-16, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
  - .2 ASTM A240/A240M-16, Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
  - .3 ASTM A653/A653M-06a, Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
  - .4 ASTM A1008/A1008M-15, Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable.
  - .5 ASTM A1011/A1011M-15, Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength
  - .6 ASTM B29-03, Standard Specification for Refined Lead.
  - .7 ASTM B749-03, Standard Specification for Lead and Lead Alloy Strip, Sheet and Plate Products.
  - .8 ASTM E90-09, Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
- .3 Canadian General Standards Board (CGSB)
  - .1 CAN/CGSB-1.181-99, Ready-Mixed Organic Zinc-Rich Coating.
- .4 Canadian Standards Association (CSA International)
  - .1 CSA-G40.20-04/G40.21-04, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
  - .2 CSA W59-03, Welded Steel Construction (Metal Arc Welding).
- .5 National Fire Protection Association (NFPA)
  - .1 NFPA 80-99, Standard for Fire Doors and Fire Windows.
  - .2 NFPA 252-03, Standard Methods of Fire Tests of Door Assemblies.
- .6 Underwriters' Laboratories of Canada (ULC)

- .1 CAN4-S104-M80, Standard Method for Fire Tests of Door Assemblies.

## **1.2 SYSTEM DESCRIPTION**

- .1 Door and frame assemblies shall be factory fabricated units, designed to be bullet resistant to the specified threat level, designed to meet the noted Sound Transmission Class, and shall conform to applicable requirements of NAAMM HMMA 810, NAAMM HMMA 820, NAAMM HMMA 862, ASTM E90, this section, and requirements indicated on drawings. Frames shall be furnished by the door fabricator. Door silencers shall be provided to cushion the impact of the door on the frame so that steel to steel contact is not made during closing.
- .2 Design Requirements:
  - .1 Acoustic Performance: Minimum Sound Transmission Class (STC) 46 tested to ASTM E90. Label indicating sound transmission class shall be applied to the door and door frame.
  - .2 Steel fire rated doors and frames: labelled and listed by an organization accredited by Standards Council of Canada in conformance with CAN4-S104 for ratings specified or indicated.
  - .3 Provide fire labelled frames for openings requiring fire protection ratings. Test products in conformance with CAN4-S104, ASTM E152, or NFPA 252 and listed by nationally recognized agency having factory inspection services.
  - .4 General: Fabricate and install Ballistic Resistant (BR) door assemblies to achieve indicated levels of resistance. Extend resistance to include anchorages, interfaces with adjoining substrates, and hardware:
    - .1 Ballistic Resistant (BR) assemblies: Where door assembly is shown or scheduled as BR, provide door manufacturer's materials and fabrication for panel, inserts, and framing of unit. Provide rated units where shown or scheduled. //No BR resistance rating:
      - .1 UL 752 Level 7.

## **1.3 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Provide product data: in accordance with Section 01 33 00 - Submittal Procedures.
- .3 Provide shop drawings: in accordance with Section 01 33 00 - Submittal Procedures.
  - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Saskatchewan, Canada.
  - .2 Indicate each type of door, material, steel core thicknesses, mortises, reinforcements, locations of exposed fasteners, openings, arrangement of hardware, fire rating, finishes, model number, ballistic rating, Attack side and Protected side.
  - .3 Indicate each type frame material, core thickness, reinforcements, stops, location of anchors and fastenings, reinforcing, fire rating, finishes, model number, and ballistic rating.
  - .4 Include schedule identifying each unit, with door marks and numbers relating to numbering on drawings and door schedule.

- .5 Submit test and engineering data, and installation instructions.
- .6 Submit letter from manufacturer indicating the products have been certified to meet the specified ratings.
- .4 Provide samples in accordance with Section 01 33 00 - Submittal Procedures.
- .5 Submit one 300 x 300 mm corner sample of each type of door and frame.

#### **1.4 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Waste Management and Disposal:
  - .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

#### **1.5 QUALITY ASSURANCE**

- .1 Certified units: provide units, including frames, sub-frames, and doors which are produced by manufacturer who has previously produced, within last 10 years, units of similar security attack resistance of equivalent size and resistance ratings.

### **Part 2 Products**

#### **2.1 MATERIALS**

- .1 Hot-Rolled Steel Sheets and Strips: to ASTM A1011, commercial quality, pickled and oiled, except as otherwise indicated.
- .2 Cold-Rolled Steel Sheets: to ASTM A1008, commercial quality, except as otherwise indicated.
- .3 Galvanized Steel Sheets: to ASTM A653 with G90 zinc coating, mill phosphatized; commercial quality, except as otherwise indicated.
- .4 Stainless Steel Sheets: to AISI Type 302/304, complying with ASTM A240; commercial quality, No. 4 directional polish.
- .5 Supports and Anchors: to CSA G40.20/G40.21, Type 44W, coating designation to ASTM A653M, ZF75, but of not less than 1.5 mm sheet steel.
- .6 Inserts, Bolts, Fasteners: Standard units of strengths required to endure performances; in compliance with ASTM A153, Class C/D.

#### **2.2 ADHESIVES**

- .1 Honeycomb cores and steel components: heat resistant, spray grade, resin reinforced neoprene/rubber (polychloroprene) based, low viscosity, contact cement.
  - .1 Adhesive: maximum VOC content 50.
- .2 Polystyrene and polyurethane cores: heat resistant, epoxy resin based, low viscosity, contact cement.

- .3 Lock-seam doors: fire resistant, resin reinforced polychloroprene, high viscosity, sealant/adhesive.

### **2.3 PRIMER**

- .1 Touch-up prime CAN/CGSB-1.181.
  - .1 Maximum VOC limit 50 g/L.

### **2.4 PAINT**

- .1 Field paint security doors and frames in accordance with Section 09 91 23 - Interior Painting. Provide final finish free of scratches or other blemishes.
  - .1 Maximum VOC emission level 50 g/L.

### **2.5 ACCESSORIES**

- .1 Door silencers: single stud rubber/neoprene type.
- .2 Top and bottom caps: as recommended by manufacturer..
- .3 Metallic paste filler: to manufacturer's standard.
- .4 Fire labels: metal rivited.
- .5 Sealant: in accordance with Section 07 92 00 – Joint Sealants.
  - .1 Maximum VOC limit 250 g/L.

### **2.6 HARDWARE**

- .1 Hardware for bullet-resistant door assembly shall be provided by the door assembly manufacturer to ensure a complete bullet resistant assembly. Where test standard requires hardware to be tested with the door assembly, hardware shall be included in the labeling and/or test certification. Keying shall be as specified in Section 08 71 53– Security Door Hardware.

### **2.7 BULLET RESISTANT METAL FRAMES**

- .1 Provide frames of the type and profile indicated, not less than thickness indicated; to comply with ANSI/SDI A250.8.
- .2 Sheet steel, metal thickness and appropriate to maintain ballistic door ratings, mitred corners.
- .3 Fabricate frames with "closed and tight" mitered, full depth continuously welded seams, finished smooth with no visible seam unless otherwise indicated. Knock down type frames are not permitted.
- .4 Minimum 1.7 mm (14 gauge) thick steel sheet.
- .5 Reinforce frames wider than 1200 mm (48 inches) with roll formed steel channels welded tightly into frame head, flush with top.
- .6 Provide three single silencers for single doors on strike side, and two single silencers on frame head at double doors without mullions..

## **2.8 FRAME ANCHORAGE**

- .1 Jamb Anchors
  - .1 Masonry Type: Adjustable strap-and-stirrup anchors to suit frame size, not less than 0.8mm (16 gauge) thickness, with corrugated or perforated straps not less than 50 mm wide by 250 mm long.
- .2 Floor Anchors: Floor anchors to be provided at each jamb. Formed from same material as frames, not less than 1.7 mm (14 gauge) thick.
- .3 Mortar Guards: Provide minimum 26 gage mortar guards welded to the back of each hardware cutout.

## **2.9 BULLET RESISTANT HOLLOW METAL DOORS**

- .1 Doors: swing type, flush panel.
- .2 Provide 45 mm doors of type and design indicated, not less than thickness indicated; fabricated with smooth surfaces, without visible joints or seams on exposed faces unless otherwise indicated. Comply with ANSI/SDI A250.8
- .3 Sheet steel faces, thickness, design, and core suitable to achieve specified ballistic performance.
- .4 Core Construction: Manufacturer's standard bullet resistant door core construction designed and tested for the specified UL752 standard Level 7 rating.
  - .1 Laminated core construction, longitudinal edges, mechanically inter-locked or welded, with no visible edge seams.
  - .2 Proprietary ballistic armour core.
- .5 Vertical Edges: Vertical edges to have the face sheets joined by a continuous weld extending the full height of the door. Welds are to be ground, filled and dressed smooth. Beveled Edge, 3 mm in 50 mm.
- .6 Top and Bottom Edges: Reinforce tops and bottoms of doors with a continuous steel channel not less than 2.7 mm (12 gauge), extending the full width of the door and welded to the face sheet. Finish top and bottom to provide a smooth flush condition.
- .7 Weld hardware reinforcement plates in place.
- .8 Fabrication Tolerances: To HMMA 841.
- .9 Surface Applied Hardware Reinforcements: Fabricate according to ANSI/SDI A250.6 with reinforcing plates from same material as door face sheets.

## **2.10 FABRICATION**

- .1 Fabricate bullet resistant hollow metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for thickness of metal. Where practical, fit and assemble units in manufacturer's plant. When shipping limitations so dictate, frames for large openings are to be fabricated in sections for splicing or splining in the field by others.
- .2 Tolerances: Fabricate bullet resistant hollow metal work to tolerances indicated in ANSI/SDI A250.8.

- .3 Bullet Resistant Hollow Metal Doors:
  - .1 Exterior Doors: Provide weep-hole openings in bottom of exterior doors to permit moisture to escape.
  - .2 Astragals: Provide overlapping astragals on one leaf of pairs of doors where required for bullet resistance level standard or by NFPA 80 for fire-performance rating. Extend minimum 3/4 inch (19 mm) beyond edge of door on which astragal is mounted.
  - .3 Continuous Hinge Reinforcement: Provide welded continuous 12 gage strap for continuous hinges specified in hardware sets in Division 08 Section, "Door Hardware".
- .4 Bullet Resistant Hollow Metal Frames: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.
  - .1 Welded Frames: Full depth continuously weld frame seams; grind, fill, dress, and make smooth and flush.
    - .1 Welded frames are to be provided with two steel spreaders temporarily attached to the bottom of both jambs to serve as a brace during shipping and handling. Spreader bars are for bracing only and are not to be used to size the frame opening.
  - .2 High Frequency Hinge Reinforcement: Provide 12 gage angle reinforcements for butt type hinges on every door and frame assembly.
  - .3 Continuous Hinge Reinforcement: Provide welded continuous 12 gage straps for continuous hinges specified in hardware sets in Division 08 Section, "Door Hardware".
  - .4 Electrical Knock Out Boxes: Factory weld 18 gage electrical knock out boxes to frame for electrical hardware preps; this includes but not limited to electric through wire transfer hardware, electrical raceways and wiring harnesses, door position switches, electric strikes, magnetic locks, and jamb mounted card readers as noted in door hardware sets in Division 08 Section, "Door Hardware".
    - .1 Provide electrical knock out boxes as required for Project.
    - .2 Conduit to be coordinated and installed in the field (Division 26) from middle hinge box and strike box to door position box.
    - .3 Electrical knock out boxes to comply with NFPA requirements and fit electrical door hardware as specified in hardware sets in Division 08 Section, "Door Hardware".
    - .4 Electrical knock out boxes for continuous hinges should be located in the center of the vertical dimension on the hinge jamb.
  - .5 Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.
  - .6 Jamb Anchors: Provide number and spacing of anchors as follows:
    - .1 Masonry Types: Locate anchors not more than 450 mm from top and bottom of frame. Space anchors not more than 800 mm o.c. and as follows:
      - .1 Four anchors per jamb plus 1 additional anchor per jamb for each 600 mm or fraction thereof above 2135 mm high.



- .5 Surface Hardware Preparation: Factory prepare bullet resistant hollow metal work to receive template mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to the Door Hardware Schedule and templates furnished as specified in Division 08 Section, "Door Hardware."
  - .1 Locate hardware as indicated, or if not indicated, according to ANSI/SDI A250.8.
  - .2 Reinforce doors and frames to receive non-template, mortised and surface-mounted door hardware.
  - .3 Comply with applicable requirements in ANSI/SDI A250.6 and ANSI/DHI A115 Series specifications for preparation of bullet resistant hollow metal work for hardware.

### **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 FRAME INSTALLATION**

- .1 Set frames plumb, square, level and at correct elevation.
- .2 Secure anchorages and connections to adjacent construction.
- .3 Brace frames rigidly in position while building-in. Install temporary horizontal wood spreader at third points of door opening to maintain frame width. Provide vertical support at centre of head for openings over 1200 mm wide. Remove temporary spreaders after frames are built-in.
- .4 Make allowances for deflection of structure to ensure structural loads are not transmitted to frames.
- .5 Caulk perimeter of frames between frame and adjacent material.
- .6 Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with post-installed expansion anchors.
- .7 Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with appropriate mortar.
- .8 Grout Requirements: Do not grout head of frames unless reinforcing has been installed in head of frame.

#### **3.3 DOOR INSTALLATION**

- .1 Install doors and hardware in accordance with hardware templates and manufacturer's instructions and Section 08 71 00 - Door Hardware.
- .2 Provide even margins between doors and jambs and doors and finished floor and thresholds as follows.
  - .1 Hinge side: 1.0 mm.

- .2 Latchside and head: 1.5 mm.
- .3 Finished floor: 13 mm.
- .3 Adjust operable parts for correct function.

### **3.4 FINISH REPAIRS**

- .1 Touch up with primer finishes damaged during installation.
- .2 Fill exposed frame anchors surfaces with imperfections with metallic paste filler and sand to a uniform smooth finish.

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

### **3.6 PROTECTION**

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by door and frame installation.

**END OF SECTION**

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**Part 1            General**

**1.1                REFERENCES**

- .1 American Society for Testing and Materials International (ASTM)
  - .1 ASTM A653/A653M-11, Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
  - .2 ASTM E90-09 – Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
  - .3 ASTM E413-11 – Classification for Rating Sound Insulation
- .2 Canadian General Standards Board (CGSB)
  - .1 CAN/CGSB-1.181-99, Ready-Mixed Organic Zinc-Rich Coating.
  - .2 CGSB 41-GP-19Ma-84, Rigid Vinyl Extrusions for Windows and Doors.
- .3 Canadian Standards Association (CSA International)
  - .1 CSA-G40.20-13/G40.21-13, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
  - .2 CSA W59-13, Welded Steel Construction (Metal Arc Welding).
- .4 Canadian Steel Door Manufacturers' Association (CSDMA)
  - .1 CSDMA, Recommended Specifications for Commercial Steel Doors and Frames, 2006.
  - .2 CSDMA, Selection and Usage Guide for Commercial Steel Doors, 2009.
- .5 National Fire Protection Association (NFPA)
  - .1 NFPA 80-2013, Standard for Fire Doors and Fire Windows.
  - .2 NFPA 252-2013, Standard Methods of Fire Tests of Door Assemblies.
- .6 Underwriters' Laboratories of Canada (ULC)
  - .1 CAN/ULC S104-10, Standard Method for Fire Tests of Door Assemblies.

**1.2                SYSTEM DESCRIPTION**

- .1 Design Requirements:
  - .1 Acoustic Performance: Minimum Sound Transmission Class (STC) 46 tested to ASTM E90. Label indicating sound transmission class shall be applied to the door and door frame.
  - .2 Steel fire rated doors and frames: labelled and listed by an organization accredited by Standards Council of Canada in conformance with CAN/ULC S104 for ratings specified or indicated.
  - .3 Provide fire labelled frames for openings requiring fire protection ratings. Test products in conformance with CAN/ULC S104, ASTM E152 or NFPA 252 and listed by nationally recognized agency having factory inspection services.

### **1.3 SUBMITTALS**

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Provide product data: in accordance with Section 01 33 00 - Submittal Procedures.
- .3 Provide shop drawings: in accordance with Section 01 33 00 - Submittal Procedures.
  - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Saskatchewan, Canada.
  - .2 Indicate each type of door, material, steel core thicknesses, mortises, reinforcements, location of exposed fasteners, openings, glazed, louvres, arrangement of hardware and fire rating and finishes.
  - .3 Indicate each type frame material, core thickness, reinforcements, glazing stops, location of anchors and exposed fastenings and reinforcing, fire rating, and finishes.
  - .4 Include schedule identifying each unit, with door marks and numbers relating to numbering on drawings and door schedule.
  - .5 Test Data:
    - .1 Submit test data indicating compliance with the Sound Transmission Class (STC) requirements. Include laboratory name, test report number, and date of test.
    - .2 Submit certification from test laboratory qualified under the National Voluntary Accreditation Program (NVLAP) of the U.S. Bureau of Standards.

### **1.4 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.

### **1.5 WARRANTY**

- .1 Manufacturer's Limited Warranty: Five (5) years from date of supply, covering material and workmanship.

## **Part 2 Products**

### **2.1 MATERIALS**

- .1 Hot dipped galvanized steel sheet: to ASTM A653M, ZF75, minimum base steel thickness in accordance with CSDMA Table 1 - Thickness for Component Parts.
- .2 Reinforcement channel: to CSA G40.20/G40.21, Type 44W, coating designation to ASTM A653M, ZF75.

### **2.2 ACCESSORIES**

- .1 Hinges: Heavy weight butt type as recommended by the manufacturer.
- .2 Primer: Rust inhibitive zinc chromate.

- .3 Threshold: Smooth and flush, to provide a seal for door on closed position.
- .4 Perimeter acoustic seals: Primary and secondary perimeter acoustic seals to provide a seal for door in closed position to meet specified STC rating.
- .5 Head seal: Acoustic neoprene at header.
- .6 Bottom acoustic seals: Acoustic mortised drop door bottom to provide a seal for door in closed position to meet specified STC rating.

### **2.3 STEEL DOORS**

- .1 Sheet steel faces, thickness, design, and core suitable to achieve specified STC performance.
- .2 Acoustic core construction, longitudinal edges, mechanically interlocked with visible edge seams.
- .3 Reinforce doors where hardware is required.
- .4 Drill and tap for mortised, templated hardware.
- .5 Top and Bottom Channels: Inverted, recessed, welded steel channels.

### **2.4 STEEL FRAMES**

- .1 Sheet steel, metal thickness appropriate to maintain door STC ratings, mitred corners, fully welded seams.
- .2 Factory assemble and weld frames.
- .3 Affix permanent metal nameplates to frame indicating manufacture's name, door tag, and STC rating where it shall be clearly visible.

### **2.5 PRIMER**

- .1 Touch-up prime CAN/CGSB-1.181.
  - .1 Maximum VOC limit 50 g/L.

### **2.6 PAINT**

- .1 Field paint steel doors and frames in accordance with Sections 09 91 23 - Interior Painting. Provide final finish free of scratches or other blemishes.

### **2.7 FRAME ANCHORAGE**

- .1 Provide appropriate anchorage to floor and wall construction.
- .2 Locate each wall anchor immediately above or below each hinge reinforcement on hinge jamb and directly opposite on strike jamb.
- .3 Provide 2 anchors for rebate opening heights up to 1520 mm and 1 additional anchor for each additional 760 mm of height or fraction thereof.

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**Part 3 Execution**

**3.1 MANUFACTURER'S INSTRUCTIONS**

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

**3.2 INSTALLATION GENERAL**

- .1 Install doors and frames to CSDMA Installation Guide.
- .2 Install components to manufacturer's written instructions.
- .3 Utilize welders certified by Canadian Welding Bureau (CWB).

**3.3 FRAME INSTALLATION**

- .1 Set frames plumb, square, level and at correct elevation.
- .2 Coordinate with masonry and gypsum board wall construction for anchor placement.
- .3 Brace frames rigidly in position while building-in. Install temporary horizontal wood spreader at third points of door opening to maintain frame width. Provide vertical support at centre of head for openings over 1200 mm wide. Remove temporary spreaders after frames are built-in.
- .4 Make allowances for deflection of structure to ensure structural loads are not transmitted to frames.
- .5 Caulk perimeter of frames between frame and adjacent material.
- .6 Maintain continuity of air barrier and vapour retarder.

**3.4 DOOR INSTALLATION**

- .1 Install doors and hardware in accordance with hardware templates and manufacturer's instructions and Section 08 71 00 - Door Hardware.
- .2 Provide even margins between doors and jambs and doors and finished floor and thresholds to allow easy operation and proper function of seals.
- .3 Adjust operable parts for correct function.

**3.5 FINISH REPAIRS**

- .1 Touch up with primer finishes damaged during installation.
- .2 Fill exposed frame anchors and surfaces with imperfections with metallic paste filler and sand to a uniform smooth finish.

**3.6 FIELD QUALITY CONTROL**

- .1 Provide qualified manufacturer's representative to instruct installers on the proper installation and adjustment of door assemblies.
- .2 Provide manufacturer's representative to inspect door installation, and test minimum ten (10) cycles of operation. Correct any deficient doors.

**END OF SECTION**

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**Part 1            General**

**1.1                RELATED REQUIREMENTS**

- .1            Section 08 88 56 – Ballistic-Resistant Glazing.

**1.2                REFERENCES**

- .1            Aluminum Association (AA)
  - .1            AA DAF 45-03(R2009), Designation System for Aluminum Finishes.
- .2            ASTM International (ASTM)
  - .1            ASTM A36/A36M-14, Standard Specification for Carbon Structural Steel.
  - .2            ASTM A123/A123M-12, Standard Specification for Zinc (Hot-Dip galvanized) Coatings on Iron and Steel Products.
  - .3            ASTM A320/A320M-15a, Standard Specification for Alloy-Steel and Stainless Steel Bolting for Low-Temperature Service.
  - .4            ASTM A500/A500M-13, Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
  - .5            ASTM A666-15, Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
  - .6            ASTM C920-14a, Standard Specification for Elastomeric Joint Sealants
  - .7            ASTM C1036-11e1, Standard Specification for Flat Glass.
  - .8            ASTM D635-14, Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position.
  - .9            ASTM D2000-12, Standard Classification System for Rubber Products in Automotive Applications.
- .3            CSA Group
  - .1            AAMA/WDMA/CSA 101/I.S.2/A440-11, NAFS - North American Fenestration Standard for Windows, Doors, and Skylights.
  - .2            CSA A440S1-09, Canadian Supplement to AAMA/WDMA/CSA 101/I.S.2/A440, NAFS - North American Fenestration Standard for Windows, Doors, and Skylights.
- .4            Master Painters Institute (MPI)
  - .1            Architectural Painting Specification Manual - current edition.
    - .1            MPI #79, Primer, Alkyd, Anti-Corrosive for Metal.
- .5            Underwriters Laboratories (UL)
  - .1            UL 752, Standard for Bullet-Resisting Equipment.

**1.3                DEFINITIONS**

- .1            Security glazing: The term ‘Security Glazing’ as used in the Section refers to monolithic polycarbonate sheets, glass clad polycarbonates, and laminated polycarbonate sheets specially fabricated for ballistic resistance.



#### **1.4 PERFORMANCE REQUIREMENTS**

- .1 Ballistics-Resistance Performance Requirements: Provide security window frames identical to those tested for compliance with requirements indicated, and as follows.
  - .1 Security window to meet or exceed the testing requirements of Underwriters Laboratory Ballistic Standards; UL 752 Level VII.
- .2 Blast Resistant Performance and Design Requirements: Provide window frame and the anchorage analysis that comply with requirements indicated and as follows.
  - .1 Security windows to be calculated to meet: blast level GSA Level D with a standoff distance of 10 metres.
  - .2 Security window to comply with design build blast drawings and calculations.
  - .3 A detailed engineered blast calculations by a qualified blast engineer to substantiate that the system design and anchorage meets or exceeds the minimum performance required.

#### **1.5 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 security windows and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
  - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Saskatchewan, Canada.
  - .2 Indicate materials and details in full size scale for head, jamb and sill, profiles of components, junction between combination units, elevations of unit, anchorage details, description of related components, exposed finishes, fasteners, and caulking.
- .4 Samples:
  - .1 Submit for review and acceptance of each unit.
  - .2 Samples will be returned for inclusion into work.
  - .3 Submit one representative model of each type window.
  - .4 Include frame, sash, sill, glazing, surface finish, and hardware.
- .5 Test and Evaluation Reports:
  - .1 Submit test reports from approved independent testing laboratories, certifying compliance with specifications.
  - .2 All test reports that reference the NAFS must include, on the first page, a summary of the results including, at minimum:
    - .1 The product manufacturer.
    - .2 The type of product.
    - .3 The model number/series number.
    - .4 The primary product designation.

- .5 The secondary product designation.
- .6 The test completion date.
- .3 The report will also contain the following information:
  - .1 Test dates.
  - .2 Report preparation dates.
  - .3 Test information retention period.
  - .4 Location of testing facilities.
  - .5 Complete description of amendments, as applicable.
  - .6 Conclusion.
  - .7 Drawings signed by the testing laboratory, if provided.
- .6 Sustainable Design Submittals:
  - .1 Construction Waste Management:
    - .1 Submit project Waste Reduction Workplan highlighting recycling and salvage requirements.

## **1.6 CLOSEOUT SUBMITTALS**

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for security windows for incorporation into manual.

## **1.7 QUALITY ASSURANCE**

- .1 Certifications: product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.
- .2 Identify each piece of ballistics resistant security glazing material with a permanent stencil indicating the manufacturer and applicable rating achieved when tested to UL 752. Place stencil on the glass, readable from the secure side. Locate label in the upper right corner, 50mm from top and side of frame.

## **1.8 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials off ground, indoors, and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect security windows from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.
- .4 Develop Waste Reduction Workplan related to Work of this.

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**Part 2            Products**

**2.1                MATERIALS**

- .1     Stainless Steel: ASTM A666, Type 304; formed stainless steel members.
- .2     Aluminum Extrusions: ASTM B221.
  - .1     Framing Members: Alloy 6063 T5, T6, or T52, or alloy 6061 T6; 5 mm (3/16 inch) minimum thickness.
  - .2     Trim and Stops not exposed to forced entry attack: Alloy 6063 T5, T6, or T52; 1.5 mm (1/16 inch) minimum thickness.
- .3     Steel Shapes/Plates/Bars: ASTM A36/A36M, except where another designation is indicated.
- .4     Bolts and Fasteners: ASTM A320/A320M; Type 300 series stainless steel screws, bolts, nuts, and washers. Non removable type where accessible from attack side.
- .5     Chemically Strengthened Float Glass: to ASTM C1036, Type I (transparent), Class 1 (clear), quality Q3 (glazing select0, chemically tempered. Modulus of Rupture 30,000psi. Cut chemically strengthened glass to final size and seam edges before treatment.
- .6     Polycarbonate: Extruded polycarbonate, UV stabilized, mar-resistant surface coating, smoke density rating less than 75 (ASTM D2843); extent of burning characteristics less than 25 mm when tested in accordance with ASTM D635.
- .7     Interlayer for laminating polycarbonate to glass (clear): polyurethane, as recommended by the security glazing manufacturer, specifically designed for lamination, with demonstrated long-term ability to maintain physical and visual properties under installed conditions.
- .8     Interlayer for laminating polycarbonate to polycarbonate (clear): polyurethane, as recommended by the security glazing manufacturer.
- .9     Interlayer for laminating glass to glass (clear): polyvinyl butyral interlayer specifically designed for lamination with demonstrated long-term ability to maintain physical and visual properties under installed conditions.
- .10    Materials: to AAMA/WDMA/CSA 101/I.S.2/A440.
- .11    All windows by same manufacturer.
- .12    Main frame: aluminum or stainless steel.
- .13    Glass: in accordance with Section 08 88 56 - Ballistic-Resistant Glazing.
- .14    Isolation coating: alkali resistant bituminous paint.
- .15    Sealants:
  - .1     VOC limit 250 g/L maximum.

**2.2                WINDOW TYPE AND CLASSIFICATION**

- .1     Product type:
  - .1     FW- Fixed window.

- .2 Aluminum Extrusions: Aluminum alloy and temper – 6005-T5. Ultimate tensile strength of 37.7 ksi, and shear strength of 29.7 ksi.
- .3 Aluminum Extrusions: Aluminum alloy and temper – 6005-T5. Ultimate tensile strength of 37.7 ksi, and shear strength of 29.7 ksi.
  - .1 Steel plates, shapes and bars ASTM A36
  - .2 Seamless steel structural tubing ASTM A500.
- .4 Silicone: Structural silicone GE SCS 1000 complies with ASTM-C920-05
- .5 Setting blocks – Neoprene 80-85 durometer ASTM-D2000

### **2.3 FABRICATION**

- .1 Fabricate in accordance with AAMA/WDMA/CSA 101/1.S.2/A440:
- .2 Fabricate units square and true with maximum tolerance of plus or minus 1.5 mm for units with a diagonal measurement of 1800 mm or less and plus or minus 3 mm for units with a diagonal measurement over 1800 mm.
- .3 Face dimensions detailed are maximum permissible sizes.
- .4 Brace frames to maintain squareness and rigidity during shipment and installation.
- .5 Finish steel clips and reinforcement with 380 g/m<sup>2</sup> zinc coating to ASTM A123/A123M.

### **2.4 ALUMINUM FINISHES**

- .1 Finish exposed surfaces of aluminum components in accordance with Aluminum Association Designation System for Aluminum Finishes.
  - .1 Clear anodic finish.

### **2.5 ISOLATION COATING**

- .1 Coatings: in accordance with manufacturer's recommendations for surface conditions.
  - .1 Primer: VOC limit 100 g/L maximum.
  - .2 Coating: VOC limit 100 g/L maximum.
  - .3 Paint: VOC limit 150 g/L maximum.
- .2 Isolate aluminum from following components, by means of isolation coating:
  - .1 Dissimilar metals except stainless steel, zinc, or white bronze of small area.
  - .2 Concrete, mortar and masonry.
  - .3 Wood.

### **2.6 GLAZING**

- .1 Glaze windows in accordance with Section 08 88 56 - Ballistic-Resistant Glazing.

### **2.7 HARDWARE**

- .1 Hardware: stainless steel.

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**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 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
  - .2 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

**3.2 INSTALLATION**

- .1 Window installation:
  - .1 Install in accordance with AAMA/WDMA/CSA 101/I.S.2/A440.
  - .2 Arrange components to prevent abrupt variation in colour.
- .2 Sill installation:
  - .1 Install metal sills level in length, straight in alignment with plumb upstands and faces.
  - .2 Secure sills in place with anchoring devices as recommended by manufacturer.
- .3 Caulking:
  - .1 Seal joints between windows and window sills with sealant. Bed sill expansion joint cover plates and drip deflectors in bedding compound. Caulk between sill upstand and window-frame. Caulk butt joints in continuous sills.
  - .2 Apply sealant in accordance with Section 07 92 00 - Joint Sealants.

**3.3 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
  - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

**3.4 PROTECTION**

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by window installation.

**END OF SECTION**

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**Part 1            General**

**1.1                REFERENCES**

- .1    American National Standards Institute (ANSI) / Builders Hardware Manufacturers Association (BHMA)
  - .1        ANSI/BHMA A156.1-2000, American National Standard for Butts and Hinges.
  - .2        ANSI/BHMA A156.2-2003, Bored and Preamsembled Locks and Latches.
  - .3        ANSI/BHMA A156.4-2000, Door Controls - Closers.
  - .4        ANSI/BHMA A156.6-2005, Architectural Door Trim.
  - .5        ANSI/BHMA A156.12-2005, Interconnected Locks and Latches.
  - .6        ANSI/BHMA A156.13-2002, Mortise Locks and Latches Series 1000.
  - .7        ANSI/BHMA A156.16-2002, Auxiliary Hardware.
- .2    Canadian Steel Door and Frame Manufacturers' Association (CSDMA)
  - .1        CSDMA Recommended Dimensional Standards for Commercial Steel Doors and Frames - 2009.

**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 door hardware and include product characteristics, performance criteria, physical size, finish and limitations.
- .3    Hardware List:
  - .1        Submit contract hardware list.
  - .2        Indicate specified hardware, including make, model, material, function, size, finish and other pertinent information.
- .4    Manufacturer's Instructions: submit manufacturer's installation instructions.
- .5    Sustainable Design Submittals:
  - .1        Construction Waste Management:
    - .1            Submit project Waste Reduction Workplan highlighting recycling and salvage requirements.

**1.3                CLOSEOUT SUBMITTALS**

- .1    Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2    Operation and Maintenance Data: submit operation and maintenance data for door hardware for incorporation into manual.

**1.4                MAINTENANCE MATERIALS SUBMITTALS**

- .1    Extra Stock Materials:

.1 Supply maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.

.2 Tools:

.1 Supply 2 sets of wrenches for door closers, locksets, and fire exit hardware.

## **1.5 QUALITY ASSURANCE**

.1 Regulatory Requirements:

.1 Hardware for doors in fire separations and exit doors certified by a Canadian Certification Organization accredited by Standards Council of Canada.

.2 Certificates: product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

## **1.6 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 Package items of hardware including fastenings, separately or in like groups of hardware, label each package as to item definition and location.

.4 Storage and Handling Requirements:

.1 Store materials indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect door hardware from damage.

.3 Protect prefinished surfaces with wrapping.

.4 Replace defective or damaged materials with new.

.5 Develop Waste Reduction Workplan related to Work of this Section.

## **Part 2 Products**

### **2.1 HARDWARE ITEMS**

.1 Use one manufacturer's products only for similar items.

### **2.2 DOOR HARDWARE**

.1 Locks and latches:

.1 Bored and preassembled locks and latches: to ANSI/BHMA A156.2, series 2000 preassembled lock, grade 1, designed for function as stated in Hardware Schedule.

.2 Interconnected locks and latches: to ANSI/BHMA A156.12, series 5000 interconnected lock, grade 1, designed for function as stated in Hardware Schedule.



- .3 Mortise locks and latches: to ANSI/BHMA A156.13, series 1000 mortise lock, grade 1, designed for function as stated in Hardware Schedule.
- .4 Lever handles and escutcheon: Sargent 'LE1L' design.
- .5 Normal strikes: box type, lip projection not beyond jamb.
- .6 Cylinders: Sargent 6 pin, L4 keyway, 0 bitted; keying by Owner.
- .7 Finished to 26D.
- .8 Acceptable manufacturer: Sargent.
- .9 List of Locksets:
  - a) ANSI F01; Sargent Model 8215-LE1L-26D (Passage)
  - b) ANSI F13; Sargent Model 8225-LE1L-26D (Exit Lock)
  - c) ANSI F15; Sargent Model 8250-LE1L-26D (Hotel)
  - d) ANSI F21; Sargent Model 8224-LE1L-26D (Store Door)
- .2 Butts and hinges:
  - .1 Butts and hinges: to ANSI/BHMA A156.1, listed in Hardware Schedule.
  - .2 List of hinges:
    - a) FBB 168 114 x 114
    - b) FBB 168 114 x 114 NRP
- .3 Door Closers and Accessories:
  - .1 Door controls (closers): to ANSI/BHMA A156.4, listed in Hardware Schedule, size in accordance with ANSI/BHMA A156.4, table A1, finished to 630.
    - .1 Grade 1, heavy duty, adjustable hydraulic back check, separate regulation of closing speed and latching speed, rack and pinion action.
    - .2 List of closers:
      - .1 LCN 4040 with delayed action function.
    - .3 Acceptable manufacturers: LCN, Sargent, Norton, Rixson, or approved substitution.
- .4 Architectural door trim: to ANSI/BHMA A156.6, as listed in Hardware Schedule, finish as noted.
  - .1 Door protection plates: kick plate type, 1.27 mm thick stainless steel, bevelled edges, 300 mm high by 25 mm less than door width, 32D finish.
- .5 Auxiliary hardware: to ANSI/BHMA A156.16, as listed in Hardware Schedule and as listed below.
  - .1 Wall stop: concave wall stop with concealed mounting, 62 mm diameter, 30 mm projection, cast brass with rubber bumper, 26D finish.
    - .1 Acceptable products: Hager 234, Richelieu 2205, or approved substitution.
  - .2 Door check chain: heavy duty compression springs, heavy duty welded steel chain, vinyl cover, 650 mm long, 26D finish.
- .6 Door bottom seal: heavy duty, door seal of extruded aluminum frame and solid closed cell neoprene seal, surface mounted, closed ends, adjustable, automatic retract mechanism when door is open, clear anodized finish.

- .7 Thresholds:
  - a) 127 mm wide x full width of door opening, extruded aluminum, mill finish, plain surface.
- .8 Weatherstripping:
  - .1 Head and jamb seal:
    - .1 Extruded aluminum frame and solid closed cell neoprene insert, clear anodized finish.
    - .2 Door bottom seal:
      - .1 Heavy duty, extruded aluminum frame and closed cell neoprene weather seal, surface mounted, closed ends, adjustable, clear anodized finish.
- .9 Sound Seals:
  - .1 Head and jamb seal:
    - .1 Self-adhesive silicone perimeter gasketing.
      - .2 Acceptable Manufacturer: Pemko S773, DraftSeal DS340CS or approved substitution.
    - .2 Door bottom seal:
      - .1 Auto door bottom: heavy duty, door seal of extruded aluminum frame and solid closed cell neoprene seal, full mortise, end, automatic retract mechanism when door is open, clear anodized finish.
      - .2 Acceptable manufacturer: Pemko 434\_RL, Draft Seal DS342AN or approved substitution.
- .10 Electric strike: SDC Model 55 Uni-flex electric strike complete with ABCDU trim for the electric strike. No substitutions.
  - .1 Strike edge plate to match ANSI function of electric strike.
- .11 Card reader: provided by Owner.

## **2.3 FASTENINGS**

- .1 Use only fasteners provided by manufacturer. Failure to comply may void warranties and applicable licensed labels.
- .2 Supply screws, bolts, expansion shields and other fastening devices required for satisfactory installation and operation of hardware.
- .3 Exposed fastening devices to match finish of hardware.
- .4 Where pull is scheduled on one side of door and push plate on other side, supply fastening devices, and install so pull can be secured through door from reverse side. Install push plate to cover fasteners.
- .5 Use fasteners compatible with material through which they pass.

## **2.4 KEYING**

- .1 Construction keying:

- .1 Provide construction cores. Contractor to install construction cores and perform operation verification for all locks. Construction cylinders to be "0" bitted Sargent LA cylinders. Perimeter doors may have random bitting.
- .2 Permanent keying:
  - .1 Provide 000000 bitted for keying by Owner.
  - .2 Provide two blank keys, in duplicate, for every lock in this Contract.

### **Part 3 Execution**

#### **3.1 INSTALLATION**

- .1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, and data sheets.
- .2 Supply metal door and frame manufacturers with complete instructions and templates for preparation of their work to receive hardware.
- .3 Supply manufacturers' instructions for proper installation of each hardware component.
- .4 Install hardware to standard hardware location dimensions in accordance with CSDFMA Canadian Metric Guide for Steel Doors and Frames (Modular Construction).
- .5 Where door stop contacts door pulls, mount stop to strike bottom of pull.
- .6 Install key control cabinet.
- .7 Use only manufacturer's supplied fasteners.
  - .1 Use of "quick" type fasteners, unless specifically supplied by manufacturer, is unacceptable.
- .8 Remove construction cores when directed by Departmental Representative.
  - .1 Install permanent cores and ensure locks operate correctly.

#### **3.2 ADJUSTING**

- .1 Adjust door hardware, operators, closures and controls for optimum, smooth operating condition, safety and for weather tight closure.
- .2 Lubricate hardware, operating equipment and other moving parts.
- .3 Adjust door hardware to ensure tight fit at contact points with frames.

#### **3.3 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
  - .1 Leave Work area clean at end of each day.
  - .2 Clean hardware with damp rag and approved non-abrasive cleaner, and polish hardware in accordance with manufacturer's instructions.
  - .3 Remove protective material from hardware items where present.
  - .4 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment 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.
  - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

**3.4 DEMONSTRATION**

- .1 Maintenance Staff Briefing:
  - .1 Brief maintenance staff regarding:
    - .1 Proper care, cleaning, and general maintenance of projects complete hardware.
    - .2 Description, use, handling, and storage of keys.
    - .3 Use, application and storage of wrenches for door closers, locksets and fire exit hardware.
  - .2 Demonstrate operation, operating components, adjustment features, and lubrication requirements.

**3.5 PROTECTION**

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by door hardware installation.

**3.6 SCHEDULE**

**Door 102A (STC 46)**

1 lockset b)  
1½ pair hinges  
1 closer  
1 wall stop  
1 set sound seals c/w auto door bottom  
1 threshold a)  
2 kickplates

**Door 102B (STC 46)**

1 lockset b)  
1½ pair hinges  
1 closer  
1 wall stop  
1 set sound seals c/w auto door bottom  
1 threshold a)  
2 kickplates

**Door 102.1A (STC 46)**

1 lockset c)  
1½ pair hinges NRP  
1 closer  
1 wall stop  
1 set sound seals c/w full mortise auto door

**Door 102.2A (STC 46)**

1 lockset c)  
1½ pair hinges NRP  
1 closer  
1 wall stop  
1 set sound seals c/w full mortise auto door

bottom (by Acoustical door supplier)  
1 threshold (by Acoustical door supplier)  
1 electric strike (see Note 1 below)  
2 kickplates

**Door 198A**

1 lockset a)  
1½ pair hinges  
1 closer  
1 wall stop  
1 set weatherstripping c/w door bottom seal  
1 threshold a)

**Door M1**

1 lockset d)  
1½ pair hinges NRP  
1 check chain  
2 kick plates

bottom (by Acoustical door supplier)  
1 threshold (by Acoustical door supplier)  
1 electric strike (see Note 1 below)  
2 kickplates

**Door 198B**

1 lockset a)  
1½ pair hinges  
1 closer  
1 wall stop  
1 set weatherstripping c/w door bottom seal  
1 threshold a)

**Door M2**

1 lockset d)  
1½ pair hinges NRP  
1 check chain  
2 kick plates

**Note 1:** prepare frame for installation of SDC Model 55 Uni-flex electric strike. Ensure Deadbolt keepers are installed and aligned in door frame where there are locksets with deadbolts.

**END OF SECTION**

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**Part 1            General**

**1.1                REFERENCES**

- .1    ASTM International
  - .1    ASTM C542-05, Standard Specification for Lock-Strip Gaskets.
  - .2    ASTM D2240-05, Standard Test Method for Rubber Property - Durometer Hardness.
- .2    Canadian General Standards Board (CGSB)
  - .1    CAN/CGSB-12.1-M90, Tempered or Laminated Safety Glass.
- .3    Glass Association of North American (GANA)
  - .1    GANA Glazing Manual - 2008.
  - .2    GANA Laminated Glazing Reference Manual - 2009.

**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 glass, sealants, and glazing accessories and include product characteristics, performance criteria, physical size, finish and limitations.
- .3    Shop Drawings:
  - .1    Submit drawings stamped in accordance with Section 01 33 00 - Submittal Procedures.
- .4    Test Reports: certified test reports showing compliance with specified performance characteristics and physical properties.
  - .1    Submit testing and analysis of glass under provisions of Section 01 45 00 - Quality Control.
- .5    Sustainable Design Submittals:
  - .1    Construction Waste Management:
    - .1    Submit project Waste Management Plan highlighting recycling and salvage requirements.
  - .2    Recycled Content:
    - .1    Submit listing of recycled content products used, including details of required percentages or recycled content materials and products, showing their costs and percentages of post-consumer and post-industrial content, and total cost of materials for project.

**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 glazing for incorporation into manual.

#### **1.4 QUALITY ASSURANCE**

- .1 Certificates: product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

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

- .1 Deliver, store and handle materials in accordance with 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 glazing and frames from nicks, scratches, and blemishes.
  - .3 Protect prefinished aluminum surfaces with wrapping and strippable coating.
  - .4 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove for reuse and return of pallets, crates, padding, as specified in Waste Reduction Workplan in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

#### **1.6 AMBIENT CONDITIONS**

- .1 Ambient Requirements:
  - .1 Install glazing when ambient temperature is 10 degrees C minimum. Maintain ventilated environment for 24 hours after application.
  - .2 Maintain minimum ambient temperature before, during and 24 hours after installation of glazing compounds.

### **Part 2 Products**

#### **2.1 MATERIALS**

- .1 Flat Glass:
  - .1 Safety glass: to CAN/CGSB-12.1, transparent, 6 mm and 10 mm thick as indicated.
    - .1 Type: 1-laminated and 2-tempered.
    - .2 Class B-float.
    - .3 Category 1.
- .2 Sealant: in accordance with Section 07 92 00 - Joint Sealants.
  - .1 VOC limit 250 g/L maximum.

## **2.2 ACCESSORIES**

- .1 Setting blocks: neoprene, 80-90 Shore A durometer hardness to ASTM D2240, to suit glazing method, glass light weight and area.
- .2 Spacer shims: neoprene, 50-60 Shore A durometer hardness to ASTM D2240, 75 mm long x one half height of glazing stop x thickness to suit application. Self adhesive on one face.
- .3 Glazing tape:
  - .1 Preformed butyl compound with integral resilient tube spacing device, 10-15 Shore A durometer hardness to ASTM D2240; coiled on release paper; black colour.
- .4 Glazing splines: resilient polyvinyl chloride, extruded shape to suit glazing channel retaining slot, colour as selected.
- .5 Glazing clips: manufacturer's standard type.
- .6 Lock-strip gaskets: to ASTM C542.

## **Part 3 Execution**

### **3.1 EXAMINATION**

- .1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for glazing installation in accordance with manufacturer's written instructions.
  - .1 Verify that openings for glazing are correctly sized and within tolerance.
  - .2 Verify that surfaces of glazing channels or recesses are clean, free of obstructions, and ready to receive glazing.
  - .3 Visually inspect substrate in presence of Departmental Representative.
  - .4 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
  - .5 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

### **3.2 PREPARATION**

- .1 Clean contact surfaces with solvent and wipe dry.
- .2 Seal porous glazing channels or recesses with substrate compatible primer or sealer.
- .3 Prime surfaces scheduled to receive sealant.

### **3.3 INSTALLATION: INTERIOR - DRY METHOD (TAPE AND TAPE)**

- .1 Perform work in accordance with GANA Glazing Manual, and GANA Laminated Glazing Reference Manual for glazing installation methods.
- .2 Cut glazing tape to length and set against permanent stops, projecting 1.6 mm above sight line.



- .3 Place setting blocks at 1/4 points, with edge block maximum 150 mm from corners.
- .4 Rest glazing on setting blocks and push against tape for full contact at perimeter of light or unit.
- .5 Place glazing tape on free perimeter of glazing in same manner described.
- .6 Install removable stop without displacement of tape. Exert pressure on tape for full continuous contact.
- .7 Knife trim protruding tape.

### **3.4 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
  - .1 Leave Work area clean at end of each day.
    - .1 Remove traces of primer, caulking.
    - .2 Remove glazing materials from finish surfaces.
    - .3 Remove labels.
    - .4 Clean glass using approved non-abrasive cleaner in accordance with manufacturer's instructions.
  - .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.

### **3.5 PROTECTION**

- .1 Protect installed products and components from damage during construction.
- .2 After installation, mark each light with an "X" by using removable plastic tape or paste.
  - .1 Do not mark heat absorbing or reflective glass units.
- .3 Repair damage to adjacent materials caused by glazing installation.

**END OF SECTION**

**Part 1 General**

**1.1 RELATED SECTIONS**

- .1 Section 08 56 53 - Security Windows.

**1.2 REFERENCES**

- .1 ASTM International
  - .1 ASTM B209-14, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
  - .2 ASTM C542-05, Standard Specification for Lock-Strip Gaskets.
  - .3 ASTM C1036-11e1, Standard Specification for Flat Glass.
  - .4 ASTM D635-14, Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position.
  - .5 ASTM D1003-07e1, Standard Test Method for Haze and Luminous Transmittance of Plastics.
  - .6 ASTM D1929-96(R2001)e1, Standard Test Method for Determining Ignition Temperature of Plastics.
  - .7 ASTM D2843-16, Standard Test Method for Density of Smoke from the Burning or Decomposition of Plastics.
  - .8 ASTM E84-10, Standard Test Method for Surface Burning Characteristics of Building Materials.
  - .9 ASTM F1233-08, Standard Test Method for Security Glazing Materials and Systems.
- .2 Glass Association of North American (GANA)
  - .1 GANA Glazing Manual - 2008.
  - .2 GANA Laminated Glazing Reference Manual - 2009.
- .3 Underwriters Laboratories (UL)
  - .1 UL752 – Standard for Bullet-Resisting Equipment.

**1.3 ADMINISTRATIVE REQUIREMENTS**

- .1 Pre-Installation Meetings:
  - .1 Convene pre-installation meeting 1 week prior to beginning work of this Section, with Contractor's Representative, Departmental Representative, and Consultant in accordance with Section 01 31 19 - Project Meetings to:
    - .1 Verify project requirements.
    - .2 Review installation and substrate conditions.
    - .3 Co-ordination with other building subtrades.
    - .4 Review manufacturer's written installation instructions and warranty requirements.

- .2 Arrange for site visit with Departmental Representative prior to start of Work to examine existing site conditions adjacent to demolition Work.
- .3 Ensure key personnel, site supervisor, project manager, and subcontractor representatives attend.

#### **1.4 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 ballistics-resistant glazing, sealants, and glazing accessories and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
  - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Saskatchewan, Canada.
- .4 Samples:
  - .1 Submit for review and acceptance of each unit.
  - .2 Samples will be returned for inclusion into work.
- .5 Certificates: submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.
- .6 Test Reports: certified test reports showing compliance with specified performance characteristics and physical properties.
  - .1 Submit testing and analysis of glass under provisions of Section 01 45 00 - Quality Control.
  - .2 Submit shop testing for glass.
- .7 Sustainable Design Submittals:
  - .1 Construction Waste Management:
    - .1 Submit project Waste Reduction Workplan highlighting recycling and salvage requirements.

#### **1.5 CLOSEOUT SUBMITTALS**

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for ballistics-resistant glazing for incorporation into manual.

#### **1.6 QUALITY ASSURANCE**

- .1 Certificates: product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.
- .2 Manufacturer Qualifications: All primary products specified in this section will be supplied by a single manufacturer with a minimum of ten (10) years' experience.

- .3 Installer Qualifications: All products listed in this section are to be installed by a single installer with a minimum of five (5) years demonstrated experience in installing products of the same type and scope as specified.
- .4 Mock-ups:
  - .1 Construct mock-ups in accordance with Section 01 45 00 - Quality Control.
  - .2 Construct mock-up to include glazing, framing and wall construction.
  - .3 Mock-up will be used:
    - .1 To judge quality of work, substrate preparation, operation of equipment and material application.
  - .4 Locate where directed.
  - .5 Allow 24 hours for inspection of mock-up before proceeding with work.
  - .6 When accepted, mock-up will demonstrate minimum standard of quality required for this work. Approved mock-up may remain as part of finished work.

## **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.
- .3 Storage and Handling Requirements:
  - .1 Store materials off ground, indoors, and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect glazing and frames from nicks, scratches, and blemishes.
  - .3 Protect prefinished stainless steel or aluminum surfaces with wrapping.
  - .4 Replace defective or damaged materials with new.
- .4 Develop Waste Reduction Workplan related to Work of this Section.

## **1.8 AMBIENT CONDITIONS**

- .1 Ambient Requirements:
  - .1 Install glazing when ambient temperature is 10 degrees C minimum. Maintain ventilated environment for 24 hours after application.
  - .2 Maintain minimum ambient temperature before, during and 24 hours after installation of glazing compounds.

## **Part 2 Products**

### **2.1 MATERIALS**

- .1 Design Criteria:
  - .1 Limit glass deflection to 1/200 with full recovery of glazing materials.

- .2 Chemically Strengthened Float Glass: to ASTM C1036, Type I (transparent), Class 1 (clear), quality Q3 (glazing select0, chemically tempered. Modulus of Rupture 30,000psi. Cut chemically strengthened glass to final size and seam edges before treatment.
- .3 Polycarbonate: Extruded polycarbonate, UV stabilized, mar-resistant surface coating, smoke density rating less than 75 (ASTM D2843); extent of burning characteristics less than 25 mm when tested in accordance with ASTM D635.
- .4 Interlayer for laminating polycarbonate to glass (clear): polyurethane, as recommended by the security glazing manufacturer, specifically designed for lamination, with demonstrated long-term ability to maintain physical and visual properties under installed conditions.
- .5 Interlayer for laminating polycarbonate to polycarbonate (clear): polyurethane, as recommended by the security glazing manufacturer.
- .6 Interlayer for laminating glass to glass (clear): polyvinyl butyral interlayer specifically designed for lamination with demonstrated long-term ability to maintain physical and visual properties under installed conditions.
- .7 Bullet Resistant Glazing:
  - .1 Bullet resistant glazing: to ASTM F1233 and UL752.
  - .2 Glazing Type: laminated bullet resistant glass.
  - .3 Glazing Panels: panels shall be made of multiple layers of woven roving ballistic grade fiberglass cloth impregnated with a thermoset polyester resin and compressed into flat rigid sheets. The production technique and materials used shall provide the controlled internal delamination to permit the encapture of a penetrating projectile
  - .4 Rating and testing: to UL752 Level 1 and UL752 Level 7 as noted in drawings.
  - .5 Glazing thickness: as per manufacturer's tested assembly meeting noted rating requirements.
  - .6 Light transmittance: to ASTM D1003.
  - .7 Surface burning characteristics for flame and smoke spread: to ASTM E84.
  - .8 Self-ignition characteristics: to ASTM D1929
- .8 Aluminum Sections: in accordance with ASTM B209
  - .1 Extruded aluminum alloy 6063 T5. Ultimate tensile strength of 37.7 ksi, and shear strength of 29.7 ksi.
  - .2 Anodized or powder coated finish, free of sharp edges or burrs.
  - .3 Glazing Channel: U-Channel specifically designed for securing transparencies tightly in place. Angles and stops are only acceptable for top attachment.
  - .4 Window Frames: 1 3/4 inch by 4 inches by 1/8 min. (44mm x 102mm x 3mm) wall thickness. Anodized or powder coated finish, free of sharp edges or burrs.
- .9 Sealant: in accordance with Section 07 92 00 - Joint Sealants.
  - .1 VOC limit 250 g/L maximum.

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**2.2 ACCESSORIES**

- .1 Setting blocks: as per manufacturer's recommendations.
- .2 Spacer shims: as per manufacturer's recommendations.
- .3 Glazing tape:
  - .1 As per manufacturer's recommendations.
- .4 Glazing clips: manufacturer's standard type.
- .5 Lock-strip gaskets: to ASTM C542.

**Part 3 Execution**

**3.1 EXAMINATION**

- .1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for glazing installation in accordance with manufacturer's written instructions.
  - .1 Verify that openings for glazing are correctly sized and within tolerance.
  - .2 Verify that surfaces of glazing channels or recesses are clean, free of obstructions, and ready to receive glazing.
  - .3 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
  - .4 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 Clean contact surfaces with solvent and wipe dry.
- .2 Seal porous glazing channels or recesses with substrate compatible primer or sealer.
- .3 Prime surfaces scheduled to receive sealant.

**3.3 INSTALLATION: INTERIOR - DRY METHOD (TAPE AND TAPE)**

- .1 Perform work in accordance with GANA Glazing Manual and GANA Laminated Glazing Reference Manual for glazing installation methods.
- .2 Cut glazing tape to length and set against permanent stops, projecting 1.6 mm above sight line.
- .3 Place setting blocks at 1/4 points, with edge block maximum 150 mm from corners.
- .4 Rest glazing on setting blocks and push against tape for full contact at perimeter of light or unit.
- .5 Place glazing tape on free perimeter of glazing in same manner described.
- .6 Install removable stop without displacement of tape. Exert pressure on tape for full continuous contact.

- .7 Knife trim protruding tape.

### **3.4 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
  - .1 Leave Work area clean at end of each day.
    - .1 Remove traces of primer, caulking.
    - .2 Remove glazing materials from finish surfaces.
    - .3 Remove labels.
    - .4 Clean glazing using approved non-abrasive cleaner in accordance with manufacturer's instructions.
  - .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.
  - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

### **3.5 PROTECTION**

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by glazing installation.

### **3.6 SCHEDULE**

- .1 As indicated in drawings.

**END OF SECTION**

General notes:

- .1 This schedule is to be read in conjunction with the Drawings and applicable Specification Sections.
- .2 Refer to Section 08 71 10, Door Hardware for hardware groups.
- .3 Refer to Drawings for door and frame types
- .4 Refer to Electrical for Card reader rough-ins, door contacts, power operators and associated power. Hardware manufacturer/installer shall be responsible for making all low voltage connections.
- .5 Verify all door and frame sizes prior to ordering.

Door No.	Door			Frame			Rating (Min.)	Glass	Additional Requirements
	Size	Type	Mat'l	Fin.	Type	Mat'l			
<b>Main Floor</b>									
102A	1000x2150	A	BMD	PT	2	BMF	PT	-	STC 46
102B	1000x2150	A	BMD	PT	2	BMF	PT	-	STC 46
102.1A	1000x2150	A	ASD	PT	1*	PS	PT	-	Electric strike, STC 46
102.2A	1000x2150	A	ASD	PT	1*	PS	PT	-	Electric strike, STC 46
198A	1000x2150	B	HM	PT	2	PS	PT	TG	
198B	1000x2150	B	HM	PT	2	PS	PT	TG	
M1	1000x2150	A	SCW	S/V	2	PS	PT	-	50mm undercut
M2	1000x2150	A	SCW	S/V	2	PS	PT	-	50mm undercut

**Abbreviations:**

- ASD – Acoustic Steel Door (08 34 74)
- BMD – Ballistic Metal Door (08 34 53)
- BMF – Ballistic Metal Frame (08 34 53)
- BRG – Ballistic Resistant Glazing (08 88 56)
- HM – Hollow Metal Door (08 11 00)

- PS – Pressed Steel Frame (welded) (08 11 00 & 08 34 74)
- PT – Paint (09 91 23)
- TG – Tempered Glass (08 80 50)
- SCW – Solid Core Wood Door (08 14 16)
- S/V – Stain and Varnish (09 91 23)

**Notes:**

# \* denotes a frame with special security requirements, refer to electrical drawings



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		
102	CONC/RSF	CBP/RB	CBP/BAP	CBP/BAP	CBP/BAP	CBP/PWP	SBA/GBP/AT-1	
102.1	VCT	RB	CBP/GBP	CBP	GBP	GBP	AT-2	
102.2	VCT	RB	GBP	CBP	GBP	GBP	AT-2	
196	EX	EX/RB	EX	EX/GBP	EXP/CBP	EX	EX/EXP/GBP	
198	EX/VCT	EX/RB	EXP/GBP	GBP/CBP	EXP/GBP	EXP/GBP	AT-3/GBP/EXP/EX	
199	EX	EX/RB	EXP/CBP	EX/GBP	EX	EX	EX/EXP/GBP	

**List of Abbreviations:**

<b>FLOORS</b>		<b>WALL</b>	
EX	EXISTING TO REMAIN	BAP	BALLISTIC ACOUSTICAL RUBBER PANEL (13 54 00)
CONC	CONCRETE - SEALER	CBP	CONCRETE BLOCK - PAINT
RSF	RUBBER SPORTS FLOORING (09 65 20)	EXP	EXISTING - PAINT
VCT	VINYL COMPOSITE TILE	GBP	GYPSUM BOARD – PAINT
		PWP	PERFORATED WALL PANEL – PAINT (05 50 00)
<b>BASE</b>		<b>CEILING</b>	
CBP	CONCRETE BLOCK - PAINT	AT-1	ACOUSTICAL CEILING TILE – TYPE 1 (09 51 13)
EX	EXISTING TO REMAIN	AT-2	ACOUSTICAL CEILING TILE – TYPE 2 (09 51 13)
RB	RESILIENT BASE (09 65 20)	AT-3	ACOUSTICAL CEILING TILE (MATCH EXISTING) (09 51 13)
		EX	EXISTING TO REMAIN
		EXP	EXISTING - PAINT
		GBP	GYPSUM BOARD – PAINT
		SBA	STEEL BAFFLE ASSEMBLY
	<b>GENERAL NOTE</b>		
	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 REFERENCES**

- .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 C841-03(2013), Standard Specification for Installation of Interior Lathing and Furring.
  - .4 ASTM C1002-07, Standard Specification for Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs.
  - .5 ASTM C1047-09, Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base.
  - .6 ASTM C1280-99, Standard Specification for Application of Gypsum Sheathing.
  - .7 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.
  - .2 Construction Waste Management:
    - .1 Submit project Waste Management Plan and Waste Reduction Workplan highlighting recycling and salvage requirements.
    - .2 Submit calculations on end-of-project recycling rates, salvage rates, and landfill rates demonstrating that 50% of construction wastes were recycled or salvaged.
  - .3 Recycled Content:

- .1 Submit listing of recycled content products used, including details of required percentages or recycled content materials and products, showing their costs and percentages of post-consumer and post-industrial content, and total cost of materials for project.
- .4 Low-Emitting Materials:
  - .1 Submit listing of adhesives and sealants, and paints and coatings used in building, showing compliance with VOC and chemical component limits or restriction requirements.

### **1.3 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store gypsum board assemblies materials level, indoors, in dry location, and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect gypsum board assemblies from nicks, scratches, and blemishes.
  - .3 Protect from weather, elements and damage from construction operations.
  - .4 Handle gypsum boards to prevent damage to edges, ends or surfaces.
  - .5 Replace defective or damaged materials with new.
- .4 Develop Construction Waste Management Plan and Waste Reduction Workplan related to Work of this Section.
- .5 Packaging Waste Management: remove for reuse and return of pallets, crates, padding, packaging materials as specified in Construction Waste Management Plan and Waste Reduction Workplan in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

### **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 C and Type X, 12.7 mm and 16 mm thick, 1200 mm wide x maximum practical length, ends square cut, edges bevelled.

- .2 Moisture and mold resistant board: to ASTM C1396/C1396M regular 12.7 mm and 16 mm thick, 1200 mm wide x maximum practical length, end square cut, edges bevelled.
- .3 Metal access doors: frameless, welded construction, push latching door, removable door, accepts 12.7 mm and 16 mm gypsum board, exposed frames paintable.
- .4 Metal furring runners, hangers, tie wires, inserts, and anchors: to ASTM C841.
- .5 Drywall furring channels: 0.5 mm core thickness galvanized steel channels for screw attachment of gypsum board.
- .6 Resilient drywall furring: 0.5 mm base steel thickness galvanized steel for resilient attachment of gypsum board.
- .7 Metal carrying channel: 1.4mm thick cold rolled steel, coated with rust inhibitive coating.
- .8 Steel drill screws: to ASTM C1002.
- .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 VOC limit 250 g/L maximum.
  - .2 Acoustic sealant: in accordance with Section 07 92 00 - Joint Sealants.
- .11 Polyethylene: to CAN/CGSB-51.34, Type 2.
- .12 Insulating strip: rubberized, moisture resistant, 3 mm thick closed cell neoprene strip, 12 mm wide, with self-sticking permanent adhesive on one face, lengths as required.
- .13 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, access panels, on four sides. Extend furring into reveals. Check clearances with equipment suppliers.
- .11 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 bucks, anchors, blocking, sound attenuation, electrical and mechanical work has been approved.
- .2 Apply single and double layer gypsum board (as indicated on drawings) to metal furring or framing using 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 12 mm diameter bead of acoustic sealant continuously around periphery of each face of partitioning to seal gypsum board/structure junction where partitions abut fixed building components. Seal full perimeter of cut-outs around electrical boxes, and ducts, in partitions where perimeter sealed with acoustic sealant.

- .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 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 around perimeter of suspended ceilings.
- .3 Install casing beads where gypsum board butts against surfaces having no trim concealing junction and where indicated. Seal joints with sealant.
- .4 Construct control joints of preformed units set in gypsum board facing and supported independently on both sides of joint.
- .5 Provide continuous polyethylene dust barrier behind and across control joints.
- .6 Locate control joints at approximate 10 m spacing on long corridor runs.
- .7 Install control joints straight and true.
- .8 Install access doors to electrical and mechanical fixtures specified in respective sections.
  - .1 Rigidly secure frames to furring or framing systems.
- .9 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.
- .10 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.
- .11 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.
- .12 Fill screw head depressions with joint and taping compounds to bring flush with adjacent surface of gypsum board so as to be invisible after surface finish is completed.
- .13 Sand lightly to remove burred edges and other imperfections. Avoid sanding adjacent surface of board.
- .14 Completed installation to be smooth, level or plumb, free from waves and other defects and ready for surface finish.
- .15 Apply one coat of white primer sealer over surface to be textured. When dry apply textured finish in accordance with manufacturer's instructions.
- .16 Mix joint compound slightly thinner than for joint taping.
- .17 Apply thin coat to entire surface using trowel or drywall broad knife to fill surface texture differences, variations or tool marks.
- .18 Allow skim coat to dry completely.
- .19 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.
  - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

### **3.6 PROTECTION**

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by gypsum board assemblies installation.

### **3.7 SCHEDULES**

- .1 Levels of finish: Interior partitions;
  - .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) exposed to view.
  - .2 Ceilings and underside of bulkheads exposed to view.
- .3 Level 5:
  - .1 AS noted in drawings.

**END OF SECTION**



**Part 1 General**

**1.1 REFERENCES**

- .1 ASTM International
  - .1 ASTM C645-11a, Standard Specification for Nonstructural Steel Framing Members.
- .2 CSA International
  - .1 CSA W59-M03(R2008), Welded Steel Construction (Metal Arc Welding).
- .3 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (MSDS).
- .4 The Master Painters Institute (MPI)
  - .1 Architectural Painting Specification Manual - 2004.
    - .1 MPI #26, Primer, Galvanized Metal, Cementitious.

**1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for metal framing and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Sustainable Design Submittals:
  - .1 Construction Waste Management:
    - .1 Submit project Waste Management Plan and Waste Reduction Workplan highlighting recycling and salvage requirements.
    - .2 Submit calculations on end-of-project recycling rates, salvage rates, and landfill rates demonstrating that 50% of construction wastes were recycled or salvaged.
    - .3 Recycled Content:
      - .1 Submit listing of recycled content products used, including details of required percentages or recycled content materials and products, showing their costs and percentages of post-consumer and post-industrial content, and total cost of materials for project.

**1.3 QUALITY ASSURANCE**

- .1 Test Reports: submit certified test reports showing compliance with specified performance characteristics and physical properties.
- .2 Certificates: 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 off ground, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect metal framing from damage.
  - .3 Replace defective or damaged materials with new.
- .4 Develop Construction Waste Management Plan and Waste Reduction Workplan related to Work of this Section.
- .5 Packaging Waste Management: remove for reuse and return of pallets, crates, padding, packaging materials as specified in Construction Waste Management Plan and Waste Reduction Workplan in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

## **Part 2 Products**

### **2.1 MATERIALS**

- .1 Non-load bearing channel stud framing: to ASTM C645, stud size as noted on drawings and Partition Schedule, roll formed from 0.478 mm steel (25ga) and 1.146 mm steel (18ga) thickness hot dipped galvanized steel sheet, for screw attachment of gypsum board.
  - .1 Knock-out service holes at 460 mm centres.
- .2 Floor and ceiling tracks: to ASTM C645, in widths to suit stud sizes, 32 mm flange height.
- .3 Non-load bearing truss stud framing system: to consist of:
  - .1 Floor track: snap-in type formed to hold studs securely in place at 50 mm intervals; fabricated from 0.5 mm thick steel sheet; size to suit studs.
  - .2 Ceiling track: channel shaped track for use with stud shoes and 1.2 mm diameter double wire ties; size to suit studs.
  - .3 After fabrication apply one shop coat of MPI #26 primer to steel surfaces.
    - .1 Descale and clean surfaces before painting.
- .4 Metal channel stiffener: cold rolled steel, coated with rust inhibitive coating.
- .5 Acoustical sealant: in accordance with Section 07 92 00 - Joint Sealants.
- .6 Sealants: VOC limit 250 g/L maximum.
- .7 Insulating strip: rubberized, moisture resistant 3 mm thick closed cell neoprene strip, 12 mm wide, with self-sticking adhesive on one face, lengths as required.
- .8 Welding materials: to CSA W59.

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**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 non-structural metal framing application 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 Align partition tracks at top and bottom and secure at 600 mm on centre maximum.
- .2 Place studs vertically at 400 mm on centre and not more than 50 mm from abutting walls, and at each side of openings and corners.
  - .1 Position studs in tracks at floor and ceiling. Cross brace steel studs as required to provide rigid installation to manufacturer's instructions.
- .3 Erect metal studding to tolerance of 1:1000.
- .4 Attach studs to bottom and ceiling track using screws.
- .5 Co-ordinate simultaneous erection of studs with installation of service lines. When erecting studs ensure web openings are aligned.
- .6 Co-ordinate erection of studs with installation of door/window frames and special supports or anchorage for work specified in other Sections.
- .7 Provide two studs extending from top to bottom at each side of openings wider than stud centres specified.
  - .1 Secure studs together, 50 mm apart using column clips or other approved means of fastening placed alongside frame anchor clips.
- .8 Install heavy gauge double jamb studs at openings.
- .9 Frame openings and around built-in equipment, cabinets, access panels, on four sides. Extend framing into reveals. Check clearances with equipment suppliers.
- .10 Provide 40 mm stud or furring channel secured between studs for attachment of fixtures behind lavatory basins, toilet and bathroom accessories, and other fixtures including grab bars and towel rails, attached to steel stud partitions.
- .11 Install steel studs or furring channel between studs for attaching electrical and other boxes.
- .12 Extend partitions to ceiling height except where noted otherwise on drawings.
- .13 Maintain clearance under beams and structural slabs to avoid transmission of structural loads to studs.

- .14 Install continuous insulating strips to isolate studs from uninsulated surfaces.
- .15 Install two continuous beads of acoustical sealant under studs and tracks around perimeter of sound control partitions.

### **3.3 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
  - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

### **3.4 PROTECTION**

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by non-structural metal framing application.

**END OF SECTION**

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**Part 1            General**

**1.1                SUMMARY**

- .1 Section Includes:
  - .1 Materials and application of acoustical units for direct application or for application and installation within a suspended ceiling.

**1.2                REFERENCES**

- .1 American Society for Testing and Materials International (ASTM)
  - .1 ASTM E1264-98, Standard Classification for Acoustical Ceiling Products.
  - .2 ASTM E1477-98a(2003), Standard Test Method for Luminous Reflectance Factor of Acoustical Materials by Use of Integrating-Sphere Reflectometers.
- .2 Canadian General Standards Board (CGSB)
  - .1 CAN/CGSB-92.1-M89, Sound Absorptive Prefabricated Acoustical Units.
- .3 Canadian Standards Association (CSA International)
  - .1 CSA B111-1974(R2003), Wire Nails, Spikes and Staples.
- .4 Department of Justice Canada (Jus)
  - .1 Canadian Environmental Protection Act (CEPA), 1999, c. 33.
  - .2 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 Underwriter's Laboratories of Canada (ULC)
  - .1 CAN/ULC-S102-2003, Surface Burning Characteristics of Building Materials and Assemblies.

**1.3                ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit samples in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data: submit WHMIS MSDS in accordance with Section 02 81 01 - Hazardous Materials.

**1.4                QUALITY ASSURANCE**

- .1 Regulatory Requirements:
  - .1 Fire-resistance rated floor/ceiling and roof/ceiling assembly: certified by Canadian Certification Organization accredited by Standards Council of Canada.
- .2 Mock-up:
  - .1 Construct mock-ups in accordance with Section 01 45 00 - Quality Control.

- .2 Construct mock-up 10 m<sup>2</sup> minimum of each type acoustical panel ceiling including one inside corner and one outside corner.
  - .3 Construct mock-up where directed.
  - .4 Allow 48 hours for inspection of mock-up by Departmental Representative before proceeding with ceiling work.
  - .5 When accepted, mock-up will demonstrate minimum standard for this work. Mock-up may remain as part of the finished work.
- .3 Health and Safety:
- .1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

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

- .1 Protect on site stored or installed absorptive material from moisture damage.
- .2 Store extra materials required for maintenance, where directed by Departmental Representative.
- .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.
  - .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
  - .3 Collect and separate for disposal paper, plastic, polystyrene, and corrugated cardboard packaging material for recycling in accordance with Waste Management Plan (WMP).
  - .4 Separate for reuse and recycling and place in designated containers Steel, Metal, and Plastic waste in accordance with Waste Management Plan.
  - .5 Place materials defined as hazardous or toxic in designated containers.
  - .6 Handle and dispose of hazardous materials in accordance with Regional and Municipal regulations.
  - .7 Ensure emptied containers are sealed and stored.
  - .8 Fold up metal and plastic banding, flatten and place in designated area for recycling.

### **1.6 ENVIRONMENTAL REQUIREMENTS**

- .1 Permit wet work to dry before beginning to install.
- .2 Maintain uniform minimum temperature of 15 degrees C and humidity of 20% to 40% before and during installation.
- .3 Store materials in work area 48 hours prior to installation.

### **1.7 EXTRA MATERIALS**

- .1 Provide extra materials of acoustic units in accordance with Section 01 78 00 - Closeout Submittals.

- .2 Provide acoustical units amounting to 2% of gross ceiling area for each pattern and type required for project.
- .3 Ensure extra materials are from same production run as installed materials.
- .4 Clearly identify each type of acoustic unit, including colour and texture.
- .5 Deliver to Departmental Representative, upon completion of the work of this section.

## **Part 2 Products**

### **2.1 MATERIALS**

- .1 Acoustic units for suspended ceiling system: to CAN/CGSB-92.1 and ASTM E1264, designated by AT-1 in Room Finish Schedule.
  - .1 Type XII, Form 2, Pattern E (match surface of Armstrong Cirrus).
  - .2 Class A.
  - .3 Wet formed mineral fibre with minimum 80% recycled content.
  - .4 Pattern: non-directional
  - .5 Textures: fine.
  - .6 Flame spread rating of 25 or less in accordance with CAN/ULC-S102.
  - .7 Smoke developed 50 or less in accordance with CAN/ULC-S102.
  - .8 Noise Reduction Coefficient (NRC) designation of 0.70.
  - .9 Ceiling Attenuation Class (CAC) rating 40, in accordance with ASTM E1264
  - .10 Light Reflectance (LR) range of 0.86 to ASTM E1477.
  - .11 Edge type: tegular.
  - .12 Colour: white.
  - .13 Size 610 x 610 x 22 mm thick.
  - .14 Shape: flat.
  - .15 Humidity resistant: proprietary coating.
  - .16 Surface coverings: low VOC paint.
  - .17 Acceptable manufactures:
    - .1 Armstrong, CGC, CertainTeed, or approved alternate.
  - .18 Acoustical backing material
    - .1 Size: 610 x 1219 x 12.7 mm thick.
    - .2 Material: 12.7 Type 'C' gypsum board. Laminate to top surface of finish ceiling tile.
- .2 Acoustic units for suspended ceiling system: to CAN/CGSB-92.1 and ASTM E1264, designated by AT-2 in Room Finish Schedule.
  - .1 Type XII, Form 2, Pattern E (match surface of Armstrong Optima Tegular)
  - .2 Class A.
  - .3 Fibreglass with minimum 80% recycled content.
  - .4 Pattern: non-directional.

- .5 Textures: fine.
- .6 Flame spread rating of 25 or less in accordance with CAN/ULC-S102.
- .7 Smoke developed 50 or less in accordance with CAN/ULC-S102.
- .8 Noise Reduction Coefficient (NRC) designation of 0.95.
- .9 Ceiling Attenuation Class (CAC) rating 26, in accordance with ASTM E1264
- .10 Light Reflectance (LR) range of 0.90 to ASTM E1477.
- .11 Edge type: square.
- .12 Colour: white.
- .13 Size: 610 x 610 x 25 mm thick.
- .14 Shape: flat.
- .15 Humidity resistant: proprietary coating.
- .16 Surface coverings: low VOC paint.
- .17 Acceptable manufacturers:
  - .1 Armstrong, CGC, CertainTeed, or approved alternate.
- .3 Acoustic units for suspended ceiling system: to CAN/CGSB-92.1 and ASTM E1264, designated by AT-3 in Room Finish Schedule.
  - .1 Colour: white.
  - .2 Size 610 x 610 x 22 mm thick.
  - .3 Shape: flat.
  - .4 Match existing
- .4 Adhesive: low VOC type recommended by acoustic unit manufacturer.
- .5 Staples, nails and screws: to CSA B111 non-corrosive finish as recommended by acoustic unit manufacturer.

### **Part 3 Execution**

#### **3.1 EXAMINATION**

- .1 Do not install acoustical panels and tiles until work above ceiling has been inspected by Departmental Representative.

#### **3.2 INSTALLATION**

- .1 Install acoustical panels and tiles in ceiling suspension system.
- .2 In fire rated ceiling systems, secure lay-in panels with hold-down clips and protect over light fixtures, diffusers, air return grilles and other appurtenances according to Certification Organizations design requirements.

#### **3.3 APPLICATION**

- .1 Install acoustical units parallel to building lines with edge unit not less than 50% of unit width. Refer to reflected ceiling plan.
- .2 Scribe acoustic units to fit adjacent work. Butt joints tight, terminate edges with moulding.



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**3.4 INTERFACE WITH OTHER WORK**

- .1 Co-ordinate with Section 09 53 00.01 - Acoustical Suspension.
- .2 Co-ordinate ceiling work to accommodate components of other sections, such as light fixtures, diffusers, speakers, sprinkler heads, to be built into acoustical ceiling components.

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

**END OF SECTION**

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**Part 1            General**

**1.1                REFERENCES**

- .1    ASTM International
  - .1    ASTM A641/A641M-09a(2014), Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire
  - .2    ASTM C635/C635M-07, Standard Specifications for the Manufacture, Performance and Testing of Metal Suspension Systems for Acoustical Tile and Lay-In Panel Ceilings.
- .2    Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1    Material Safety Data Sheets (MSDS).

**1.2                ACTION AND INFORMATIONAL SUBMITTALS**

- .1    Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2    Product Data:
  - .1    Submit manufacturer's instructions, printed product literature and data sheets for acoustical suspension and include product characteristics, performance criteria, physical size, finish and limitations.
- .3    Samples:
  - .1    Submit for review and acceptance of each unit.
  - .2    Samples will be returned for inclusion into work.
  - .3    Submit one representative model of each type ceiling suspension system.
  - .4    Ceiling system to show basic construction and assembly, treatment at walls, recessed fixtures, splicing, interlocking, finishes, acoustical unit installation.
  - .5    Construction Waste Management:
    - .1    Submit project Waste Management Plan and Waste Reduction Workplan highlighting recycling and salvage requirements.
    - .2    Submit calculations on end-of-project recycling rates, salvage rates, and landfill rates demonstrating that 50% of construction wastes were recycled or salvaged.

**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 acoustical suspension 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 off ground, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect acoustical ceiling tiles and tracks from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.

## **Part 2 Products**

### **2.1 MATERIALS**

- .1 Heavy duty system to ASTM C635/ASTM C635M.
- .2 Coordinate suspension components with suspended tile and panel requirements.
- .3 Basic materials for suspension system: commercial quality cold rolled steel, hot dipped galvanized steel.
- .4 Suspension system: non fire rated, made up as follows:
  - .1 Two directional exposed tee bar grid.
  - .2 Perimeter angle grid.
- .5 Exposed tee bar grid components: shop painted satin sheen. Components die cut. Hot dipped galvanized steel. Main tee with double web, rectangular bulb and 24 mm rolled cap on exposed face. Cross tee with rectangular bulb; web extended to form positive interlock with main tee webs; lower flange extended and offset to provide flush intersection. Wall moulding: L shaped, hemmed edges, 43 mm leg height, 24 mm reveal, shop painted satin sheen. Manufacturer's standard moldings for edges and penetrations, including light fixtures, that fit type of edge detail and suspension system indicated.
  - .1 Structural Classification: ASTM C635 HD.
  - .2 Colour: White
  - .3 Acceptable material:
    - .1 Armstrong Prelude XL;
    - .2 Donn DX/DXL;
    - .3 Approved alternate.
- .6 Attachment Devices: Size for five times design load indicated in ASTM C635, Table 1, Direct hung unless otherwise indicated.
- .7 Hanger wire: galvanized soft annealed steel wire to ASTM A641:
  - .1 Class 1 zinc coating, soft temper, pre-stretched, with a yield stress load of at least three times design load, but not less than:
    - .1 3.6 mm diameter for access tile ceilings. Increase sizes as required for ceiling loads.
    - .2 2.6 mm diameter for other ceilings.

- .8 Hanger inserts: purpose made.
- .9 Carrying channels: 38 mm channel, of thickness to suit, galvanized steel.
- .10 Accessories: splices, clips, wire ties, retainers and wall moulding flush, to complement suspension system components, as recommended by system manufacturer.

**Part 3 Execution**

**3.1 EXAMINATION**

- .1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for acoustical ceiling tile and track installation in accordance with manufacturer's written instructions.
  - .1 Visually inspect substrate 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 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, and data sheets.
- .2 Installation: to ASTM C636/C636M except where specified otherwise.
- .3 Install suspension system to manufacturer's instructions.
- .4 Do not erect ceiling suspension system until work above ceiling has been inspected and approved by Departmental Representative.
- .5 Secure hangers to overhead structure using industry approved attachment methods.
- .6 Install hangers spaced at maximum 1200 mm centres and within 150 mm from ends of main tees.
- .7 Refer to reflected ceiling plan for lay out of ceiling. Provide balanced borders at room perimeter, with border units not less than 50% of standard unit width.
- .8 Ensure suspension system is co-ordinated with location of related components.
- .9 Install wall moulding to provide correct ceiling height.
- .10 Completed suspension system to support super-imposed loads, such as lighting fixtures, diffusers, grilles, and speakers.
- .11 Support at light fixtures and diffusers with additional ceiling suspension hangers within 150 mm of each corner and at maximum 600 mm around perimeter of fixture.
- .12 Interlock cross member to main runner to provide rigid assembly, except as noted.
- .13 Frame at openings for light fixtures, air diffusers, speakers and at changes in ceiling heights.

- .14 Install access splines to provide 75% ceiling access.
- .15 Finished ceiling system to be square with adjoining walls and level within 1:1000.

**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 Touch up scratches, abrasions, voids and other defects in painted surfaces.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
  - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

**3.4 PROTECTION**

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by acoustical suspension installation.

**END OF SECTION**

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**Part 1            General**

**1.1                REFERENCES**

- .1    American Society for Testing and Materials (ASTM International)
  - .1        ASTM F710-11, Practice for Preparing Concrete Floors to Receive Resilient Flooring.
  - .2        ASTM F1344-12e1, Standard Specification for Rubber Floor Tile.
- .2    Canadian General Standards Board (CGSB)
  - .1        CAN/CGSB-25.20-95, Surface Sealer for Floors.
  - .2        CAN/CGSB-25.21-95, Detergent-Resistant Floor Polish.

**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 rubber sports flooring and include product characteristics, performance criteria, physical size, finish and limitations.
- .3    Samples:
  - .1        Submit duplicate tile in size and colour specified, edge strips, and accessories.

**1.3                CLOSEOUT SUBMITTALS**

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

**1.4                WASTE MANAGEMENT AND DISPOSAL**

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

**1.5                ENVIRONMENTAL REQUIREMENTS**

- .1    Maintain air temperature and structural base temperature at flooring installation area above 20°C for 48 hours before, during and for 48 hours after installation.

**1.6                EXTRA MATERIALS**

- .1    Provide maintenance materials of resilient tile flooring, base and adhesive in accordance with Section 01 78 00 - Closeout Submittals.
- .2    Provide 5 m<sup>2</sup> of each colour, pattern and type flooring material required for this project for maintenance use.
- .3    Extra materials to be from same production run as installed materials.

- .4 Clearly identify each container of floor tile and each container of adhesive.
- .5 Deliver to Owner, upon completion of the work of this section.
- .6 Store where directed by Owner.

**1.7 WARRANTY**

- .1 Five year manufacturer warranty.

**Part 2 Products**

**2.1 MATERIALS**

- .1 Rubber floor tile: prefabricated rubber sports surfacing, dual durometer vulcanized and calandered with special embossing, including adhesive. Prefabricated rubber surface to be sheet goods, calandered and vulcanized with a base of natural and synthetic rubber, stabilizing agents and pigmentation. To be manufactured in two layers, vulcanized together.
  - .1 Thickness: 10mm total thickness, with wear layer thickness of 3mm
  - .2 Tile size: 610 x 610 mm or 915 x 915 mm.
  - .3 Pattern: smooth textured pattern from manufacture’s standard range , solid color field with speckle throughout entire thickness of wear layer
  - .4 Colour: 2 colours to be selected from standard range.
  - .5 The shore hardness of the lower layer shall be less than the upper layer within the limits of following table. Field laminated material is not acceptable.

Physical Properties	Standard	Specification
Hardness Shore A	ASTM D-2240	75 (+-5) top layer 55(+-) bottom layer
Tensile strength	ASTM D-412	565 psi (+-50)
Elongation at break	ASTM D-412	226 (+-50)
100% modulus	ASTM D-412	64 psi (+-25)
Taber abrasion H18 wheels 500gr/1000 cycles	STM C-501	0.0001gr
Critical radiant flux	ASTM E-648-94A	Class 1
Water absorption 24hr/23 degree C	ASTM D-570	0.49%
Coefficient of friction	ASTM D-2047	0.91 dry/ 0.94 wet
Static load limit	ASTM F-970	0.003 in
Flame spread	ASTM E-648-94A	0.46 watts/sq.cm, class 1

- .2 Resilient base: continuous, top set, complete with premoulded end stops and external corners:

- .1 Type: Type TS vulcanized rubber or Type TP thermoplastic rubber
  - .2 Style: cove.
  - .3 Thickness: 3.17 mm.
  - .4 Height: 101.6 mm.
  - .5 Lengths: cut lengths minimum 2400 mm.
  - .6 Colour: selected by Departmental Representative.
- .3 Primers and adhesives: two part polyurethane adhesive suitable for adherence of flooring to concrete substrate. Adhesive to be supplied by or approved by the rubber flooring manufacturer.
  - .4 Sub-floor filler and leveller: as recommended by flooring manufacturer for use with their product.
  - .5 Edge transition strips: rubber transition strips, colour: black.

### **Part 3 Execution**

#### **3.1 INSPECTION**

- .1 Ensure concrete floors are dry, by using test methods recommended by tile manufacturer. Concrete must have cured for a minimum of 30 days. Vapour emission from the substrate must be less than 1.35 kg per 93 Sq.m in 24 hours as per ASTM 1869-98.
- .2 Installer must have successfully completed installations of the same scale as this project, within the last three years and be recognized and approved by the sport surfacing manufacturer.

#### **3.2 SUB-FLOOR TREATMENT**

- .1 Prepare to ASTM F 710 and as recommended by rubber sport floor manufacturer.
- .2 Remove sub-floor ridges and bumps. Fill low spots, cracks, joints, holes and other defects with sub-floor filler. Floor must be level to not more than 3mm in 3 metre radius.
- .3 Clean floor and apply filler; trowel and float to leave smooth, flat hard surface. Prohibit traffic until filler cured and dry.
- .4 General Contractor and installer shall thoroughly inspect subfloor surface prior to proceeding with installation. Report any deficiencies to Consultant.

#### **3.3 FLOORING APPLICATION**

- .1 Provide a high ventilation rate, with maximum outside air, during installation, and for 48 to 72 hours after installation. Vent directly to the outside. Do not let contaminated air re-circulate through a district or whole building air distribution system. Maintain extra ventilation for at least one month following installation.
- .2 To minimize emissions from adhesives, use lowest V.O.C. emitting material that will meet requirements of this specification.



- .3 Apply adhesive uniformly using recommended trowel in accordance with flooring manufacturer's instructions. Do not spread more adhesive than can be covered by flooring before initial set takes place.
- .4 Install rubber sport flooring in accordance with manufacturer's printed instructions.
- .5 Lay flooring with joints parallel to building lines to produce tile pattern required. Border tiles minimum half tile width. Cut and adjust flooring prior to adhesion.
- .6 As installation progresses, and after installation, ensure full adhesion of tiles in adhesive. Hold all seams in place in accordance with manufacturer's recommendations.
- .7 Cut tile and fit neatly around fixed objects.
- .8 Terminate flooring at centerline of door in openings where adjacent floor finish or colour is dissimilar.
- .9 Install edge transition strips at unprotected or exposed edges where flooring terminates at openings.

### **3.4 APPLICATION: BASE**

- .1 Lay out base to keep number of joints at minimum.
- .2 Clean substrate and prime with one coat of adhesive.
- .3 Apply adhesive to back of base.
- .4 Set base against wall and floor surfaces tightly by using 3 kg hand roller.
- .5 Install straight and level to variation of 1:1000.
- .6 Scribe and fit to door frames and other obstructions. Use premoulded end pieces at flush door frames.
- .7 Cope internal corners. Use premoulded corner units for right angle external corners. Use formed straight base material for external corners of other angles.

### **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.
  - .1 Clean flooring and base surfaces to flooring manufacturer's printed instructions.
- .3 Remove excess adhesive from floor, base and wall surfaces without damage.
- .4 Clean, seal and wax floor and base surface to flooring manufacturer's instructions. In carpeted areas clean, seal and wax base surface before carpet installation.

.5 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.

**3.6 PROTECTION**

.1 Protect new floors from time of final set of adhesive until final inspection.

.2 Prohibit traffic on floor for 48 hours after installation.

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCES**

- .1 Department of Justice Canada (Jus)
  - .1 Canadian Environmental Protection Act (CEPA), 1999, c. 33
- .2 Environmental Protection Agency (EPA)
  - .1 EPA Test Method for Measuring Total Volatile Organic Compound Content of Consumer Products, Method 24 - 1995, (for Surface Coatings).
- .3 Health Canada / Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (MSDS).
- .4 Master Painters Institute (MPI)
  - .1 MPI Architectural Painting Specifications Manual, 2004.

**1.2 QUALITY ASSURANCE**

- .1 Qualifications:
  - .1 Contractor: minimum of five years proven satisfactory experience. Provide list of last three comparable jobs including, job name and location, specifying authority, and project manager.
  - .2 Journeymen: qualified journeymen who have "Tradesman Qualification Certificate of Proficiency" engaged in painting work.
  - .3 Apprentices: working under direct supervision of qualified trades person in accordance with trade regulations.
- .2 Health and Safety:
  - .1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

**1.3 SCHEDULING**

- .1 Submit work schedule for various stages of painting to Departmental Representative for review. Submit schedule minimum of 48 hours in advance of proposed operations.
- .2 Obtain written authorization from Departmental Representative for changes in work schedule.
- .3 Schedule painting operations to prevent disruption of occupants.

**1.4 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit product data and instructions for each paint and coating product to be used.

- .2 Submit product data for the use and application of paint thinner.
- .3 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00 - Submittal Procedures. Indicate VOCs during application and curing.
- .3 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 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.
  - .4 Manufacturer's Instructions:
    - .1 Submit manufacturer's installation [application] instructions.
  - .5 Closeout Submittals: submit maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals include following:
    - .1 Product name, type and use.
    - .2 Manufacturer's product number.
    - .3 Colour numbers.
    - .4 MPI Environmentally Friendly classification system rating.

## **1.5 MAINTENANCE**

- .1 Extra Materials:
  - .1 Deliver to extra materials from same production run as products installed. Package products with protective covering and identify with descriptive labels. Comply with Section 01 78 00 - Closeout Submittals.
  - .2 Quantity: provide one - one litre can of each type and colour of primer and finish coating. Identify colour and paint type in relation to established colour schedule and finish system.
  - .3 Delivery, storage and protection: comply with Departmental Representative requirements for delivery and storage of extra materials.

## **1.6 DELIVERY, STORAGE AND HANDLING**

- .1 Packing, Shipping, Handling and Unloading:
  - .1 Pack, ship, handle and unload materials in accordance with Section 01 61 00 - Common Product Requirements and manufacturer's written instructions.
- .2 Acceptance at Site:
  - .1 Identify products and materials with labels indicating:
    - .1 Manufacturer's name and address.
    - .2 Type of paint or coating.
    - .3 Compliance with applicable standard.

- 
- .4 Colour number in accordance with established colour schedule.
  - .3 Remove damaged, opened and rejected materials from site.
  - .4 Storage and Protection:
    - .1 Provide and maintain dry, temperature controlled, secure storage.
    - .2 Store materials and supplies away from heat generating devices.
    - .3 Store materials and equipment in well ventilated area with temperature range 7 degrees C to 30 degrees C.
  - .5 Store temperature sensitive products above minimum temperature as recommended by manufacturer.
  - .6 Keep areas used for storage, cleaning and preparation clean and orderly. After completion of operations, return areas to clean condition.
  - .7 Remove paint materials from storage only in quantities required for same day use.
  - .8 Fire Safety Requirements:
    - .1 Provide one 9 kg Type ABC fire extinguisher adjacent to storage area.
    - .2 Store oily rags, waste products, empty containers and materials subject to spontaneous combustion in ULC approved, sealed containers and remove from site on a daily basis.
    - .3 Handle, store, use and dispose of flammable and combustible materials in accordance with National Fire Code of Canada requirements.
  - .9 Waste Management and Disposal:
    - .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
    - .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
    - .3 Collect and separate for disposal paper, plastic, polystyrene, and corrugated cardboard packaging material for recycling in accordance with Waste Management Plan (WMP).
    - .4 Separate for reuse and recycling and place in designated containers Steel, Metal, and Plastic waste in accordance with Waste Management Plan (WMP).
    - .5 Place materials defined as hazardous or toxic in designated containers.
    - .6 Handle and dispose of hazardous materials in accordance with Regional and Municipal, regulations.
    - .7 Ensure emptied containers are sealed and stored safely.
    - .8 Unused paint and coating materials must be disposed of at official hazardous material collections.
    - .9 Paint, stain and wood preservative finishes and related materials (thinners, and solvents) are regarded as hazardous products and are subject to regulations for disposal. Information on these controls can be obtained from Provincial Ministries of Environment and Regional levels of Government.
    - .10 Material which cannot be reused must be treated as hazardous waste and disposed of in an appropriate manner.

- .11 Place materials defined as hazardous or toxic waste, including used sealant and adhesive tubes and containers, in containers or areas designated for hazardous waste.
- .12 To reduce the amount of contaminants entering waterways, sanitary/storm drain systems or into ground follow these procedures:
  - .1 Retain cleaning water for water-based materials to allow sediments to be filtered out.
  - .2 Retain cleaners, thinners, solvents and excess paint and place in designated containers and ensure proper disposal.
  - .3 Return solvent and oil soaked rags used during painting operations for contaminant recovery, proper disposal, or appropriate cleaning and laundering.
  - .4 Dispose of contaminants in approved legal manner in accordance with hazardous waste regulations.
  - .5 Empty paint cans are to be dry prior to disposal or recycling (where available).
- .13 Where paint recycling is available, collect waste paint by type and provide for delivery to recycling or collection facility.

## 1.7 SITE CONDITIONS

- .1 Heating, Ventilation and Lighting:
  - .1 Ventilate enclosed spaces.
  - .2 Provide heating facilities to maintain ambient air and substrate temperatures above 10 degrees C for 24 hours before, during and after paint application until paint has cured sufficiently.
  - .3 Provide continuous ventilation for seven days after completion of application of paint.
  - .4 Coordinate use of existing ventilation system with Departmental Representative and ensure its operation during and after application of paint as required.
  - .5 Provide temporary ventilating and heating equipment where permanent facilities are not available or supplemental ventilating and heating equipment if ventilation and heating from existing system is inadequate to meet minimum requirements.
  - .6 Provide minimum lighting level of 323 Lux on surfaces to be painted.
- .2 Temperature, Humidity and Substrate Moisture Content Levels:
  - .1 Unless pre-approved written approval by 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 15% for wood.
    - .2 12% for plaster and gypsum board.
  - .3 Test for moisture using calibrated electronic Moisture Meter..
  - .4 Test concrete, masonry and plaster surfaces for alkalinity as required.
- .3 Surface and Environmental Conditions:
    - .1 Apply paint finish in areas where dust is no longer being generated by related construction operations or when wind or ventilation conditions are such that airborne particles will not affect quality of finished surface.
    - .2 Apply paint to adequately prepared surfaces and to surfaces within moisture limits.
    - .3 Apply paint when previous coat of paint is dry or adequately cured.
  - .4 Additional interior application requirements:
    - .1 Apply paint finishes when temperature at location of installation can be satisfactorily maintained within manufacturer's recommendations.
    - .2 Apply paint in occupied facilities during silent hours only. Schedule operations to approval of Departmental Representative such that painted surfaces will have dried and cured sufficiently before occupants are affected.

## **Part 2 Products**

### **2.1 MATERIALS**

- .1 Paint materials listed in the MPI Approved Products List (APL) are acceptable for use on this project.
- .2 Provide paint materials for paint systems from single manufacturer.
- .3 Only qualified products with E2 or E3 "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 Materials (primers, paints, coatings, varnishes, stains, lacquers, fillers, thinners, solvents, etc.) in accordance with MPI Architectural Painting Specification Manual "Approved Product" listing.

- .6 Linseed oil, shellac, and turpentine: highest quality product from approved manufacturer listed in MPI Architectural Painting Specification Manual, compatible with other coating materials as required.
- .7 Provide paint products meeting MPI "Environmentally Friendly" E2 and E3 ratings based on VOC (EPA Method 24) content levels.
- .8 Use MPI listed materials having minimum E3 rating where indoor air quality (odour) requirements exist.
- .9 Paints, coatings, adhesives, solvents, cleaners, lubricants, and other fluids:
  - .1 Water-based.
  - .2 Non-flammable.
  - .3 Manufactured without compounds which contribute to ozone depletion in the upper atmosphere.
  - .4 Manufactured without compounds which contribute to smog in the lower atmosphere.
  - .5 Do not contain methylene chloride, chlorinated hydrocarbons, and toxic metal pigments.
- .10 Formulate and manufacture water-borne surface coatings with no aromatic solvents, formaldehyde, halogenated solvents, mercury, lead, cadmium, hexavalent chromium or their compounds.
- .11 Flash point: 61.0 degrees C or greater for water-borne surface coatings and recycled water-borne surface coatings.
- .12 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.
- .13 Water-borne paints and stains, recycled water-borne surface coatings and water borne varnishes to meet minimum "Environmentally Friendly" E2 rating.

## 2.2

### COLOURS

- .1 Departmental Representative will provide Colour Schedule after Contract award.
- .2 Colour schedule will be based upon selection of six base colours and three accent colours. No more than ten colours will be selected for entire.
- .3 Selection of colours from manufacturers full range of colours.
- .4 Where specific products are available in restricted range of colours, selection based on limited range.
- .5 Second coat in three coat system to be tinted slightly lighter colour than top coat to show visible difference between coats.



**2.3 MIXING AND TINTING**

- .1 Perform colour tinting operations prior to delivery of paint to site. 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.

**2.4 GLOSS/SHEEN RATINGS**

- .1 Paint gloss is defined as sheen rating of applied paint, in accordance with following values:

	Gloss @ 60 degrees	Sheen @ 85 degrees
Gloss Level 1 - Matte Finish (flat)	Max. 5	Max. 10
Gloss Level 2 - Velvet-Like Finish	Max.10	10 to 35
Gloss Level 3 - Eggshell Finish	10 to 25	10 to 35
Gloss Level 4 - Satin-Like Finish	20 to 35	min. 35
Gloss Level 5 - Traditional Semi-Gloss Finish	35 to 70	
Gloss Level 6 - Traditional Gloss	70 to 85	
Gloss Level 7 - High Gloss Finish	More than 85	

- .2 Gloss level ratings of painted surfaces herein and as noted on Finish Schedule.

**2.5 INTERIOR PAINTING SYSTEMS**

- .1 Concrete vertical surfaces:
  - .1 INT 3.1M – Institutional low odour/low VOC, match existing gloss finish. Premium grade, 1 coat primer, two top coats.
- .2 Concrete horizontal surfaces:
  - .1 INT 3.2C - Epoxy finish (Floor markings of interior floors).
  - .2 INT 3.2F – Concrete floor sealer (confirm requirements for specified floor finishes.)
- .3 Concrete masonry units: smooth and split face block and brick:
  - .1 INT 4.2D - High performance architectural latex, Gloss Level 5, Semi-Gloss Finish. Premium grade, 1 coat primer, two top coats.
  - .2 INT 4.2F - Epoxy (tile-like) finish for dry environments.
- .4 Structural steel and metal fabrications: columns, beams, joists, panels:

- .1 INT 5.1Q – Latex, Gloss Level 5 – Semi-Gloss Finish (over alkyd primer). Premium grade, 1 coat primer, two top coats.
- .5 Galvanized metal: doors, frames, and miscellaneous steel.
  - .1 INT 5.3M - High performance architectural latex, Gloss Level 5 – Semi-Gloss finish. Premium grade, 1 coat primer, two top coats.
- .6 Dressed lumber: including wood doors, window frames, casings, and mouldings:
  - .1 INT 6.3A - High performance architectural latex, Gloss Level 5 – Semi-Gloss finish. Premium grade, 1 coat primer, two top coats.
  - .2 INT 6.3W - Waterborne clear acrylic, Gloss Level 5 – Semi-Gloss finish (over stain). Premium grade, 1 coat stain, two coats varnish.
- .7 Wood paneling and casework: perforated panels, shelving, millwork:
  - .1 INT 6.4S - High performance architectural latex, Gloss Level 5 – Semi-Gloss finish. Premium grade, 1 coat primer, two top coats.
- .8 Plaster and gypsum board: gypsum wallboard, drywall, "sheet rock type material", and textured finishes:
  - .1 INT 9.2B - High performance architectural latex, Gloss Level 3 – Egg Shell finish. Premium grade, 1 coat primer, two top coats.

## **2.6 SPECIAL FINISHES**

- .1 Acoustic ballistic rubber panels
  - .1 Paint to be compatible with acoustic ballistic rubber panels. Gloss Level 5 – Semi-Gloss. Premium grade, 1 coat primer, two top coats. Colour to be selected by Departmental Representative.

## **2.7 TARGET DISTANCE IDENTIFICATION NUMBERS**

- .1 Each target distance identification number is to be painted in a contrasting colour, 250 mm high. Paint to be compatible with acoustic ballistic sound panels. Colour to be selected by Departmental Representative.

## **Part 3 Execution**

### **3.1 MANUFACTURER'S INSTRUCTIONS**

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

### **3.2 GENERAL**

- .1 Perform preparation and operations for interior painting in accordance with MPI Architectural Painting Specifications Manual except where specified otherwise.
- .2 Apply paint materials in accordance with paint manufacturer's written application instructions.

### 3.3 EXAMINATION

- .1 Investigate existing substrates for problems related to proper and complete preparation of surfaces to be painted. Report to Departmental Representative damages, defects, unsatisfactory or unfavourable conditions before proceeding with work.
- .2 Conduct moisture testing of surfaces to be painted using properly calibrated electronic moisture meter, except test concrete floors for moisture using simple "cover patch test". Do not proceed with work until conditions fall within acceptable range as recommended by manufacturer.
- .3 Maximum moisture content as follows:
  - .1 Stucco, plaster and gypsum board: 12%.
  - .2 Concrete: 12%.
  - .3 Wood: 15%.

### 3.4 PREPARATION

- .1 Protection:
  - .1 Protect existing building surfaces and adjacent structures from paint spatters, markings and other damage by suitable non-staining covers or masking. If damaged, clean and restore surfaces as directed by Departmental Representative.
  - .2 Protect items that are permanently attached such as Fire Labels on doors and frames.
  - .3 Protect factory finished products and equipment.
  - .4 Protect passing pedestrians, building occupants, and general public in and about the building.
- .2 Surface Preparation:
  - .1 Remove electrical cover plates, light fixtures, surface hardware on doors, bath accessories and other surface mounted equipment, fittings and fastenings prior to undertaking painting operations. Identify and store items in secure location and re-installed after painting is completed.
  - .2 Move and cover furniture and portable equipment as necessary to carry out painting operations. Replace as painting operations progress.
  - .3 Place "WET PAINT" signs in occupied areas as painting operations progress. Signs to approval of Departmental Representative.
- .3 Clean and prepare surfaces in accordance with MPI Architectural Painting Specification Manual requirements. Refer to MPI Manual in regard to specific requirements and as follows:
  - .1 Remove dust, dirt, and other surface debris by 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 Where possible, prime non-exposed surfaces of new wood surfaces before installation. Use same primers as specified for exposed surfaces.
  - .1 Apply vinyl sealer to MPI #36 over knots, pitch, sap and resinous areas.
  - .2 Apply wood filler to nail holes and cracks.
  - .3 Tint filler to match stains for stained woodwork.
- .6 Sand and dust between coats as required to provide adequate adhesion for next coat and to remove defects visible from a distance up to 1000 mm.
- .7 Clean metal surfaces to be painted by removing rust, loose mill scale, welding slag, dirt, oil, grease and other foreign substances in accordance with MPI requirements. Remove traces of blast products from surfaces, pockets and corners to be painted.
- .8 Touch up of shop primers with primer as specified.
- .9 Do not apply paint until prepared surfaces have been accepted by Departmental Representative

### 3.5

#### APPLICATION

- .1 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.
- .2 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.
- .3 Use dipping, sheepskins or daubers only when no other method is practical in places of difficult access.
- .4 Apply coats of paint continuous film of uniform thickness. Repaint thin spots or bare areas before next coat of paint is applied.
- .5 Allow surfaces to dry and properly cure after cleaning and between subsequent coats for minimum time period as recommended by manufacturer.
- .6 Sand and dust between coats to remove visible defects.
- .7 Finish surfaces both above and below sight lines as specified for surrounding surfaces, including such surfaces as tops of interior cupboards and cabinets and projecting ledges.
- .8 Finish closets and alcoves as specified for adjoining rooms.
- .9 Finish top, bottom, edges and cutouts of doors after fitting as specified for door surfaces.

### 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 Boiler room, mechanical and electrical rooms: paint exposed conduits, piping, hangers, ductwork and other mechanical and electrical equipment.
- .3 Other unfinished areas: leave exposed conduits, piping, hangers, ductwork and other mechanical and electrical equipment in original finish and touch up scratches and marks.
- .4 Touch up scratches and marks on factory painted finishes and equipment with paint as supplied by manufacturer of equipment.
- .5 Do not paint over nameplates.
- .6 Keep sprinkler heads free of paint.
- .7 Paint inside of ductwork where visible behind grilles, registers and diffusers with primer and one coat of matt black paint.
- .8 Paint fire protection piping red.
- .9 Paint disconnect switches for fire alarm system and exit light systems in red enamel.
- .10 Paint natural gas piping yellow.
- .11 Paint both sides and edges of backboards for telephone and electrical equipment before installation. Leave equipment in original finish except for touch-up as required, and paint conduits, mounting accessories and other unfinished items.
- .12 Do not paint interior transformers and substation equipment.

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**3.7 FIELD QUALITY CONTROL**

- .1 Standard of Acceptance:
  - .1 Walls: no defects visible from a distance of 1000 mm at 90 degrees to surface.
  - .2 Ceilings: no defects visible from floor at 45 degrees to surface when viewed using final lighting source.
  - .3 Final coat to exhibit uniformity of colour and uniformity of sheen across full surface area.
- .2 Advise Departmental Representative when surfaces and applied coating is ready for inspection. Do not proceed with subsequent coats until previous coat has been approved.
- .3 Cooperate with inspection firm and provide access to areas of work.
- .4 Retain purchase orders, invoices and other documents to prove conformance with noted MPI requirements when requested by Departmental Representative.

**3.8 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**

**Part 1 General**

**1.1 REFERENCES**

- .1 Green Building Rating System Reference Guide for Commercial Interiors.
- .2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (MSDS).

**1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 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 01 35 29.06 - Health and Safety Requirements.
- .3 Submit shop drawings and indicate:
  - .1 Fan performance curves with point of operation.
- .4 Quality control submittals: submit following in accordance with Section 01 45 00 - Quality Control.
  - .1 Rating certificates: provide catalogued or published ratings obtained from tests carried out by manufacturer or those ordered from independent testing agency signifying adherence to codes and standards.
  - .2 Manufacturer's Instructions: submit manufacturer's installation instructions and special handling criteria, installation sequence, and cleaning procedures.
- .5 Closeout Submittals:
  - .1 Provide operation and maintenance data for vacuum cleaning system for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

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

**1.4 EXTRA MATERIALS**

- .1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Furnish list of individual manufacturer's recommended spare parts for equipment:

- .1 Bearings and seals.
- .3 Provide list of addresses of suppliers, together with list of specialized tools necessary for adjusting, repairing or replacing, for placement into operating manual.

## **Part 2 Products**

### **2.1 GRANULAR VACUUM CLEANING SYSTEM**

- .1 Complete portable system as specified.
- .2 Vacuum power unit:
  - .1 One piece unit with vacuum turbine type fan in one container.
  - .2 Power unit:
    - .1 5 HP, 230VAC, 14 AMP FL, three phase motor handling 75 L/s air capacity at 100 mm opening.
    - .2 Provide 27.5 kPa vacuum pressure with sealed orifice.
    - .3 Construct from 1 mm thick steel with corrosion resistant interior and enamel exterior.
    - .4 Cord length: minimum 9.0m (30 feet).
  - .3 Unit to operate in stable portion of performance curve at all times.
- .3 Tubing system:
  - .1 100 mm nominal rigid PVC complete with exhaust outside vent cover, long sweep elbows and tees, supports and brackets as recommended by manufacturer.
  - .2 Make connections between tubing and fittings as recommended by manufacturer.
- .4 Inlet valves:
  - .1 Constructed of cast aluminum.
  - .2 Manual switch to operate on low voltage control to power unit.
    - .1 Micro switch to control unit upon insertion of hose.
- .5 Hoses and fittings:
  - .1 One flexible nylon reinforced lightweight intake hose, 100 mm nominal diameter by minimum 7.5 m long complete with fittings.
  - .2 One flexible nylon reinforced lightweight discharge hose, 100 mm nominal diameter by minimum 7.5 m long complete with fittings.

## **Part 3 Execution**

### **3.1 MANUFACTURER'S INSTRUCTIONS**

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

### **3.2 INSTALLATION**

- .1 Install in accordance with manufacturer's instructions.



- .2 Refer to Drawing E3.1 for outlet mounting.
- .3 Commissioning: adjust to ensure operation in stable portion of fan performance curve at all times.

**3.3 FIELD QUALITY CONTROL**

- .1 Manufacturer's Field Services:
  - .1 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.

**3.4 CLEANING**

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

**3.5 SCHEDULE**

- .1 Quantity: 2 complete units.

**END OF SECTION**

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**Part 1            General**

**1.1                SUMMARY**

- .1    Provide a complete granular bullet trap including but not limited to metal frame, protective AR500
- .2    Provide a complete target control system including but not limited to fixed turning target system, lateral moving target system, master control unit, wireless control unit, target control system, computer control software, equipment, communication links, power supplies, infrastructure, electrical controls, electrical components, all components to operate the target control system, and other electrical items required for complete power system, erection, installation, operation, set-up, and commissioning of the system.
- .3    Refer to Division 27 – Communications for communication cable requirements.

**1.2                REFERENCES**

- .1    ASTM International
  - .1    ASTM A123/A123M-09, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
  - .2    ASTM A653/A653M-10, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- .2    CSA International
  - .1    CSA W59-M03(R2008), Welded Steel Construction (Metal Arc Welding).
- .3    The Master Painters Institute (MPI)
  - .1    Architectural Painting Specification Manual - current edition.

**1.3                ACTION AND INFORMATIONAL SUBMITTALS**

- .1    Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2    Product Data:
  - .1    Submit manufacturer's instructions, printed product literature and data sheets for shooting range equipment and include product characteristics, performance criteria, physical size, finish and limitations.
- .3    Shop Drawings:
  - .1    Submit drawings stamped and signed by professional engineer registered or licensed in Province of Saskatchewan, Canada.
  - .2    Indicate on drawings:
    - .1    Construction details and materials, equipment layout and dimensions, clearances required for operation and service, auxiliary equipment, point loads, anchor bolt locations, equipment, software, electrical requirements, electrical line runs, carrier systems, target control.
- .4    Sustainable Design Submittals:

- .1 Construction Waste Management:
  - .1 Submit project Waste Reduction Workplan highlighting recycling and salvage requirements.

#### **1.4 CLOSEOUT SUBMITTALS**

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for shooting range equipment for incorporation into manual.

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

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements 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 shooting range equipment from damage.
  - .3 Replace defective or damaged materials with new.
- .4 Develop Waste Reduction Workplan related to Work of this.

#### **1.6 QUALITY ASSURANCE**

- .1 Regulatory Requirements:
  - .1 Bullet trap supplier and target system supplier: certified by a Canadian Certification Organization accredited by Standards Council of Canada.
- .2 Test Reports: certified test reports showing compliance with specified performance characteristics and physical properties.
- .3 Certificates: product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.
- .4 Pre-Installation Meetings: conduct pre-installation meeting to verify project requirements, manufacturer's installation instructions and manufacturer's warranty requirements.

### **Part 2 Products**

#### **2.1 MATERIALS**

- .1 Welding materials: to CSA W59.
- .2 Shop primer: heat resistant primer paint to manufacturer's standard.

## 2.2 SWING OUT BARRIER

- .1 Purpose made shooting barrier to provide a means of practicing shooting from behind cover.
- .2 Mechanically fastened to aluminum post. Refer to Section 05 50 00 Metal Fabrications.
- .3 Easy swing out action with gravity locking mechanism.
- .4 Barrier: Composite board consisting of high density polyethylene (HDPE) and wood flour, extruded into sizes and shapes indicated with the following physical properties
  - .1 Vertical grain.
  - .2 Colour as selected from manufacturer's standard range.
  - .3 Flexural Properties when tested in accordance with ASTM D-6109:
    - .1 Modulus of Elasticity (MOE): 542,200 psi.
    - .2 Modulus of Rupture (MOR): 3157 psi.
  - .4 Hardness when tested in accordance with ASTM D-143: 101.25 kg (225 lb.)
  - .5 Water Absorption when tested in accordance with ASTM D-1037, volume percentage <1.35%, mass percentage <1.29%.
  - .6 Flame Spread Index when tested in accordance with ASTM E-84: 75
- .5 Horizontal support, vertical support, pivot brackets and mounting brackets:
  - .1 Steel sections and plates: to CSA G40.20/G40.21, Grade 350W.
  - .2 Steel pipe: to ASTM A53/A53M extra strong, galvanized finish, Grade 241.
  - .3 Welding materials: to CSA W59.
  - .4 Powder coat all supports and brackets.
- .6 Hinges: Gravity locking mechanism. Barrier hinge shall enable the barrier to come to a secure rest position parallel to the firing line. Powder coat finish.

## 2.3 BULLET TRAP

- .1 Performance Criteria
  - .1 Granulated Bullet Trap for capturing jacketed, semi-jacketed and non-jacketed, shot and slug projectiles with velocities 600 feet per second (FPS) (183 meters) to .308/7.62 mm grade, certified up to 3600 foot-pounds (4881 joules) of impact. Granulated Bullet Trap captures projectiles fired from oblique angles and point-blank range without back-splatter or ricochet.
    - .1 Height: 2743mm (9'-0") complete with hopper.
    - .2 Maximum footprint: 4270mm (14'-0")
    - .3 The granulated trap shall decelerate bullets in a shredded rubber medium that has an average diameter of 19 mm (3/4").
    - .4 The rubber medium shall be treated with fire retardant material.
    - .5 The trap framework shall be of hot dipped galvanized metal inclined relative to the direction of incoming projectiles.
    - .6 The granulated trap shall require no rear access for cleaning or service.
    - .7 The granulated framework should be no more than 30 degrees from horizontal.

- .8 The granulated framework shall be of sufficient strength to support rubber medium, which is a minimum of 610mm (2 feet) thick as measured perpendicular to the rubber support structure.
- .9 All framework which has the potential to be impacted by projectiles is to be constructed of AR500.
- .10 A hopper located above the target region of the trap provides a supplemental volume of rubber granulate to maintain a constant depth of material. The front facing of the hopper is angled and constructed of AR500 steel and covered with 50 mm (2") thick ballistic rubber panels to provide ballistic protection and capture errant shots.
- .11 The rubber medium shall not exceed 915mm (3 feet) in depth as measured from a horizontal level.
- .12 The trap shall provide protection for the end of the range. The trap shall have a minimum height of 2743 mm (9 feet) unless otherwise noted on range specific drawings.
- .13 The granulated trap shall be inclusive of all hardware necessary for assembly of the trap.
- .14 The granulated trap shall be mounted on an existing concrete slab.
- .15 Trap shall accommodate surface variations of up to 50 mm (2") on the concrete slab.
- .16 Granulated trap shall aid in the elimination of airborne lead on the shooting range.
- .17 No EPA regulated materials or water-absorbing material shall be added to the rubber medium.
- .18 Consistent rubber thickness will be maintainable using hand tools (rakes).
- .19 The granulated trap shall allow the use of oblique angles for shooting, i.e. cross-lane.
- .20 The granulated bullet trap is to include a self-healing rubber membrane cover to reduce migration of rubber granulate material.
  - .1 Minimum thickness: 4mm
  - .2 Colour: black

## 2.4 FIXED TURNING TARGET SYSTEM

- .1 Overhead mounted target holders adequate for holding full silhouette targets and their cardboard backer panels. Holders to have either a continuous clamp across the top or two separate clip attachment points at 450mm apart at the targets top outer ends. The holders upper attachment point shall be designed to hold the target in a straight presentation to the shooter. Holders to be fabricated from formed AR500 steel.
- .2 Target holders are to be suspended upon a cross member support that consists of angle iron or other suitable steel structure which extends wall to wall, with vertical supports to the structure, and at an elevation that will allow for a clear target height of approximately 1800mm. The cross member support shall be located within a protected area behind a ceiling baffle panel and not visible from the primary firing line.
- .3 Actuator:

- .1 The actuator shall hold a target which has two positions, front face and edge, and shall be capable of turning quickly from any one position to any other position.
  - .2 Turning times to be easily adjusted, using a screwdriver, without opening the unit.
  - .3 Actuator shall contain the means to fully control turning time from edge to face. The range of control shall be from less than 0.5 second and up.
  - .4 Actuator shall be capable of being triggered completely with the use of a 12V signal of less than 200mA.
  - .5 Actuators shall be capable or independent, tandem, and multiple operations.
  - .6 Actuator shall have the ability to develop at least 31 ft-lbs of torque.
  - .7 Actuator shall be totally field repairable such that a complete field rebuild operation may be accomplished quickly by standard range personnel (without any special skills) using standard hand tools.
  - .8 The actuator shall connect to a computer to allow multiple units to operate in a pre-programmed scenario or as an option, a push-button controlled wireless interface with the ability to run pre-programmed scenarios.
  - .9 Actuator shall provide for interface with electronic hit-sensing systems for interface to manufacturer provided software.
  - .10 The mechanism shall be protected from splatter at all angles and shall inherently protect control wiring running inside. Actuator shall provide standard interface from the bottom or rear of the unit.
  - .11 A clutch on the downrigger shaft protects the turning motor if an external force is applied. The clutch shall disengage the clamp from the motor, automatically reengaging after the force is removed and the target is turned again.
- .4 Construction
- .1 All inner parts shall be covered by a hot-dipper, galvanized, removable housing to protect all components.
  - .2 All impact surfaces shall be separate from the actuator and shall be replaceable.
  - .3 Actuator shall contain electrical components for electrical signalling and operation.
  - .4 All steel surfaces to be sandblasted and be ready for paint.
- .5 Power requirements
- .1 Operated from a normal 115V AC supply with the voltage reduced to safe levels at the receiver unit. Provide twist lock receptacle.
  - .2 Control and power circuits to be made through a connector with a positive lock and a quarter-turn release.

## **2.5 LATERAL MOVING TARGET SYSTEM**

- .1 Overhead mounted lateral non-turning target track and carrier system.
- .2 Electric powered system.
- .3 Lateral moving overhead mounted target trolley adequate for holding full silhouette targets and their cardboard backer panels. Trolley to have either a continuous clamp across the top or two separate clip attachment points at 450mm apart at the targets top

- outer ends. The holder's upper attachment point shall be designed to hold the target in a straight presentation to the shooter. Holders to be fabricated from formed AR500 steel.
- .4 Target holder is to be suspended upon a cross member support that consists of angle iron or other suitable steel structure which extends wall to wall, with vertical supports to the structure, and at an elevation that will allow for a clear target height of approximately 1800mm. The cross member support shall be located within a protected area behind a ceiling baffle panel and not visible from the primary firing line.
  - .5 The target trolley is mounted on multiple ball-bearing equipped wheels for maximum stability and smooth operation.
  - .6 Heavy duty sealed ball bearings are used in all highly stressed locations of the drive mechanism.
  - .7 The lateral moving target system is designed to be located in close proximity to the fixed turning target system. Provide separate power supply lateral moving target system.
  - .8 The lateral moving target system shall have discrete and variable speed selection. The selection of discrete, rather than infinitely variable, speeds permits the repeated exact reproduction of training routines
  - .9 In its advanced modes the target is automatically programmed to move over random distances at random speeds.
  - .10 Base and rails
    - .1 Legs: 25mm x 50mm (1"x2") steel tube of 2.3mm (0.09") wall thickness
    - .2 Various steel brackets welded to the base and rails vary between 3.2mm (0.125") and 4.7mm (0.186") thickness.
    - .3 Target frame: Computer-designed, injection-molded, UV-resistant filled nylon
  - .11 Track
    - .1 Fabricated of 3.13mm (11ga) galvanized steel using maximum lengths possible.
    - .2 Sections to be designed to be bolted together.
    - .3 A solid copper bus bar that is electrically isolated from the track to provide power to the carrier.
    - .4 Special starting section provided with the track system to permit easy installation and removal of the target carrier.
    - .5 The trap end pulley for retrieval applications shall be solid steel and the assembly shall be mounted in such a way as to prevent damage to the cable and pulley.
    - .6 Provide spacers to provide additional cross-track stability.
  - .12 Carrier body
    - .1 Made of 3.13mm (11ga) galvanized steel, totally enclosed to protect internal components
  - .13 Bearings
    - .1 Heavy-duty sealed ball bearings.
  - .14 Power requirements

- .1 Operated from a normal 115V AC supply with the voltage reduced to safe levels at the receiver unit. Provide twist lock receptacle.

## **2.6 TARGET CONTROL SYSTEM**

- .1 Target control system (TCS) shall consist of one or more target control banks which are populated by one or more target control modules (TCM).
- .2 Target control head end cabinet shall consist of an outer housing, a mother board and a capacity for up to 10 TCM cards and one controller card.
- .3 Each TCM shall have three independent channels and be capable of either two output channels and one input channel, or two input channels and one output channel.
- .4 Each TCM card shall have the capacity to operate 1, 2, or 3 targets per output channel. Each TCM output channel shall be capable of being turned off and on.
- .5 The TCM system shall allow for separate isolated power supplies. One power supply shall provide the power to the controller circuit and the other shall supply the power for the target device.
- .6 TCM units shall provide 12 VDC outputs that are used to operate target devices.
- .7 TCM card shall plug into back plane and be secured with an edge connector.
- .8 TCM system shall be fan cooled and have a protective screen to keep dirt and other debris out of the enclosure.
- .9 TCM shall be able to accept input signals from the range control software and have a manual redundant emergency backup switch.
- .10 TCM shall employ quick connect plug in wire connections that do not require the use of tools.
- .11 TCM shall provide a visible LED display that shows the state of the device connected to the TCM channel.
- .12 TCM shall provide separate visual LED indication as to the condition of the device, ie. Target device shorted, open circuit, power (on/off), circuit on, hit data.
- .13 TCM cards shall provide optical isolation from the target device connected to each TCM channel.
- .14 Target control system must provide an interface for the lighting controls. Refer to Section 26 09 24 Low Voltage Lighting System.

## **2.7 RANGE CONTROL SOFTWARE**

- .1 Range Control Software (RCS) shall be capable of independent operation of all targets on the range. The software shall be capable of controlling an unlimited number of targets.
- .2 Software shall be capable of independent target addressing, which shall include multi-purpose sensor input such as target hit sensors, position sensors, electric eye sensors, etc.
- .3 The RCS shall interface to Target Control Modules and communicate via RS-232 serial protocol or TCP/IP with Ethernet.



- .4 RCS shall be able to access targets by touching the target icon on the touch screen. Targets may be grouped by the used into useable groups and the selection of the groups is also available by touch screen.
- .5 The RCS shall function on commonly available touch screen computers that shall run multiple operating systems, which shall include MS Windows and Linux. The software shall employ Graphic User Interface (GUI) in addition to written command lines using Tool Command Language (TCL)
- .6 RCS shall include the ability for creation of target and training scenarios.
- .7 All target training scenarios and system configurations shall be saved to the system hard drive and can be copied or transferred to other systems through standard windows transfer programs.
- .8 RCS shall have the option of individually customizing the on-screen layout to match actual range configuration
- .9 RCS shall allow for the creation of unique target training programs and scenarios to be accessed via use of the on-screen target control buttons. Buttons shall include
  - .1 Target Group
  - .2 Auto Group Off
  - .3 Single Target
  - .4 Auto Off Single Target
  - .5 Delay
  - .6 Run Course
  - .7 Pause
  - .8 Stop
- .10 RCS shall use target icons on the touch screen that represent the range target ins real time and change state on-screen as the range targets change state ie: edge, face.
- .11 Shape and configuration of target icons may be changed by the user. Additional screens may be created for alternate training scenarios and operations.
- .12 RCS shall be capable or interfacing with and controlling lighting, fans, and other mechanical devices. Software shall be able to use the serial or TCP/IP connection and control system presets.
- .13 RCS shall incorporate an integrated audio support system that can be incorporated into training scenarios and uses as a training device. Audio files can be accessed via GUI interface buttons.
- .14 RCS shall have the ability to pick targets and devices at random with various times and delays, also selected at random.
- .15 RCS shall have an interactive on-screen help system that operates in an HTML format. The help information shall contain a complete step-by-step tutorial to assist new users with the various functions available on the software interface.
- .16 All programming functions shall be password protected to provide security against unauthorized changes.

- .17 Software shall have the ability to print and save a training log displaying training times and events.
- .18 RCS shall incorporate a wireless interface device that allows the user to call training programs from remote locations on the range.

## **2.8 MASTER CONTROL UNIT**

- .1 Complete range control from a central location using LCD touch screen technology with user friendly operation and programming. Large display with a wide viewing angle, for constant monitoring of the range, from a sitting or standing position. The operator can rotate targets to face, back or edge for a time exposure with a single push of a button.
- .2 All screens are menu driven with on-screen help guides. Shooting scenarios for training or competition shooting can be easily programmed requiring no special computer skills. Timed shooting scenarios can vary from simple to complex depending on individual needs.
- .3 All pre-programmed shooting scenario can be downloaded simultaneously. All entered shooting scenarios can be stored, retrieved and viewed on the touch screen.
- .4 All operation screens contain a safety stop button which will edge face all targets when activated.
- .5 Commands are entered via the touch sensitive display with an audible tone to acknowledge receipt of the command.
- .6 The Master Control Unit (MCU) shall communicate with and control the range target equipment. The touch screen shall be the system's operator interface; therefore a keyboard and mouse are not required. Provide a keyboard and mouse as an alternate input system.
- .7 The MCU shall power up within 10 seconds and shall feature a sleep mode to power down after 60 minutes of inactivity. The MCU shall be part of an integrated target control system that controls the fixed turning targets, lateral moving targets, range lighting, and other optional equipment.
- .8 The MCU shall communicate with the control cabinet with a nine-pin connector.
- .9 Minimum hardware requirements
  - .1 Intel Core i5 Processor or better.
  - .2 USB 2.0 input.
  - .3 4GB SDRAM (DDR3), 500GB hard drive
  - .4 VGA, Serial, USB, 10/100/1000 Ethernet, and Wi-Fi interface.
- .10 The MCU shall use standard 120V 60Hz AC.

## **2.9 WIRELESS REMOTE TABLET**

- .1 246 mm (9.7") screen size, 64GB processor, 2048 x 1536 resolution, 1.9GHz CPU speed, 3GB internal memory expandable with external memory slot, wi-fi direct connectability, USB 2.0.
- .2 iOS, Android OS or Windows OS.
- .3 Remote shall incorporate a commercial available wireless 2.4 GHz interface.

- .4 Remote shall have 12 programmable individual control inputs.
- .5 Remote must be able to be held and operated simultaneously with both hands.
- .6 The remote shall operate on line of site to the base for a minimum of 50 metres.
- .7 Multiple devices must be able to be used in the same transmission radius without interference.
- .8 Remote shall be a self-contained, on board rechargeable battery.
- .9 Remote shall interface with 16-channel serial controlled digital input/output device and a 30-channel TCP/IP target control system.
- .10 Remote shall incorporate a graphical user interface capable of program block control logic design with unlimited target control function.
- .11 The remote base unit shall use standard 120V 60Hz AC.
- .12 Remote shall activate stored, customer defined courses of fire with a single control key.
- .13 Acceptable manufacturers
  - .1 Apple iPad
  - .2 Samsung Galaxy
  - .3 Microsoft Surface Pro
  - .4 Approved alternate

## **2.10 FABRICATION**

- .1 Build work square, true, straight and accurate to required size, with joints closely fitted and properly secured.
- .2 Where possible, shop assemble and fit work as complete package ready for installation.
- .3 Make exposed welds continuous for length of each joint.
  - .1 Do welding in accordance with CSA W59. File or grind exposed welds smooth and flush.

## **2.11 FINISHES**

- .1 Primed finish: apply shop primer to metal items, with exception of those to be galvanized.
  - .1 Apply unaltered, as prepared by manufacturer, to dry surfaces, free from rust, scale, grease.
- .2 Galvanizing: for sheet steel, Z90 zinc coating to ASTM A653/A653M; for irregular shaped articles, 380 g/m<sup>2</sup> zinc coating to ASTM A123/A123M.
- .3 Apply two coats of finish paint to exposed metal surfaces except galvanized, in accordance with manufacturer's written recommendations.

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**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 shooting range equipment installation in accordance with manufacturer's written instructions.
  - .1 Visually inspect substrate in presence of Departmental Representative.
  - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
  - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

**3.2 INSTALLATION**

- .1 Comply with requirements of provincial and local environmental regulatory agencies except where more stringent requirements are specified herein.
- .2 Install shooting range equipment in accordance with reviewed shop drawings and manufacturer's instructions, using factory trained personnel.

**3.3 FIELD QUALITY CONTROL**

- .1 Have manufacturer of products supplied under this Section review Work involved in handling, installation/application, protection and cleaning of its products, and submit written reports in acceptable format to verify compliance of Work with Contract.

**3.4 TESTING**

- .1 Acceptance Test:
  - .1 Contractor shall perform complete operating tests for all target systems. Perform no less than ten (10) complete cycles and scenarios, all safety controls, all input controls, emergency operation, and such other tests as specified in the Manufacturer's approved procedure plan. Notify the Departmental Representative a minimum of seven (7) days prior to the beginning of tests.
  - .2 Any defects disclosed by the tests shall be corrected; final adjustments of the target system and operating equipment shall be turned over to the Departmental Representative in accordance with Section 01 33 00 – Closeout Submittals. Tests of previously defective items repaired or replaced by the Contractor shall be accomplished at no additional cost to the Owner.

**3.5 START UP AND COMMISSIONING**

- .1 Test and adjust complete system for proper function and leave in perfect working order.
- .2 Conduct demonstration to accommodation maintenance staff on operation and care of shooting range equipment for a period of 2 – eight hour sessions, to instruct all shifts for the Departmental Representative's and Owner's operating and maintenance personnel in the proper operation, maintenance, and servicing of the bullet trap and target systems.

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**3.6 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
  - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

**3.7 PROTECTION**

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by installation.

**END OF SECTION**

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**Part 1            General**

**1.1                REFERENCES**

- .1    ASTM International
  - .1    ASTM A307-14, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
  - .2    ASTM A325-14, Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
  - .3    ASTM A514/A514M-14, Standard Specification for High-Yield-Strength, Quenched and Tempered Alloy Steel Plate, Suitable for Welding.
  - .4    ASTM A563-15, Standard Specification for Carbon and Alloy Steel Nuts.
  - .5    ASTM A641/A651M-09a(2014), Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire
  - .6    ASTM C645-14, Standard Specification for Nonstructural Steel Framing Members.
  - .7    ASTM A1023/A1023M-15, Standard Specification for Stranded Carbon Steel Wire Ropes for General Purposes.
  - .8    ASTM F436-11, Standard Specification for Hardened Steel Washers.
- .2    CSA International
  - .1    CSA G40.20/G40.21-04(R2009), General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
  - .2    CSA W48-06, Filler Metals and Allied Materials for Metal Arc Welding (Developed in co-operation with the Canadian Welding Bureau).
  - .3    CSA W59-M03(R2008), Welded Steel Construction (Metal Arc Welding).
- .3    Health Canada / Workplace Hazardous Materials Information System (WHMIS)
  - .1    Material Safety Data Sheets (MSDS).
- .4    The Master Painters Institute (MPI)
  - .1    Architectural Painting Specification Manual - current edition.

**1.2                SUMMARY**

- .1    Range baffles shall be for the purpose of containing or redirecting misdirected rounds within a shooting range towards the bullet trap.
- .2    Baffles shall be capable of mounting from the structure above, positioned in flat and angled manners.
- .3    Baffle panels shall consist of rectangular AR500 sheet steel. The fabrication of these panels shall not include any field cut-outs. Baffle panels shall not be formed by welding two or more plates together.
- .4    Rounds fired into the baffles shall not reflect splatter back toward the shooter. All lead fragments shall either be contained by the baffle or shall be expelled toward the bullet trap.

- .5 Baffles shall interconnect one to another in a modular fashion so that they may be taken apart, moved, and replaced.
- .6 Baffle supplier shall be responsible for complete baffle system as described in this section.

### **1.3 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for sections, plates, channels, bolts, nuts, and washers and include product characteristics, performance criteria, physical size, finish and limitations.
  - .2 Submit two copies of WHMIS MSDS in accordance with Section 01 35 29.06 - Health and Safety Requirements.
    - .1 For finishes, coatings, primers, and paints applied on site: indicate VOC concentration in g/L.
- .3 Shop Drawings:
  - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Saskatchewan, Canada.
  - .2 Indicate materials, core thicknesses, finishes, connections, and joints, method of anchorage, number of anchors, supports, reinforcement, details, and accessories.
- .4 Mock-up: construct mock-ups in accordance with Section 01 45 00 - Quality Control and to requirements supplemented as follows:
  - .1 Provide mock-up for evaluation of assembly, workmanship, and installation.
  - .2 Co-ordinate type and location of mock-ups with project requirements.
  - .3 Mock-up will be one complete 1.219m x 2.438m baffle assembly including supports, hangers, and connectors.
  - .4 Do not proceed with remaining work until assembly, workmanship, and installation are approved by Departmental Representative.
  - .5 When accepted, mock-up will demonstrate minimum standard of quality required for this work.
    - .1 Approved mock-up may remain as part of finished work.
- .5 Sustainable Design Submittals:
  - .1 Construction Waste Management:
    - .1 Submit project Waste Management Plan and Waste Reduction Workplan highlighting recycling and salvage requirements.
  - .2 Low-Emitting Materials:
    - .1 Submit listing of paints and coatings used in building; comply with VOC and chemical component limits or restrictions requirements.

### **1.4 QUALITY ASSURANCE**

- .1 Test Reports: submit certified test reports showing compliance with specified performance characteristics and physical properties.

- .2 Certifications: submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.
- .3 Range baffle manufacturer must have a minimum of ten (10) years' experience in the manufacturing of range baffles and who are regularly engaged in the design and manufacturing of the type of range baffles specified. If requested, provide five (5) actual installations of compatible design, construction, and size with proven durability.

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

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials indoors, in dry location, and in accordance with manufacturer's recommendations; in clean, dry, well-ventilated area.
  - .2 Replace defective or damaged materials with new.
- .4 Develop Construction Waste Management Plan and Waste Reduction Workplan related to Work of this Section.
- .5 Packaging Waste Management: remove for reuse and return of pallets, crates, padding, and packaging materials as specified in Construction Waste Management Plan and Waste Reduction Workplan in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

## **Part 2 Products**

### **2.1 MATERIALS**

- .1 Baffle assembly:
  - .1 Entrap bullets within the baffle assembly.
  - .2 Designed to eliminate all 'line of sight' openings, to the ceiling above, from firing line to point immediately in front of bullet trap.
  - .3 Protect lighting fixtures, HVAC ductwork, and fire protection system.
  - .4 Direct ricochets towards the bullet trap to prevent harm to range users.
- .2 Angles: to CSA G40.21, Grade 350W. Sizes as indicated.
- .3 Steel plates: to ASTM A514.
  - .1 AR500: abrasion resistant, low alloy steel plate, quench and tempered to a minimal hardness of 500 HBW.
- .4 Spacers: to ASTM C645
  - .1 Metal furring channels
  - .2 Size as indicated.



- .3 Alternate Furring Material: Fire retardant treated lumber. Thickness to be 25mm, to leave 25mm air gap between the steel and plywood.
- .5 Plywood: in accordance with Section 06 10 00 – Rough Carpentry and Section 06 05 73 – Wood Treatment.
- .6 Acoustical treatment on underside of Firing Range Baffles: in accordance with Section 07 21 13 – Insulation and Acoustical Treatment.
- .7 Suspension System: to ASTM A307 and ASTM A1023.
  - .1 Baffle supplier shall be responsible for design of the adjustable suspension system for the baffle assembly.
- .8 Baffle Support System: baffle supplier shall be responsible for design of the baffle support system.
  - .1 Steel sections and plates: to CSA G40.20/G40.21, Grade 350W.
  - .2 Welding materials: to CSA W59.
  - .3 Bolts, nuts and washers: high strength for structural requirements, conforming to ASTM A325.
- .9 Connectors: high strength for structural requirements.
  - .1 Bolts: to ASTM A325.
  - .2 Nuts: to ASTM A563
  - .3 Washers: to ASTM F436.
  - .4 Wire rope cable: to ASTM A641
- .10 Steel sections: to CSA G40.20/G40.21, Grade 300W.
- .11 Welding materials: to CSA W59.
- .12 Welding electrodes: to CSA W48 Series (low-hydrogen-producing electrodes for AR500)
- .13 Anchor bolts: new material conforming to CSA G40.21, Grade 260W.

## 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.
- .5 All bolted connections to be “bearing” type connections except where subject to stress reversal which are to “slip resistant” type connections.
- .6 Baffle joint where each steel baffle panel connects to another steel baffle panel shall include angle iron to overlap the joint created from connecting the next adjacent panel so there is not potential for small gaps were bullets or bullet fragments might escape.

- .7 The joints on all baffle plates must be covered by steel angle iron on at least 98% of the joint distance to provide for maximum coverage against rounds breaching the joint area.
- .8 All joints shall be constructed such that no small gaps remain through which bullet fragments might escape the joint by deflecting a total of less than three consecutive 90 degree impacts.
- .9 All joints shall be capable of containing high power rifle rounds.

### **2.3 FINISHES**

- .1 Shop coat primer: MPI- INT 5.1B.

### **2.4 SHOP PAINTING**

- .1 Primer: VOC limit 250 g/L maximum.
- .2 Apply one shop coat of primer to metal items, with exception of galvanized or concrete encased items.
- .3 Use primer unadulterated, as prepared by manufacturer. Paint on dry surfaces, free from rust, scale, grease. Do not paint when temperature is lower than 7 degrees C.
- .4 Clean surfaces to be field welded; do not paint.

### **2.5 ANGLES**

- .1 Steel angles: prime painted, sizes indicated. Provide 150 mm minimum bearing at ends.
- .2 Weld angles to baffle plates as per Firing Range Baffle Suppliers written instructions.
- .3 Bolt back-to-back angles to profiles as per Firing Range Baffle Suppliers written instructions.
- .4 Finish: shop painted.
  - .1 Primer: VOC limit 250 g/L maximum.

## **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 Make field connections with bolts to CSA S16 and welded field connection to CSA W59.
- .7 Deliver items over for casting into concrete and building into masonry together with setting templates to appropriate location and construction personnel.
- .8 Touch-up rivets, field welds, bolts and burnt or scratched surfaces with primer after completion of:
  - .1 Primer: maximum VOC limit 250 g/L.
- .9 Touch-up galvanized surfaces with zinc rich primer where burned by field welding.
  - .1 Primer: maximum VOC limit 250 g/L.

### **3.3 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
  - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

### **3.4 PROTECTION**

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by metal fabrications installation.

**END OF SECTION**

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**Part 1            General**

**1.1                REFERENCES**

- .1    ASTM International
  - .1    ASTM E84-15b, Standard Test Method for Surface Burning Characteristics of Building Materials
  - .2    ASTM E90-09, Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements
- .2    Canadian General Standards Board (CGSB)
  - .1    CGSB 71-GP-24M-AMEND-77(R1983), Adhesive, Flexible, for Bonding Cellular polystyrene Insulation.
- .3    Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1    Material Safety Data Sheets (MSDS).

**1.2                SUMMARY**

- .1    Ballistic rubber panels to be designed to virtually eliminate the hazards of ricochet and splatter, minimize airborne lead contaminants, and protect onsite personnel. The panels are not designed to stop or encapsulate bullets.

**1.3                ACTION AND INFORMATIONAL SUBMITTALS**

- .1    Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2    Product Data:
  - .1    Submit manufacturer's instructions, printed product literature and data sheets for panels and include product characteristics, performance criteria, physical size, finish and limitations.
  - .2    Submit 2 copies of WHMIS MSDS in accordance with Section 01 35 29.06 - Health and Safety Requirements. Indicate VOC's during application and curing.
- .3    Shop Drawings:
  - .1    Submit shop drawings in accordance with Section 01 33 00 – Submittal Procedures.
  - .2    Indicate dimensions and thickness of panels, fastening and anchoring methods, detail and location of joints, materials and finish, compliance with design criteria and requirements of related work.
- .4    Samples:
  - .1    Submit 300 x 300 mm sample of acoustic ballistic panel.
- .5    Certificates:
  - .1    Submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.
- .6    Test Reports:

.1 Submit certified test reports showing compliance with specified performance characteristics and physical properties.

.7 Manufacturer's Instructions:

.1 Submit manufacturer's installation instructions.

#### **1.4 QUALITY ASSURANCE**

.1 Test Reports: submit certified test reports showing compliance with specified performance characteristics and physical properties.

.2 Certifications: submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

.3 Range baffle manufacturer must have a minimum of ten (10) years' experience in the manufacturing of acoustic ballistic rubber panels and who are regularly engaged in the design and manufacturing of the type of acoustic ballistic baffles specified. If requested, provide five (5) actual installations of compatible design, construction, and size with proven durability.

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

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:

.1 Store materials off ground, indoors, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect specified materials from damage.

.3 Replace defective or damaged materials with new.

.4 Develop Construction Waste Management Plan.

.5 Packaging Waste Management: remove for reuse of packaging materials, pallets, padding, crates, in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

#### **1.6 EXTRA MATERIALS**

.1 Provide extra materials of acoustic ballistic panels in accordance with Section 01 78 00 – Closeout Submittals.

.2 Provide 25 additional acoustic ballistic panels for maintenance purposes.

.3 Deliver to Owner and store where directed by Departmental Representative.

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**Part 2 Products**

**2.1 ACOUSTIC BALLISTIC PANEL**

- .1 Acoustic Ballistic Rubber Panels to ASTM E90 and Ballistic Standards by Product Manufacturer.
  - .1 Rubber composite panel by vulcanized or binder method.
  - .2 Thickness: 50 mm.
  - .3 Size: 610 x 610 mm.
  - .4 Edges: square.
  - .5 Colour: black.
  - .6 Wall mounted.
  - .7 Textured surface of the face side; flat surface on the back side.
  - .8 Noise Reduction coefficient (NRC) designation of 0.65.
  - .9 Density: 1120 kg / m<sup>3</sup> (70 lbs / ft<sup>3</sup>) minimum
  - .10 Durometer: 60±5
  - .11 Tensile Strength: 7.24MPa (1050 psi).
  - .12 Friction Coefficient: 1.20 Static; 1.03 Dynamic.
  - .13 Fire protection to CAN/ULC S101.

**2.2 ADHESIVE**

- .1 Adhesive: to CGSB 71-GP-24M.
  - .1 As recommended by ballistic rubber panel manufacturer.

**2.3 ACCESSORIES**

- .1 Insulation clips as recommended by ballistic rubber panel manufacturer.

**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 ballistic panel application in accordance with manufacturer's written instructions.
  - .1 Visually inspect substrate in presence of Departmental Representative.
  - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
  - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

**3.2 INSTALLATION**

- .1 Install ballistic panels after building substrate materials are dry.

- .2 Fit ballistic panels tight to adjacent panels.
- .3 Cut and trim ballistic panels neatly to fit spaces. Butt joints tightly, align vertical and horizontal joints.
- .4 Apply adhesive to ballistic panel and wall surface in accordance with manufacturer's recommendations.

### **3.3 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
  - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

**END OF SECTION**

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**Part 1 - General**

**1.1 RELATED WORK**

- |    |   |             |
|----|---|-------------|
| .1 | Fire Suppression                          | Division 21 |
| .2 | Plumbing                                  | Division 22 |
| .3 | Heating, Ventilating and Air Conditioning | Division 23 |

**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 in the bid.
- .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 conflicts.
- .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 Refer to Division 1 for recycling requirements. Recycle all material noted for recycling. Remove from site and dispose of all excess and packaging materials not noted for recycling 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 Warranty forms have been mailed to manufacturer. Provide copy of original warranty for equipment which has warranty period longer than one year.

- .6 Submit sample of Operating/Maintenance Manuals. Arrange Operating and Maintenance Instructions and submit schedule for approval.
  - .7 Review and ensure access doors are suitably located and equipment easily accessible including plumbing cleanouts.
  - .8 Have noise and vibration control devices and flexible connections inspected by manufacturer's representative and submit written report.
- .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 including point-to-point verification and confirmation that sequences are fully operational.

### **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.
- .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") 3-ring type catalogue binders, labelled on 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 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.

### 1.17 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:

Make-Up Air Unit	(2) two hours
Exhaust System	(2) two hours
Pump	(1) one hour
System Fill	(1) one hour
Unit Controls	(2) two hours
Terminal Units	(1) one hours

### 1.18 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.

### 1.19 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 \$700.00 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.

#### **1.20 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. Clearly identify in proposal exactly how the proposed material alters the design intent and the benefits and disadvantages of said proposal. 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 EMCS (Division 25) shall be an expansion of the existing building controls
  - .2 Any products specifically noted to be supplied as specified under their respective specification sections.

#### **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 American National Standards Institute/National Fire Prevention Association (ANSI/NFPA)
  - .1 ANSI/NFPA 13- 2013, Installation of Sprinkler Systems.
- .2 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/NFPABase design for bidding in accordance with existing sprinkler design: Zoning:
      - .1 Existing system zoning to remain.
- .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.
  - .3 Sprinklers in secure areas shall be located in accordance with RCMP Security standards, as indicated on drawings.
  
- .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, to match existing pipe assumed to be Schedule 40 black, 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 gasketed grooved-end pipe and fittings with mechanical couplings are permitted in pipe sizes 32 mm and larger.
- .6 Fittings: ULC approved for use in wet pipe sprinkler systems.
- .7 Ensure fittings, mechanical couplings, and rubber gaskets are supplied by same manufacturer.
- .8 Side outlet tees using rubber gasketed fittings are not permitted.
- .9 Sprinkler pipe and fittings: metal.
- .3 Valves:
  - .1 ULC listed for fire protection service.
  - .2 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 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.

### **2.8 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 unless identified as concealed.
- .9 Sprinkler heads shall be located in the centre half or quarter point of ceiling tiles.
- .10 Provide quick response heads in all light hazard areas.
- .11 Sprinkler body shall be integrally cast with hex-shaped wrench boss to reduce the risk of damage during installations.
- .12 Wrenches shall be provided by the sprinkler manufacturer that directly engage the hex-shaped wrench boss integrally cast in the sprinkler body
- .13 Utilize fully concealed sprinkler head where indicated on the drawing.

#### **2.9 Type A PENDANT SPRINKLER HEAD**

- .1 Provide semi-recessed polished chrome glass bulb type in areas indicated on drawings or specified.

#### **2.10 Type B – EXTENDED SEMI RECESSED PENDANT SPRINKLER HEAD**

- .1 Provide semi-recessed polished chrome glass bulb type in areas indicated on drawings or specified with extended coverage 6.1m x 6.1m (20'x20') and 37.2 sq.m (400 sq.ft).

#### **2.11 Type C - SIDE WALL EXTENDED SPRINKLER HEAD**

- .1 Provide polished chrome extended coverage glass bulb type in areas indicated on drawings or specified. Spray to be 28' wide and 10' long.

#### **2.12 Type D EXTENDED OR STANDARD CONCEALED PENDANT SPRINKLER HEAD**

- .1 Standard: Provide bronze glass bulb type sprinkler head with chrome plated steel support cup and brass cover plate in areas indicated on drawings.
- .2 Extended: Provide semi-recessed polished chrome glass bulb type in areas indicated on drawings or specified with extended coverage 6.1m x 6.1m (20'x20') and 37.2 sq.m (400 sq.ft).
- .3 Cover plate to have factory applied finish to match ceiling colour.

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**2.13 Type E - UPRIGHT SPRINKLER HEAD**

- .1 Provide glass bulb type in areas indicated on drawings or specified. Bronze in mechanical rooms, chrome elsewhere.

**2.14 SIDE WALL SPRINKLER HEAD**

- .1 Provide polished chrome glass bulb type in areas indicated on drawings or specified.

**2.15 WET and DRY SPRINKLER SYSTEM**

- .1 This project is a modification to existing zone(s) on the existing wet sprinkler system. Design to reuse all existing NFPA 13 required accessories for the sprinkler system to be fully operational. Supplement existing accessories in zone as required to meet NFPA 13 requirements. System serving range is a double interlock pre-action system.

**2.16 SUPERVISORY SWITCHES**

- .1 General: to ANSI/NFPA 13 and ULC listed for fire service.
- .2 Valves: Mechanically attached to valve body, with normally open and normally closed contacts and supervisory capability.
- .3 Flow switch type:
  - .1 With normally open and normally closed contacts and supervisory capability.
- .4 Pressure alarm switch:
  - .1 With normally open and normally closed contacts and supervisory capability.

**2.17 SIGNS**

- .1 Signs for control drain and test valves: to ANSI/NFPA 13.

**2.18 SPARE PARTS CABINET**

- .1 Use existing metal cabinet and provide extra sprinkler heads and sprinkler head wrench adjacent to each alarm valve. Number and types of extra sprinkler heads as specified in NFPA 13.

**2.19 INSPECTOR'S TEST CONNECTION**

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

**2.20 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. Refer to Section 23 05 05 Installation of Pipework.
- .2 Allow for expansion and contraction when installing pipe hangers.
- .3 Install signs required by local Fire Protection Department.
- .4 Secure outdoor signs with stainless steel bolts.
- .5 Mechanical grooved joints may be used instead of threaded or welded joints.
- .6 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.
- .7 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.
- .8 Provide gate valves or approved butterfly valves, low points of piping and apparatus.
- .9 Provide drain valves at main shut-off valves, low points of piping and apparatus.

#### **3.2 SYSTEM TESTS**

- .1 Hydrostatically test entire system affected. 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 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.

### **3.5 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 Unless noted otherwise, 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.

### **3.6 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.

**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.



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**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 buried systems before backfilling.
- .2 Hydraulically test to verify grades and freedom from obstructions.

**3.3 PERFORMANCE VERIFICATION**

- .1 Cleanouts:
  - .1 Ensure accessible and that access doors are correctly located.
  - .2 Open, cover with linseed oil and re-seal.
  - .3 Verify that cleanout rods can probe as far as the next cleanout, at least.
- .2 Test to ensure traps are fully and permanently primed.
- .3 Storm water drainage:
  - .1 Verify domes are secure.
  - .2 Ensure weirs are correctly sized and installed correctly.
  - .3 Verify provisions for movement of roof system.
- .4 Ensure that fixtures are properly anchored, connected to system and effectively vented.

**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.

### **3.2 TESTING**

- .1 Pressure test buried systems before backfilling.
- .2 Hydraulically test to verify grades and freedom from obstructions.

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### 3.3 PERFORMANCE VERIFICATION

- .1 Cleanouts:
  - .1 Ensure accessible and that access doors are correctly located.
  - .2 Open, cover with linseed oil and re-seal.
  - .3 Verify cleanout rods can probe as far as the next cleanout, at least.
- .2 Test to ensure traps are fully and permanently primed.
- .3 Storm water drainage:
  - .1 Verify domes are secure.
  - .2 Ensure weirs are correctly sized and installed correctly.
  - .3 Verify provisions for movement of roof system.
- .4 Ensure fixtures are properly anchored, connected to system and effectively vented.

**END OF SECTION**

## **1 General**

### **1.1 SUMMARY**

- .1 Section Includes:
  - .1 Materials and installation for plumbing specialties and accessories.
  - .2 Sustainable requirements for construction and verification.

### **1.2 REFERENCES**

- .1 American Society for Testing and Materials International (ASTM).
  - .1 ASTM A126-95 (2001), Specification for Gray Iron Castings for Valves, Flanges and Pipe Fittings.
  - .2 ASTM B62-02, Specification for Composition Bronze or Ounce Metal Castings.
- .2 Canadian Standards Association (CSA International).
  - .1 CSA-B64 Series-01, Backflow Preventers and Vacuum Breakers.
  - .2 CSA-B79-94 (R2000), Floor, Area and Shower Drains, and Cleanouts for Residential Construction.
  - .3 CSA-B356-00, Water Pressure Reducing Valves for Domestic Water Supply Systems.
- .3 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
  - .1 Material Safety Data Sheets (MSDS).
- .4 Plumbing and Drainage Institute (PDI).
  - .1 PDI-G101-96, Testing and Rating Procedure for Grease Interceptors with Appendix of Sizing and Installation Data.
  - .2 PDI-WH201-92, Water Hammer Arresters Standard.

### **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 fixtures and equipment.
  - .2 Indicate dimensions, construction details and materials for specified items.
- .3 Shop Drawings:
  - .1 Submit shop drawings to indicate materials, finishes, method of anchorage, number of anchors, dimensions, construction and assembly details and accessories.
- .4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .5 Instructions: submit manufacturer's installation instructions.

## 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 Provide materials, equipment and labour to install plumbing as required by Provincial and Local Codes and as specified herein.
- .3 Provide water and drainage connections to equipment furnished in other sections of this specification and by the Departmental Representative.
- .4 Fittings of same type shall be product of one manufacturer.

## 2 Products

### 2.1 CLEANOUTS

- .1 Cleanout: Adjustable floor cleanout with lacquered cast iron body and anchor flange, secondary O ring test seal, 4" diameter cleanout opening and combined scoriated satin finished nickel bronze cover and plug top assembly with stainless steel vandal-proof allen key screws and primary gasket seal. Provide membrane clamp for all membrane floors. Specification based on Mifab Model C1100.
- .2 Access Covers:
  - .1 Wall Access: face or wall type, polished nickel bronze with chrome plated cap, round cover with flush head securing screws, bevelled edge frame complete with anchoring lugs.
  - .2 Floor Access: round cast iron body and frame with adjustable secured nickel bronze top and:
    - .1 Plugs: bolted bronze with neoprene gasket.
    - .2 Cover for Unfinished Concrete Floors: round, nickel bronze, gasket, vandal-proof screws.
    - .3 Cover for Terrazzo Finish: Polished nickel bronze with recessed cover for filling with terrazzo, vandal-proof locking screws.
    - .4 Cover for Tile and Linoleum Floors: polished nickel bronze with recessed cover for linoleum or tile infill, complete with vandal-proof locking screws.
    - .5 Cover for Carpeted Floors; polished nickel bronze with deep flange cover for carpet infill, complete with carpet retainer vandal-proof locking screws.
  - .3 Provide bolted cover plates on all vertical rainwater leaders.

### 2.2 HOSE BIBBS AND SEDIMENT FAUCETS

- .1 Cast brass anti-contamination faucet; exposed type, mild climate, anti-contamination wall faucet with 19 mm male hose connection and anti-siphon vacuum breaker. Exterior finish to be polished chrome plated, operating handle to be cast iron wheel handle, and inlet connection to be 19 mm F.P.T. unless specifically noted as 12 mm on drawings. Vacuum breaker to be certified to the ASSE Standard 1011 and listed by IAPMO.
- .2 Specification based on Mifab Model MHY-90.

### **2.3 VACUUM BREAKERS**

- .1 Breakers: To CSA-B64 Series.

### **2.4 STRAINERS**

- .1 Size 50 mm and under: Screwed brass, Y pattern with 0.7 mm stainless steel perforated screen.
- .2 Size 63 mm to 100 mm: Flanged iron body with bolted cap, Y pattern with 1.2 mm stainless steel perforated screen.
- .3 Size 127 mm and larger: Flanged iron body, basket pattern with 3 mm stainless steel perforated screen.
- .4 Screen free area shall be minimum three times area of inlet pipe. Provide valved drain and hose connection off strainer bottom.

### **2.5 STORM DISCHARGE NOZZLE**

- .1 All type 304 (CF8) fabricated stainless steel downspout with loose slotted, hinged cover and wall anchor mounting holes. Line size and No-Hub or Threaded inlets to match pipe.
- .2 Design is based on Zurn ZS199-HC.

## **3 Execution**

### **3.1 MANUFACTURER'S INSTRUCTIONS**

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

### **3.2 INSTALLATION**

- .1 Install in accordance with Provincial Codes, and local authority having jurisdiction.
- .2 Install in accordance with manufacturer's instructions and as specified.

### **3.3 CLEANOUTS**

- .1 Install cleanouts at base of soil and waste stacks, and rainwater leaders, at locations required by Code, and as indicated.
- .2 Bring cleanouts to wall or finished floor unless serviceable from below floor.
- .3 Building drain cleanout and stack base cleanouts: line size to maximum NPS4.
- .4 Lubricate cleanout plugs with mixture of graphite and linseed oil. Prior to building turnover remove cleanout plugs, relubricate and reinstall using only enough force to ensure permanent leak proof joint.

### 3.4 HOSE BIBBS AND SEDIMENT FAUCETS

- .1 Install at bottom of risers, at low points to drain systems, and as indicated.
- .2 Install complete with isolation valve upstream of hose bibbs.

### 3.5 STRAINERS

- .1 Install with sufficient room to remove basket.

### 3.6 VACUUM BREAKERS

- .1 Install vacuum breakers on plumbing lines where contamination of domestic water may occur; generally make-up lines, hose bibbs, and flush valves.

### 3.7 START-UP

- .1 Timing: Start-up only after:
  - .1 Pressure tests have been completed.
  - .2 Disinfection procedures have been completed.
  - .3 Certificate of static completion has been issued.
  - .4 Water treatment systems operational.
- .2 Provide continuous supervision during start-up.

### 3.8 TESTING AND ADJUSTING

- .1 Timing:
  - .1 After start-up deficiencies rectified.
  - .2 After certificate of completion has been issued by authority having jurisdiction.
- .2 Application tolerances:
  - .1 Pressure at fixtures: within tolerance allowable by manufacturer.
  - .2 Flow rate at fixtures: +/- 10%.
- .3 Adjustments:
  - .1 Verify that flow rate and pressure meet design criteria.
  - .2 Make adjustments while flow rate or withdrawal is (1) maximum and (2) 25% of maximum and while pressure is (1) maximum and (2) minimum.
- .4 Vacuum breakers, backflow preventers, backwater valves:
  - .1 Test tightness, accessibility for O&M of cover and of valve.
  - .2 Simulate reverse flow and back-pressure conditions to test operation of vacuum breakers, backflow preventers.
  - .3 Verify visibility of discharge from open ports.
- .5 Access doors:
  - .1 Verify size and location relative to items to be accessed.
- .6 Cleanouts:
  - .1 Verify covers are gas-tight, secure, yet readily removable.

- 
- .7 Strainers:
    - .1 Clean out repeatedly until clear.
    - .2 Verify accessibility of cleanout plug and basket.
    - .3 Verify that cleanout plug does not leak.
  
  - .8 Hose bibbs, sediment faucets:
    - .1 Verify operation of vacuum breakers.
  
  - .9 Training:
    - .1 In accordance with Section 21 05 01 Common Work Results - Mechanical, Training of Operation and Maintenance Personnel, supplemented as specified.
    - .2 Demonstrate full compliance with Design Criteria.

**END OF SECTION**



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**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 additional 80% filters on all intakes, 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 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
- .2 Refrigerant Piping
  - .1 Copper Tubing: ASTM B280, Type ACR hard drawn or annealed. Fittings: ASME B16.22 wrought copper. Joints: Braze, AWS A5.8 BCuP silver/phosphorus/copper alloy with melting range 640 to 805 degrees (1190 to 1480 degrees F).
- .3 Equipment Drains/Overflow
  - .1 Steel Pipe: ASTM A53 or A120, Schedule 40 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.
- .4 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.
- .5 Storm Water Piping (unburied)
  - .1 Plastic PVC-XFR-15/50 or CPVC pipe and fittings; solvent weld joints or grooved mechanical.

- .6 Natural Gas Piping
  - .1 Steel pipe, Schedule 40 black. Fittings: Malleable iron 1034 kPa (150 PSI) threaded for pipe sizes under 50mm (2"). Fittings: forged steel welding fittings and welded joints for pipe sizes 50mm (2") and above.
- .7 Use factory fabricated butt welded fittings for welded steel pipes.
- .8 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.

### **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 Victaulic 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 plastic pipe allowed where approved by the authority having jurisdiction. PVC pipe run in plenum spaces shall have flame and smoke rating for that purpose. PVC pipe to be complete with ULC labelled 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. Victaulic 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.

### 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.
- .3 Preparatory to acceptance, clean and refurbish equipment and leave in operating condition, including replacement of filters in piping systems.

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

- .1 Advise 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 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.



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**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.

## **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, 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 1/4" (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:  

$$\frac{\text{Weight per metre of object suspended (kg)} \times \text{Distance between suspension points (m)}}{\text{Weight loading per hanger suspension point (kg)}}$$

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<sup>3</sup> density insulation plus insulation protection shield to: MSS SP69, galvanized sheet carbon steel. Length designed for maximum 3 m span.

.2 Insulated hot piping:

.1 Curved plate 300 mm long, with edges turned up, welded-in centre plate for pipe sizes NPS 12 and over, carbon steel to comply with MSS SP69.

## **2.6 EQUIPMENT SUPPORTS**

.1 Fabricate equipment supports not provided by equipment manufacturer from structural grade steel meeting requirements of Section 05 50 00 - Metal Fabrications.

## **2.7 EQUIPMENT ANCHOR BOLTS AND TEMPLATES**

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

## **2.8 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.

## **2.9 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 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.

## 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 10, semi - Painting.1.

## 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     |
| Low temp heating water supply | Yellow                    | LTHW SUPPLY    |
| Low temp heating water return | Yellow                    | LTHW RETURN    |
| Storm Natural gas             | Green                     | STORM          |
| 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.

### **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 HVAC systems: plus 5 %, minus 5 %.
  - .2 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 Preliminary balance report 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 (MUA-1 and EF-1): Location, Local Identification, Manufacturer, Model, Size, Arrangement, discharge and class, Air Flow of system (supply/exhaust), Static Pressures, Fan RPM, inlet and outlet dry bulb and wet bulb temperatures.
  - .4 Electric Motors: Manufacturer, HP/BHP, Phase, Voltage, Amperage (maximum operating and full load), RPM, Service Factor, Starter Heater Elements.
  - .5 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.
  - .6 Differential pressure in firing range compared to ambient and compared to corridor.
  - .7 Estimate of current volume of air leaking from ductwork on supply side.
- .2 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 (including Roof Top Units): Location, Local Identification, Manufacturer, Model, Size, Arrangement, discharge and class, Supply Air Flow, Return/Exhaust 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 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.
  - .9 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).
  - .10 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.
  - .11 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.
  - .12 Firing Range: Balancer shall adjust supply air discharges and exhaust air intakes to meet air volume requirements and the air velocity requirements in the firing range. Air velocity at all measured points in the firing range shall target an average of 75fpm with a minimum of 50 fpm. Record the following data when complete:
    - .1 Air velocity at the static firing line in each lane at head height while standing (5' AFF) or kneeling (3' AFF) or prone (1' AFF).
    - .2 Air velocity at 7.5m from the static firing range in each lane at head height while standing (5' AFF) or kneeling (3' AFF).
    - .3 Air velocity at 15m from the static firing line in each lane at head height while standing (5' AFF) or kneeling (3' AFF).
    - .4 Differential pressure in firing range compared to ambient and compared to corridor.

## **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 as system totals. Adjust air quantities at individual inlets/outlets to meet the firing range velocity requirements. 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 deg.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
Ducts outside building	C-1	Yes	special as required to achieve RSI 4.76 (R-20) to match walls in accordance with NECB requirements.
Acoustical lining	none		25

- .2 Exposed round ducts 600 mm and larger, smaller sizes where subject to abuse:

	Rectangular	Round
.1 Use TIAC code C-1 insulation, scored to suit diameter of duct.		
.1 Finishes: conform to following TIAC codes noted in table:		
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 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) Jacketing 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/m<sup>2</sup>. 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/m<sup>2</sup> 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 fluorescent 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 and flanged valves.
- .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 (mm)	Temp deg.C.	TIAC code	Pipe sizes (NPS) & insulation thickness				
			Run out	to 1	1 1/4 to 2	2 1/2 to 4	5 to 6
Glycol Water Outside Building	n/a	A-1	50	50	50	50	50
Glycol Water Inside Building	n/a	A-1	25	25	25	25	38
Heating Water	n/a	A-1	25	38	38	38	38
Refrigerant	4 - 13	A-6	25	25	25	25	25
Refrigerant	below 4	A-6	25	25	38	38	38
RWL and RWP (insulate rainwater from roof to existing riser)		C-2	25	25	25	25	25
Cooling Coil cond. drain and pan		C-2	25	25	25	25	25 25

- .8 Finishes:
  - .1 Exposed indoors: canvas or PVC
  - .2 Exposed in mechanical rooms: PVC jacket.
  - .3 Concealed, indoors: canvas on valves, fittings. No further finish.
  - .4 Use vapour retarder jacket on TIAC code A-3, 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 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**

## **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 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.
- .3 Standpipe System: Test to 2070 kPa water pressure at the valve.
- .4 Sprinkler System: Test as required by authorities having jurisdiction.
- .5 Refrigerant Piping: Test with nitrogen to 2070 kPa on high pressure side and 1035 kPa on low side and refrigerant halide torch test.
- .6 Gas Piping: Test as required by authority having jurisdiction.
- .7 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.
- .8 During heating and cooling piping system tests, check linear expansion at elbows, U bends, expansion joints, and offsets for proper clearance.
- .9 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.
- .10 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.
- .11 Sprinkler system: Test as required by authorities having jurisdiction.

### 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 Cooling 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 Set thermostats on associated AHU's for maximum cooling.
    - .2 Start system.
    - .3 After system has stabilized, record supply air and exhaust air temperatures.

### **3.6 WET AND DRY PIPE SPRINKLER SYSTEM, STANDPIPE AND HOSE SYSTEMS**

- .1 Cleaning, testing, start-up, performance verification of equipment, systems, components, and devices is specified elsewhere in Division 23.
- .2 Verification of controls, detection devices, alarm devices is specified Division 26.
- .3 Demonstrate that fire hose will reach to most remote location regardless of partitions, and obstructions.
- .4 Verify operation of interlocks between HVAC systems and fire alarm systems as required by Code or specified.

### **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 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 POT FEEDER**

- .1 1.9L (2 quart) capacity cast iron or welded steel with quick opening cap for working pressure of 1200 kPa.

### **2.4 SIDESTREAM FILTER**

- .1 Refer to Section 23 21 14 Hydronic Specialties.

### **2.5 WATER METER**

- .1 Displacement type cold water meter with sealed, tamper-proof magnetic drive, impulse contact register, single pole, double throw dry contact switch.

### **2.6 SOLENOID VALVES**

- .1 Forged brass body globe pattern, normally open or closed as required, general purpose solenoid enclosure, and continuous duty coil.

### **2.7 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

### **2.8 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 equipment being installed (copper, aluminum, cast iron, stainless steel, etc.) and in accordance with the equipment manufacturer's requirements. The contractor shall ensure that the chemical treatment Agency has all necessary information regarding the equipment. All chemicals used and system maintenance information shall be provided and included in the maintenance manuals.

- .3 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.

## 2.9 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 Refractometer 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.

## 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 Engineer.
  - .5 Refill system with water or water/glycol solution as specified.
- .4 Use neutralizer agents on recommendation of system cleaner supplier and approval of Consultant.
- .5 Inspect, remove sludge, and flush low points with clean water after cleaning process is completed. Include disassembly of components as required.
- .6 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 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

### **3.6 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 PTFE 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 Butt welding 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 NPS2 1/2 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 NPS2 1/2 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 NPS2 1/2 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 NPS2 1/2 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 NPS2 1/2 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 NPS2 1/2 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.

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**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 10: Submittals for project closeout.
- .2 Record actual locations of flow controls.

### **1.6 OPERATION AND MAINTENANCE DATA**

- .1 Section 01 78 10: 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 Glycol System:
  - .1 Select expansion tank pressure relief valve to match boiler..
- .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 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.

## 2.6 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.

## 2.7 RELIEF VALVES

- .1 Bronze body, teflon seat, stainless steel stem and springs, automatic, direct pressure actuated, capacities ASME certified and labelled.

## 2.8 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 10: 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.

## 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.

### 3.4 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 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-Polyester 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 Rating: 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	A
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**

<b>Size</b>	<b>Working Load Limit (kg)</b> <b>Working Load Limit (lbs)</b>
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 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

## **1.6 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.

## **1.7 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 spread Rating: 0 (zero).
- .5 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:

$$\text{Weight per metre of object suspended (kg) x Distance between suspension points (m) = Weight loading per hanger suspension point (kg).}$$

**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 Silencers.

### **1.2 REFERENCES**

- .1 AABC - National Standards for Total System Balance.
- .2 AMCA 300 - Reverberant Room Method for Sound Testing of Fans.
- .3 AMCA 301 - Methods for Calculating Fan Sound Ratings from Laboratory Test Data.
- .4 AMCA 302 - Application of Sone Ratings for Non-Ducted Air Moving Devices.
- .5 AMCA 303 - Application of Sound Power Level Ratings for Fans.
- .6 ANSI S1.1 - Acoustical Terminology.
- .7 ANSI S1.8 - Preferred Reference Quantities for Acoustical Levels.
- .8 ANSI S1.13 - Measurement of Sound Pressure Levels in Air.
- .9 ARI 270 - Sound Rating of Outdoor Unitary Equipment.
- .10 ARI 575 - Measuring Machinery Sound Within an Equipment Space.
- .11 ASA 16 (ANSI S1.36) - Survey Methods for Determination of Sound Power Levels of Noise Sources.
- .12 ASA 47 (ANSI S1.4) - Specification for Sound Level Meters.
- .13 ASA 49 (ANSI S12.1) - Preparation of Standard Procedures to Determine the Noise Emission from Sources.
- .14 ASHRAE 68 - Laboratory Method of Testing to Determine the Sound Power in a Duct.
- .15 ASHRAE Handbook - Systems Volume, Chapter "Sound and Vibration Control".
- .16 ASTM E90 - Method for Laboratory Measurement of Airborne Sound Transmission loss of Building Partitions and Elements.
- .17 ASTM E477 - Method of Measuring Acoustical and Airflow Performance of Duct Liner Materials and Prefabricated Silencers.
- .18 ASTM E596 - Method for Laboratory Measurement of Noise Reduction of Sound-Isolating Enclosures.
- .19 NEBB - Procedural Standards for Measuring Sound and Vibration.
- .20 SMACNA - HVAC Duct Construction Standards - Metal and Flexible.

### **1.3 SUBMITTALS**

- .1 Section 01 33 00: Procedures for submittals.
- .2 Shop Drawings: Indicate assembly, materials, thicknesses, dimensional data, pressure losses, acoustical performance, layout, and connection details.
- .3 Product Data: Provide catalogue information indicating, materials, dimensional data, pressure losses, and acoustical performance.
- .4 Design Data: Provide engineering calculations, referenced to specifications and AMCA 301 standards indicating that maximum room sound levels are not exceeded.
- .5 Test Reports: Indicate dynamic insertion loss and noise generation values of silencers.
- .6 Manufacturer's Installation Instructions: Indicate installation requirements which maintain integrity of sound isolation.

## **1.4 PROJECT RECORD DOCUMENTS**

- .1 Section 01 78 00: Submittals for project closeout.
- .2 Record actual locations of silencers and sound attenuating devices.

## **1.5 QUALITY ASSURANCE**

- .1 Perform Work to AMCA 300 standards and recommendations of ASHRAE 68.

## **1.6 QUALIFICATIONS**

- .1 Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
- .2 Design application of duct silencers under direct supervision of a Departmental Representative experienced in design of this work and licensed at the place where the Project is located.

## **2 Products**

### **2.1 DUCT SILENCERS**

- .1 Description: Duct section with sheet metal outer casing, sound absorbing fill material, and inner casing of perforated sheet metal; incorporating interior baffles of similar construction. Fabricate to SMACNA HVAC Duct Construction Standards - Metal and Flexible.
- .2 Configuration and performance: as noted on equipment schedule, insertion loss to ASTM E477
- .3 Materials:
  - .1 Outer Casing: Minimum 0.8 mm (22 gauge) thick galvanized steel stiffened as required, with mastic filled lock formed seams, 50 mm long, 2.9 mm slip joints on both ends.
  - .2 Inner Casing and Splitters: Minimum 0.6 mm (26 gauge) thick perforated galvanized steel.
  - .3 Fill: Formaldehyde free Glass fibre or mineral wool of minimum 64 kg/cu m density.
  - .4 Fill Liner: 0.0254 mm Mylar or Tedlar film.

## **3 Execution**

### **3.1 INSTALLATION**

- .1 Install to manufacturer's written instructions.
- .2 Support duct silencers independent of duct work with flexible duct connections, lagged with leaded vinyl sheet on inlet and outlet. Refer to Section 23 33 00.

**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 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.

### 2.3 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.

### 2.4 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 mm 0.55 inch thick, 4.2 kg/sq m 0.87 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.

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**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. Construct ductwork in fire-rated floor-ceiling or roof-ceiling assembly systems with air ducts that pierce ceiling to conform with ULC.

### **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 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 Firing Range 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 RETURN AND EXHAUST GRILLES AND REGISTERS**

- .1 Sidewall and ceiling exhaust grilles shall have streamlined blades, depth of which exceeds 20 mm spacing. Provide spring tension or other device to set blades. Provide units with horizontal face.
- .2 Provide 25 mm narrow margin frame with countersunk screw holes.
- .3 Fabricate of steel with 20 gauge minimum frames and 22 gauge minimum blades, steel and aluminum with 20 gauge minimum frame, or heavy aluminum extrusions.
- .4 Provide exhaust grilles, with integral, gang-operated opposed blade dampers with removable key operator, operable from face, where indicated.
- .5 Finish in factory baked enamel finish, colour by Departmental Representative.

## **2.4 GRID CORE RETURN AND EXHAUST GRILLES**

- .1 Fabricate fixed grilles of 13 mm x 13 mm x 13 mm louvres.
- .2 Provide 32 mm margin frame with lay-in frame for suspended grid ceilings.
- .3 Fabricate of aluminum.
- .4 Provide exhaust grilles, where not individually connected to exhaust fans, with integral, gang-operated opposed blade dampers with removable key operator, operable from face, where indicated.

## **2.5 LOUVRED SUPPLY GRILLES**

- .1 Ceiling supply grilles shall have streamlined and individually adjustable curved blades to discharge air along face of grille. Units shall have two-way deflection.
- .2 Provide 25 mm narrow margin frame with countersunk screw holes.
- .3 Fabricate of heavy aluminum extrusions.
- .4 Provide grilles with integral, gang-operated opposed blade dampers with removable key operator, operable from face, and equalizing grid, where indicated.
- .5 Finish in factory enamel finish, 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 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 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 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.

## **1.5 EXTRA MATERIALS**

- .1 Spare filters: in addition to filters to be installed immediately prior to acceptance by Engineer , supply one complete set of filters for each filter unit or filter bank in accordance with section 01 78 00 - Closeout Submittals.

## **2 Products**

### **2.1 GENERAL**

- .1 Media: suitable for air at 100% RH and air temperatures between 15 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.

### **2.2 ACCESSORIES**

- .1 Holding frames: permanent channel section construction of galvanized steel, 1.6 mm thick, except where specified otherwise.
- .2 Seals: to ensure leakproof operation.
- .3 Blank-off plates: as required, to fit all openings and of same material as holding frames.
- .4 Access and servicing: through doors/panels on each side and/or from upstream or downstream face of filter bank.

### **2.3 COTTON PANEL FILTERS**

- .1 Disposable pleated reinforced cotton dry media: to CAN/CGSB 115.18.
- .2 Holding frame: galvanized steel, or slide in channel for side access.
- .3 Performance:
  - .1 Average atmospheric dust spot efficiency 30% to ASHRAE 52.1.
- .4 Fire Rated: to ULC -S111.
- .5 Nominal thickness: as indicated.

### **2.4 CARTRIDGE TYPE FILTERS 95 %EFFICIENCY**

- .1 Media: disposable, high efficiency, to CAN/CGSB-115.15.
- .2 Holding frame: galvanized steel with bracing.
- .3 Media support: welded wire grid.
- .4 Performance: average atmospheric dust spot efficiency 95% to ASHRAE 52.1.
- .5 Fire rated: to ULC -S111.

## **2.5 HEPA ABSOLUTE PACKAGE FILTERS 99.97 % EFFICIENCY**

- .1 Media: water resistant fibrous glass.
- .2 Holding frame: cadmium plated steel by unit manufacturer.
- .3 Housing and sealing system: manufacturers' standard, suitable for pressure application.
- .4 Unit bank installation: Class 100 level, to US Federal Standard 209A.
- .5 Efficiency: minimum 99.97% overall on hot DOP test, using 0.003 mm particles MIL-STD-282.

## **3 Execution**

### **3.1 INSTALLATION GENERAL**

- .1 Install in accordance with manufacturer's recommendations and with adequate space for access, maintenance and replacement.

### **3.2 REPLACEMENT MEDIA**

- .1 Filter media to be new and clean, as indicated by pressure gauge, at time of acceptance.

### **3.3 HEPA FILTERS**

- .1 Use components and devices recommended by manufacturer to ensure complete integrity and to ensure easy removal and replacement, even when dressed in anti-contamination clothing.
- .2 Provide proper permanent facilities for challenging integrity with aerosol injector downstream of pre-filters and test sampling manifold downstream of HEPA filter. Location of injector and sampling manifold to be approved by manufacturer.
- .3 During TAB, install substitute media having similar pressure drop.
- .4 Before acceptance, perform tests to demonstrate integrity of complete installation.

### **3.4 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 self-contained multizone and single zone, gas, electric, hot water and refrigeration packaged rooftop HVAC units.
  - .2 Sustainable requirements for construction and verification:

### **1.2 REFERENCES**

- .1 American National Standards Institute (ANSI)/Air Conditioning and Refrigeration Institute (ARI)
  - .1 ANSI/ARI 210/240-03, Unitary Air-Conditioning and Air-Source Heat Pump Equipment.
  - .2 ARI 270-95, Sound Rating of Outdoor Unitary Equipment.
- .2 ANSI/UL 1995 B-1998, Standard for Heating and Cooling Equipment.
- .3 Canadian Standards Association (CSA International)
  - .1 CSA B52-99, Mechanical Refrigeration Code.
  - .2 CSA C22.1 HB-02, Canadian Electrical Code Handbook.
- .4 Health Canada / Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (MSDS).
- .5 National Fire Protection Association
  - .1 NFPA 90A-02, Standard for the Installation of Air Conditioning and Ventilating Systems.

### **1.3 SUBMITTALS**

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Co-ordinate submittal requirements and provide submittals required by Section 01 47 15 - Sustainable Requirements: Construction.
- .3 Product Data:
  - .1 Submit manufacturer's printed product literature, specifications and datasheet for packaged rooftop HVAC units.
- .4 Submit WHMIS MSDS in accordance with Section 01 47 15 - Sustainable Requirements: Construction and Section 02 61 33 - Hazardous Materials. Indicate VOC's for adhesive and solvents during application and curing.
- .5 Shop Drawings:
  - .1 Submit shop drawings to indicate project layout and dimensions; indicate:
    - .1 Equipment, piping, and connections, together with valves, strainers, control assemblies, thermostatic controls, auxiliaries and hardware, and recommended ancillaries which are mounted, wired and piped ready for final connection to building system, its size and recommended bypass connections.
    - .2 Piping, valves, fitting shipped loose showing final location in assembly.
    - .3 Control equipment shipped loose, showing final location in assembly.

- .4 Complete internal panel pneumatic tube piping and wiring and external panel pneumatic tube piping and wiring, both as schematics and as actually assembled.
  - .5 Dimensions, internal and external construction details, recommended method of installation with proposed structural steel support, mounting curb details, sizes and location of mounting bolt holes; include mass distribution drawings showing point loads.
  - .6 Detailed composite wiring diagrams for control systems showing factory installed wiring and equipment on packaged equipment or required for controlling devices of ancillaries, accessories, controllers.
  - .7 Pump and fan performance curves.
  - .8 Details of vibration isolation.
  - .9 Estimate of sound levels to be expected across individual octave bands in dB referred to A rating.
  - .10 Type of refrigerant used.
- .6 Test Reports: submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.
- .7 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .8 Instructions: submit manufacturer's installation instructions.
- .9 Manufacturer's Field Reports: manufacturer's field reports specified.
- .10 Closeout submittals: submit maintenance and engineering data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals include data as follows:
- .1 Indicate: brief description of unit, indexed, with details of function, operation, control, and service for components.
  - .2 Provide for units, manufacturer's name, type, year, number of units, and capacity.

#### 1.4 QUALITY ASSURANCE

- .1 Air Handling Units shall be built to the level of quality as herein specified and to the description of the Air Handling Unit Schedule.
- .2 The design is based on the unit identified in the Equipment Schedule. Substitution of any product other than that specified, must ensure no deviation below the stated capacities, air flow rate, heat transfer rate, filtration efficiency and air mixing quality. Power requirements must not be exceeded, and where specifically defined, sound power levels must not be exceeded. Refer to Section 21 05 01.
- .3 Unless stated otherwise, air-handling units are to be shipped to the job in one piece, factory assembled. Modular units assembled to achieve a close approximation to the intent of this specification will not be considered equal. All equipment shall where specified and applicable, be pre-wired, and factory certified by an approved testing agency such as CETL, ETLUS, UL, CSA prior to shipment.
- .4 Pre-wired air handling units shall bear an approved label with all the necessary identification marks, electrical data, and any necessary cautions as required by the Canadian Electrical Code.

- .1 Unit must conform to regulations set out in the Canadian Energy Efficiency Act for large air conditioners (condensing units). Packaged units shall be tested to CSA Standard C746-98 and must bear an EEV (energy efficiency verification) label provided by CSA. "Where specified as factory packaged air conditioning unit, factory assembled split systems do not conform to the Canadian Energy Efficiency Act and will not be considered."
- .5 All electrical circuits shall undergo a dielectric strength test, and shall be factory tested and checked as to proper function.
- .6 The air handling units and major components shall be products of manufacturers regularly engaged in the production of such equipment and with a minimum of fifteen continuous years of proven production experience.
- .7 The design is based on the unit identified in the Equipment Schedule. Manufacturers may propose alternate equipment to that specified and receive a designated Alternate status. In this instance, alternates will be based on specific equipment as submitted by the Manufacturer

## **1.5 WARRANTY**

- .1 For Work of this Section 23 74 00 Packaged Outdoor HVAC Equipment, 12 months warranty period prescribed in subsection GC 32.1 of General Conditions "C" shall apply.
- .2 Contractor hereby warrants that packaged rooftop HVAC units and refrigeration compressors will function and operate in accordance with CCDC 2 GC 24.

## **2 Products**

### **2.1 UNIT CONSTRUCTION**

- .1 Unit casing shall be of minimum 16 gauge (1.6mm) satin coat galvanized sheet metal. Surfaces shall be cleaned with a degreasing solvent to remove oil and metal oxides and primed with a two-part acid based etching primer. Finish coat shall be an electrostatically applied enamel, to all exposed surfaces. All unprotected metal and welds shall be factory coated.
- .2 All walls, roofs and floors shall be of formed construction, with at least two breaks at each joint. Joints shall be secured by sheet metal screws or pop rivets. Wall and floor joints shall be broken in and on all outdoor units roof joints broken out (exposed) for rigidity. All joints shall be caulked with a water resistant sealant.
- .3 All sections shall be provided with a 22 gauge (.85mm) solid galvanized metal liner over all insulated areas.
- .4 Units shall be provided with access doors to the following components: fans and motors, filters, dampers and operators, access plenums, electrical control panels, burner compressor compartments and service vestibule. Access doors shall be large enough for easy access. Provide (3) jack shaft level handles on all doors over 72" from standing level. Removal of screwed wall panels will not be acceptable.
- .5 Units shall be provided with hinged access doors in welded steel frames. Doors shall be fully lined, come complete with bulb trim seal gasket and Leverlok handles, operable from both sides. Hinged access doors shall be provided with tie back clips. Single pane wire reinforced tempered glass viewing window on inside doors and double pane wire reinforced tempered glass viewing window on service corridor.

- .1 Provide marine lights with glass globes with metal protective cage in each section provided with an access door. Lights shall be wired in EMT conduit to a switch with pilot light. Lights powered through main single point power feed c/w local disconnect switch.
- .6 All units shall be internally insulated with 2"(51mm) thick nominal 3 lb./cu.ft. (48 kg./cu.m.) density acoustic insulation.
- .7 3 lb./cu.ft. (48 kg/cu.m.) insulation is secured with steel angles. All longitudinal insulation joints and butt ends shall be covered by a sheet metal break to prevent erosion of exposed edges. Drain pans and all floor areas shall be insulated on the underside.
- .8 Unit casing floors in walk in sections shall be fabricated with 14 ga. (2.0mm) black iron floor with rust resistant and non-skid coating. Provide reinforcing channels under floor to minimize deflection.
- .9 Cooling coil drain pans shall be fabricated of stainless steel and are an integral part of the floor paneling, a minimum of 2" (51mm) deep, with welded corners. Drain pans shall extend a minimum of 6" (152mm) downstream of coil face and be provided with a 1 ½" (38mm) S.S. M.P.T. drain connection. Drain pans must have a fast pan and be sloped and pitched such that there is no standing water. Intermediate fast pans shall be provided between cooling coils where required for effective moisture removal.
- .10 Provide drain in inlet louvre, inlet damper, filter access plenum and exhaust air plenum.
- .11 Service corridor (integral) shall be insulated with 2"(51mm) thick nominal 3 lb./cu. ft.(48 kg/cu. m) density acoustic insulation. Corridor shall also be fully lined with 22 gauge (0.85mm) solid liner. Floor to be 14 ga.(2.0mm) black iron floor with rust resistant and non-skid coating.
- .12 Access door(s) to service corridor shall be complete with zinc plated piano hinges and brass pins in welded steel frames. Provide with Leverlok handles. Access doors from service corridor to internal unit components shall be as specified elsewhere.
- .13 Corridor to be provided with marine lights with fluorescent fixtures with metal protective cage wired in EMT to a switch with pilot light. Corridor shall also be provided with a 10 kW electric baseboard heater with integral thermostat, and GFI duplex service receptacle. Lights, electric heater powered through main single point power feed c/w local disconnect switch.
- .14 Air handling units shall be weatherproofed and equipped for installation outdoors. This shall include generally for the prevention of infiltration of rain and snow into the unit, louvers or hoods on air intakes and exhaust openings with 1"(25mm) galvanized inlet screens; rain gutters or diverters over all access doors; all joints caulked with a water resistant sealant; roof joints turned up 2" (51mm) with three break interlocking design; outer wall panels extend a minimum of ¼"(6mm) below the floor panel; drain trap(s) connections for field supply and installation of drain traps.
- .15 Units shall have a sloped roof complete with a membrane roof material to ensure prevention of infiltration of rain and snow through the top of the unit.

- .16 Panels shall comply with the following performance tests and properties:
  - .1 Design load/deflection criteria and fastening pattern with limitation of 1/200th under positive and negative pressures. This shall be based on test design loading of 20 PSF (.96 kPa).
  - .2 Panels shall withstand at least 2 million alternate cycles of 1/180 deflection without evidence of delamination, core cracking or permanent deformation.
  - .3 Air leakage shall not exceed .0015 CFM/sq. ft. of wall area at a pressure differential of 20 psi(138 kPa).
  - .4 No uncontrolled water penetration through panel joints when tested at 20 psi(138 kPa).
  - .5 Panels shall provide nominal thermal resistance of R=7.8/inch thickness.

## 2.2 FANS

- .1 Centrifugal fans shall be rated in accordance with AMCA Standard Test Code, Bulletin 210. Fan manufacturer shall be a member of AMCA. All fans and fan assemblies shall be dynamically balanced during factory test run. Fan shafts shall be selected for stable operation at least 20% below the first critical RPM. Fan shafts shall be provided with a rust inhibiting coating.
- .2 Airfoil fans shall be equipped with greaseable, self-aligning ball or roller type pillow block bearings.
- .3 Airfoil fans shall be plenum type configuration where noted in schedules. Thrust restraint isolators shall be provided parallel to the shaft centerline when required to minimize axial movement and bending movements of the blower assembly(s). Drive side bearings on plenum fans shall be adapter style to ensure even clamping of the bearing sleeve to the shaft.
- .4 Provide optional inlet screen, open wire mesh protective discharge screen. Removable screens at access doors are not acceptable.
- .5 Fixed drives shall be provided. All drives shall be provided with a rust inhibiting coating. The air balancer shall provide for drive changes (if required) during the air balance procedure.
- .6 Motor, fan bearings and drive assembly shall be located inside the fan plenum to minimize bearing wear and to allow for internal vibration isolation of the fan-motor assembly, where required. Motor mounting shall be adjustable to allow for variations in belt tension.
- .7 Provide OSHA approved belt guards on all units with walk in sections over 60" (1524 mm) high.
- .8 Fan-motor assemblies shall be provided with vibration isolators. Isolators shall be bolted to steel channel welded to unit floor, which is welded to the structural frame of the unit. All other fans shall incorporate vertical spring type isolators with leveling bolts, bridge bearing waffled pads with minimum 2" (50mm) static deflection designed to achieve high isolation efficiency. Fans shall be attached to the discharge panel by a polyvinyl chloride coated polyester woven fabric, with a sealed double locking fabric to metal connection.
- .9 Fan motors shall be TEFC super high efficiency complete with shaft grounding ring.

## 2.3 AIR FILTERS

- .1 Refer to section 23 41 00 and drawings for filter locations and performance.

- .2 Filter sections shall be provided with adequately sized access doors to allow easy removal of filters. Filter removal shall be from one side as noted on the drawings.
- .3 Filters shall be lift out from an access plenum upstream of the filters. Lift out 2" (50mm) filters shall fit into a horizontal track from which they are lifted up and out.
- .4 Bag or cartridge filters shall be inserted into a frame grid from the upstream side of the filter section. Associated prefilters shall slip into the same frame structure and all shall be secured with clips. Filter frame structure shall be reinforced to withstand a 6"w.c. (1500 Pa) differential pressure.
- .5 2"(50mm) Pleated Panel Disposable Pre-Filters: An optimum blend of natural and synthetic fiber media with a rust resistant support grid and high-wet strength beverage board enclosing frame with diagonal support members bonded to the air entering and air exiting side of each pleat. Permanent re-usable metal enclosing frame. The filter media shall have a minimum efficiency of 20-25% on ASHRAE Standard 52.1-92, and a minimum of MERV 8A per ASHRAE 52.2. Rated U.L. Class 2.
- .6 Rigid Style Support Media Box Filters:
  - .1 Air filters shall be high performance. 12" deep pleated, totally rigid and disposable type. Each filter shall consist of media support grid, contour stabilizers and enclosing frame. Filters shall be classified by Underwriters Laboratories as Class 2.
  - .2 The minimum MERV when tested under ASHRAE 52.2 shall be no less than MERV 14. Initial resistance at 500 feet per minute approach velocity shall not exceed 0.60" w.g.
  - .3 The media shall be of a completely synthetic, micro fiber mat, with spun bonded support scrim. The media shall be supported with a rust resistant grid. The grid shall be bonded to the media to prevent media oscillation and media pull away. Contour stabilizers of all-metal construction shall be permanently installed on both the air entering and air exiting sides of the filter. A steel enclosing frame shall be constructed. It shall be assembled in a manner to ensure that a rigid and durable enclosure is affected.
  - .4 The media pack shall be mechanically and chemically bonded to the inside periphery of the enclosing frame. The enclosing frame shall be equipped with steel protective diagonal support braces on both the entering and air exiting sides of the filters.
- .7 HEPA (High Efficiency Particulate Air) filters:
  - .1 Cell sides shall be constructed of galvanized steel. Filter cells shall contain water resistant glass media. Cells shall have neoprene gaskets on the downstream side and the media pack shall be chemically bonded to the enclosing frame. Certified efficiency shall be not less than 99.99%) on 0.3 micron DOP particles. HEPA filters shall be installed only on the negative pressure side of the air exhaust fan.
  - .2 Holding frames shall be constructed of a minimum of 16 ga (1.6mm) rust resistant steel. Frames shall be welded with filter sealing flange, bolt assemblies and pre-drilled mounting holes for easy assembly.
- .8 Filter media shall meet UL Class 2 standards.
- .9 Provide filter bank with "Dwyer 2000 magnehelic" air filter gauge complete with static pressure tips and aluminum tubing all factory installed. Each filter section to have its own gauge

## 2.4 HEAT EXCHANGERS AND BURNERS

- .1 General
  - .1 Heating units shall be indirect natural gas fired approved for both sea level and high altitude areas. The entire package, including damper controls, fan controls, and all other miscellaneous controls and accessories shall be approved by an independent testing authority and carry the approval label of that authority as a complete operating package.
  - .2 Operating natural gas pressure at unit(s) manifold shall be 14"w.c.(3500 Pa).
  - .3 Gas fired units shall be approved for operation in -40°F(-40°C). Packaged controls to allow operation below -40°F(-40°C); shutdown at -40°F(-40°C) by control package is not acceptable.
- .2 Heat Exchanger/Burner Assembly
  - .1 Heat exchanger shall be a primary cylindrical drum of welded titanium stainless steel with multi-tube stainless steel secondary complete with multi-plane metal turbulators. Heat exchanger must utilize a floating suspension system to allow free thermal expansion and contraction without stress. Heat exchanger shall be provided with condensate drain connection. The heat exchanger casing shall have 1"(25 mm) of insulation between the outer cabinet and heat reflective galvanized steel inner liner. Diamond shaped heat exchangers are not acceptable. Dual or triple blower assemblies shall be provided, as required, to ensure even air distribution across the heat exchangers. Blower location shall be engineered to improve the required air flow pattern around the heat exchanger. Using duct type furnaces and closed coupled blowers are not acceptable.
  - .2 The heat exchanger/burner assembly shall be a blow through positive pressure type. Units incorporating the G-TRAC module shall have an interrupted pilot ignition system to provide a high seasonal efficiency. Units incorporating continuous or intermittent pilots are not acceptable.
  - .3 Flame surveillance shall be with a solid state programmed flame relay complete with flame rod. The burner and gas train shall be in a cabinet enclosure. Atmospheric burners or burners requiring power assisted venting are not acceptable.
  - .4 Heat exchanger / burner assembly shall have a 20:1 turndown providing that the minimum input is at least 325 MBH.
- .3 Factory testing of indirect fired gas heating section.
  - .1 *The minimum test requirements on all cabinet / fan size / fan type / fan orientation / heat exchanger / outlet configuration combinations previously built are listed below.*
    - Tests shall be performed after complete final unit assembly, just prior to shipping to job site. The tests shall be performed in accordance with the equipment standard that the gas heating section is certified.
    - Heat exchanger shall be clocked with a dedicated calibrated gas meter to insure proper set up of the gas manifold.
    - High and Low input flue gas combustion analysis using a calibrated combustion analyzer including O<sub>2</sub> and CO to provide proper air fuel ratio throughout the entire operating range.
  - .2 *Any previously untested combination of cabinet / fan size / fan type / fan orientation / heat exchanger / outlet orientation and all duct furnaces shall have the following additional tests performed. Any single component or size or type or orientation change requires these tests. The tests shall be performed with standard factory temperature air, not design temperature air, through the unit as an additional heat exchanger safety factor.*

- Heat Exchanger airflow pattern shall be tested to ensure uniform airflow across all parts of the heat exchanger.
- Once the equilibrium operating temperatures have been reached, the heat exchanger temperatures shall be checked to insure that all surfaces are below 1075°F (579.4°C). Temperatures above this can lead to premature heat exchanger failure.
- Flue gas temperature and combustion analysis shall be performed. The heat exchanger efficiency shall be analyzed and must meet current requirements.
- High limit operational check shall be performed to ensure proper function at all normal airflows including loaded filters.
- If the unit is capable of or intended to operate at varying airflows, all of the above tests must be performed at high flow and low flow.
- A copy of the test report shall be provided.

.4 Venting

.1 Venting is to be provided by manufacture and field installed by the installing contractor. Installation and venting provisions must be in accordance with CAN/CSA Standard B149.1, ANSI Z223.1-NFPA54 and local authorities having jurisdiction. Where flue requirements exceed 36" (914 mm) above the unit casing height, it is the installing contractor's responsibility to provide and install venting including all structural-supporting requirements. Support is to be independent of the unit.

.5 Control: High Turndown Natural Gas

.1 Electronic Modulating Fuel w/ Modulating Combustion Air complete with proportional and integral control and with a discharge air sensor to maintain set point temperature and provide rapid response to incremental changes in discharge air temperature. Design is based on G-TRAC Controller and shall include the following standard features:

- Service analyzer with diagnostic lights for ease of set-up and service
- self check on start-up to make sure air proving and discharge air sensors are operating within design tolerances to make sure air switches are not shorted or jumpered
- interface with C-TRAC controller
- -40°F(-40°C) minimum operating ambient temperature
- built in pre-purge
- maintained purge to decrease temperature cycles
- built in post purge
- interrupted pilot
- low fire start
- inlet damper control
- economizer enable control
- built-in alternate blower and damper functions and set back temperatures for unoccupied mode operation using a single room thermostat
- damper contact that allows fan to start after dampers opens, damper to close after fan stops and damper to close on flame failure
- ambient reset and night setback features
- non-recycling auto bypass low limit with alarm contacts and built in sensor checking
- blower contact that starts fan after burner pre-purge
- controlled burner start-up and shut down
- built in electronic linearization of the combustion air damper and gas valve producing higher efficiencies and reduced inputs



- separate gas and air actuators independently controlled to give the correct air to fuel ratio though out the entire firing range. Single operator with mechanical linkage is not acceptable.
- .6 Provide a make up air reverse airflow high limit switch in series with the standard high limit switch mounted in the blower discharge.

## 2.5 DAMPERS

- .1 Damper frames shall be U--shaped galvanized metal sections securely screwed or welded to the air handling unit chassis. Pivot rods of 1/2" (13mm) aluminum shall turn in nylon or bronze bushings. Rods shall be secured to the blade by means of straps and set screws.
- .2 Dampers shall be extruded aluminum, low leak, thermally broken, insulated blade, multi-leaf, refer to Section 23 33 15.

## 2.6 MECHANICAL COOLING

- .1 Conform to CSA B52 and ANSI/UL 1995 requirements.
- .2 Compressors shall be scroll type set on resilient neoprene mounts and complete with line voltage break internal overload protection, internal pressure relief valve and crankcase heater.
- .3 Air Cooled Condenser
- .1 Condenser coils shall be copper tube type, mechanically expanded into aluminum fins. Coils shall be factory tested with air at 300 psig (2070 kPa) while immersed in an illuminated water tank.
  - .2 Condenser fans shall be direct driven propeller type arranged for vertical draw through airflow. Motors shall be weather resistant type, with integral overload protection and designed for vertical shaft condenser fan applications. Fan and motor assemblies shall be mounted on a formed orifice plate for optimum efficiency with minimum noise level.
  - .3 Condenser to form an integral part of the unit.
- .4 Packaged Air Conditioning Units
- .1 Packaged units shall be cETL approved and operate down to 50°F(10°C) as standard. Where applicable, multiple refrigeration circuits shall be separate from each other. Refrigeration circuits shall be complete with liquid line filter-driers, and service ports fitted with Schraeder fittings. Scroll compressor units shall have condensers designed for 15°F (8°C) liquid subcooling and be equipped with suction line filters and liquid line manual shutoff valves. The complete piping system shall be purged and pressure tested with dry nitrogen, then tested again under vacuum. Each system shall be factory run and adjusted prior to shipment.
  - .2 Packaged units shall be supplied with R-410A refrigerant or equivalent HFC refrigerant.
  - .3 Controls for scroll compressor units shall include compressor and condenser fan motor contactors, supply fan contactors and overload protection, control circuit transformer, cooling relays, ambient compressor lockout, automatic reset low pressure controls, and manual reset high pressure controls on compressors over 6 tons. Head pressure actuated fan cycling control shall be provided on all multiple condenser fan units.
  - .4 Provide hot gas bypass on the lead compressor to maintain adequate suction pressure in the event of low loads.
  - .5 Compressors shall be located inside the service corridor.

- .6 Provide low ambient controls for 58°F( 14.4°C) operation.
- .5 Cooling Control
  - .1 C-TRAC3 Controller
    - .1 The controller shall automatically start in heating or cooling mode based on continuously monitored ambient temperature and load requirements.
    - .2 The controller shall include an adjustable low limit set point for freeze protection to cease equipment operation in the event of low discharge temperature. If the discharge air temperature falls below the adjusted set point, the blowers will shut down and the outside air dampers shall close. The low limit bypass timer shall vary automatically depending on the thermal coefficient of the style of heat exchanger.
    - .3 If the discharge air temperature approaches the low limit set point, the controller shall automatically reduce the economizer minimum fresh air down to half of its original setting to compensate.
    - .4 Dual sensors shall be used in the discharge air for precise temperature control.
    - .5 When a G-TRAC2 controller is used as a secondary controller, the C-TRAC3 shall automatically pre-heat and cool down the heat exchanger before enabling or disabling the supply blower.
    - .6 The heat/cool function shall be modulating discharge air complete with sensor and integral selector with variable room control.
    - .7 The discharge air set point shall be located on the face of the C-TRAC3 controller.
    - .8 The C-TRAC3 electronic temperature control system shall provide up to 5 stages of mechanical cooling control to maintain discharge (room) temperature. The minimum run and off time for the compressors shall be variable based on load requirements. The C-TRAC3 shall automatically enable an additional mechanical cooling stage whenever the ambient temperature rises above a predetermined set point.
    - .9 When in heating mode, the C-TRAC3 will provide a signal to the G-TRAC2 programmed logic heating controller for series DG industrial gas fired heater.
    - .10 Mechanical cooling shall be disabled below an adjustable low ambient temperature set point.
    - .11 Heating shall be disabled above an adjustable ambient temperature set point.
    - .12 The controller shall attempt up to 3 ignition attempts in the event of loss of flame signal before disabling equipment operation.
    - .13 Communication
      - The C-TRAC3 shall have indication and troubleshooting LED lights, multi-meter set point and sensor temperature test points, and a common alarm contact in the event of equipment failure. Information can be accessed from a PDA (personal digital assistant) or laptop computer for improved access to control settings using Engineered Air SMC software.
    - .14 The C-TRAC3 controller shall support monitoring and control of both RS-232 PC communication to a product service tool, and RS-485 Modbus RTU protocol, meeting the specifications as defined in the EIA-485 standard.

The following points to be accessible for monitoring only (read only):

- On/off status
- Present mode of operation
- Discharge air temperature
- Ambient temperature

Heating status  
Heating output  
Heating failure  
Cooling status  
Cooling output  
Blower status  
VFD speed

The following points to be accessible for change in setpoint or status (read/write):

Unit on/off  
Discharge air temperature setpoint  
Disable heating  
Disable cooling

## 2.7 HEAT RECLAIM COILS

- .1 Coils shall be 5/8" O.D. as manufactured by Engineered Air, constructed of copper tube, aluminum fin, and copper headers with schedule 40 steel pipe connectors.
- .2 Fins constructed of aluminum or copper shall be rippled for maximum heat transfer and shall be mechanically bonded to the tubes by mechanical expansion of the tubes. The coils shall have a galvanized steel casing. All coils shall be factory tested with air at 300 psig (2070 kPa) while immersed in an illuminated water tank.
- .3 Headers with schedule 40 steel pipe connections with weldneck flanges.
- .4 Headers shall be outside the air-handling unit for maximum serviceability except for blow through applications where headers are internal. The non-headered end of the coil shall be fully concealed.
- .5 All water coils shall be equipped with a capped vent tapping at the top of the return header or connection, and a capped drain tapping at the bottom of the supply header or connection.
- .6 Water and glycol coils shall be circuited to provide adequate tube velocities to meet design requirements. Internal turbulators are not acceptable.
- .7 5/8" O.D. tube diameter water coils shall be ARI Certified.

## 2.8 FACTORY SUPPLIED CONTROLS/WIRING

- .1 Provide a system of motor control, including all necessary terminal blocks, motor contactors, motor overload protection, grounding lugs, control transformers, auxiliary contactors, variable frequency drives, air flow monitoring device on each blower complete with transmitter and terminals for the connection of external control devices or relays.
- .2 Gas fired units shall also include high limit and combustion airflow switch.
- .3 Fire alarm circuits (where required) shall be powered from a relay in unit circuitry.
- .4 Automatic controls shall be housed in a control panel mounted inside the service vestibule area. Panel to be separated from power panel.
- .5 Provide remote mounted control panel for the purpose of switching and visual indication of operations. NEMA 12 panel to include the following items:

- Engraved lamicoid faceplate
  - System ON-OFF switch
  - General alarm light
  - Filter alarm light
  - CRD display module
- .6 Provide a discharge air low limit equipped with an automatic by-pass time delay to allow for cold weather start-up. On a heating system failure, this device will shut down the fan and close the outdoor air damper. This device shall require resetting by interrupting the electrical circuit.
  - .7 Provided hard wired airflow double reverse interlock between make up air unit and exhaust fan.
  - .8 Unit is to be factory tested and all sequences of operation confirmed. Testing reports to be made available upon request.
  - .9 Provide on-site start by factory technician.
  - .10 Refer to Section 25 90 00 for sequence of operation.

## **2.9 CAPACITY/COMPONENTS**

- .1 As indicated in Equipment Schedules and on AHU plans and elevations.

## **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 as per manufacturers' instructions on roof curbs provided by manufacturer as indicated.
- .2 Manufacturer to certify installation, supervise start-up and commission unit.
- .3 Run drain line from cooling coil condensate drain pan to discharge onto roof.

### **3.3 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 products, 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 Upon completion of work, after cleaning is carried out.
- .2 Obtain reports within 3 days of review and submit immediately to Engineer.
  - .1 Performance Verification:
    - .2 General:
      - .1 In accordance with Section 23 08 02 - Cleaning and Start-up of Mechanical Piping Systems.
  - .3 Verify accessibility, serviceability of components including motorized dampers, filters coils, fans, motors, operators, humidifiers, sensors, electrical disconnects.
  - .4 Verify accessibility, cleanability, drainage of drain pans for coils.
  - .5 Performance Verification:
    - .1 General:
      - .1 In accordance with Section 23 08 02 - Cleaning and Start-up of Mechanical Piping Systems, supplemented as specified herein.
    - .2 Rooftop Air Handling Units:
      - .1 Check for smooth, vibration less correct rotation of supply fan impeller.
      - .2 Measure supply fan and exhaust capacity.
      - .3 Adjust impeller speed as necessary and repeat measurement of fan capacity.
      - .4 Measure pressure drop each component of air handling unit.
      - .5 OAD and EAD: verify for proper stroking and end switch.
      - .6 Measure DBT, WBT of SA, EA.
      - .7 Measure air cooled condenser discharge DBT.
      - .8 Simulate maximum cooling load and measure refrigerant hot gas and suction temperatures and pressures.
      - .9 Simulate maximum heating load and:
        - .1 Verify temperature rise across heat exchanger.
        - .2 Perform flue gas analysis. Adjust for peak efficiency.
        - .3 Verify combustion air flow to heat exchanger.
        - .4 Simulate minimum heating load and repeat measurements.
      - .10 Measure radiated and discharge sound power levels under maximum heating demand and under maximum cooling demand with compressors running.
      - .11 Verify operating control strategies, including:
        - .1 Heat exchanger operating and high limit.
        - .2 Early morning warm-up cycle.
        - .3 Freeze protection.
        - .4 Economizer cycle operation, temperature of change-over.
        - .5 Alarms.
        - .6 Voltage drop across thermostat wiring.
        - .7 Operation of controls and remote panel, including pilot lights, failure modes.
      - .12 Check capacity of heating unit.
      - .13 Measure DX refrigeration system performance as specified.
    - .3 Start-Up:
      - .1 General: in accordance with Section 23 08 02 - Cleaning and Start-up of Mechanical Piping Systems.
      - .4 Verify accessibility, serviceability of components including motorized dampers, filters coils, fans, motors, operators, humidifiers, sensors, electrical disconnects.
      - .5 Verify accessibility, clean ability, drainage of drain pans for coils, humidifiers.

**3.4 DEMONSTRATION**

- .1 Training: in accordance with Section 21 05 01.

**3.5 CLEANING**

- .1 Perform cleaning operations as specified and in accordance with manufacturer's recommendations.
- .2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

**END OF SECTION**

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## **1 General**

### **1.1 SECTION INCLUDES**

- .1 Cabinet unit heaters.

### **1.2 SUBMITTALS FOR REVIEW**

- .1 Section 01 33 00: Procedures for submittals.
- .2 Product Data: Provide typical catalogue of information including arrangements.
- .3 Shop Drawings:
  - .1 Indicate cross sections of cabinets, grilles, bracing and reinforcing, and typical elevations.
  - .2 Submit schedules of equipment and enclosures typically indicating length and number of pieces of element and enclosure, corner pieces, end caps, cap strips, access doors, pilaster covers, and comparison of specified heat required to actual heat output provided.
  - .3 Indicate mechanical and electrical service locations and requirements.

### **1.3 OPERATION AND MAINTENANCE DATA**

- .1 Section 01 78 10: Submittals for project closeout.
- .2 Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, installation instructions, maintenance and repair data, and parts listings.

### **1.4 QUALITY ASSURANCE**

- .1 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience who issues complete catalogue data on such products.

### **1.5 REGULATORY REQUIREMENTS**

- .1 Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

## **2 Products**

### **2.1 PERFORMANCE**

- .1 Unit performance and capacity shall be as scheduled on equipment schedule.
- .2 Electrical characteristics shall be as scheduled.

### **2.2 CABINET UNIT HEATERS**

- .1 Coils: Evenly spaced aluminum fins mechanically bonded to copper tubes, designed for maximum operating limits of 1380 kPa and 104 degrees C (200 psi and 220 deg.F.)

- .2 Cabinet: 1.5 mm (16 gauge) steel with exposed corners and edges rounded, easily removed panels, glass fibre insulation and integral air outlet.
- .3 Finish: Factory applied baked primer coat on visible surfaces of enclosure or cabinet.
- .4 Fans: Centrifugal forward-curved double-width wheels, statically and dynamically balanced, direct driven.
- .5 Motor: Tap wound multiple speed permanent split capacitor with sleeve bearings, resiliently mounted.
- .6 Motor Speed Control: 4 position speed switch factory wired and CSA approved. Located in cabinet where accessible. Provide key operated wall mounted switch where inaccessible
- .7 Filter: Easily removed 25 mm thick glass fibre throw-away type, located to filter air before coil.

### **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 Install equipment exposed to finished areas after walls and ceiling are finished and painted. Avoid damage.
- .3 Protection: Provide finished cabinet units with protective covers during balance of construction.
- .4 Maintain sufficient clearance to permit performance of service maintenance.
- .5 Check final location with Consultant if different from that indicated prior to installation. Should deviations beyond allowable clearances arise, request and follow Consultant's directive.

#### **3.3 HYDRONIC UNITS**

- .1 Provide with shut-off valve on supply and balancing valve complete with isolation on return piping. Refer to drawings for balancing valve type.
- .2 Balancing valve shall match existing style.
- .3 Provide each unit at high points with easily accessible manual air vent. If not easily accessible, extend vent to exterior surface of cabinet for easy servicing.
- .4 For inaccessible valves, provide factory-made permanently hinged access doors, 150 mm x 175 mm (6" x 7") minimum size, integral with cabinet.



- .5 Cabinet Unit Heaters: Install as indicated. Coordinate to assure correct recess size for recessed units.

### **3.5 CLEANING**

- .1 After construction is completed, including painting, clean exposed surfaces of units. Vacuum clean coils and inside of cabinets.
- .2 Touch-up marred or scratched surfaces of factory-finished cabinets, using finish materials provided by manufacturer.
- .3 Install new filters.

**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.
    - .4 Cx Performance Tests and Verification.

### **1.2 DEFINITIONS**

- .1 For additional acronyms and definitions refer to Section 25 05 01 - EMCS: General Requirements.
- .2 AEL: ratio between total test periods 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. Departmental Representative, at his discretion, may waive requirement for witnessing some of the Cx activities.
- .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 Perform CX tests as required to prove system operate as intended. Correct deficiencies, and re-test. When EMCS passes test, perform test on required sampling of systems 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.

## **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 to perform point-to-point verification on entire EMCS (i.e. from screen to on-site device) and document on standard form. Form shall be reviewed and approved by Departmental Representative prior to conducting verification.
- .3 Verify every sequence of operation. Identify every occasion where implemented sequence differs from specified and confirm acceptance of changes with Departmental Representative prior to witnessed Performance Verification Tests. Ensure that Performance Verification Tests are altered to suit such changes in sequence.
- .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 required sampling in presence of Departmental Representative once system passes Controls Contractor's verification.

#### **3.2 SCHEDULE**

- .1 Contractor shall schedule start-up, check-out and Cx activities for each scheduled work area.
- .2 Each scheduled work area shall be made fully functional before moving onto the next scheduled work area, including all Cx activities except the 30 day test.
- .3 Refer to schedule for further information.

#### **3.3 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.

### **3.4 ADJUSTING**

- .1 Final adjusting: upon completion of commissioning as reviewed by Departmental Representative, set and lock devices in final position and permanently mark settings.

### **3.5 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 Modify existing Energy Management and Control System (EMCS) to suit system revisions. Existing system consists of the following elements:
  - .1 Microcomputer based Building Controls (BC) interfacing directly with sensors, actuators and environmental delivery systems (ie: HVAC units, heat exchangers, VAV boxes, etc.).
  - .2 A two (2) wire peer communication network to allow data exchanger from BC to BC and BC's to the Central Building management computer.
  - .3 A personal computer (PC) based central and associated operator station and software functioning as the primary operator interface for the EMCS.
  - .4 Electric and electronic controls for all items indicated on drawings and described hereinafter including dampers, valves, panels and electrical installation.
  - .5 Incidental electric wiring to connect control system to interlocks, etc.
  - .6 Air flow measurement.
  - .7 Work station graphics for each and every sequence of operation.
  - .8 System to utilize TCP/IP communication and existing single mode fibre network from Central Heating Plant to Forensic Lab. Fibre and switches by Owner.
  - .9 Revise existing controls where possible. New controls to match existing.
  - .10 Update graphic to suit revisions.
- .2 Work covered by Division 25 consists of fully operational EMCS, including, but not limited to, following:
  - .1 Building Controllers.
  - .2 Control devices required to implement sequence of operation.
  - .3 Existing OWS(s).
  - .4 Data communications equipment necessary to effect EMCS data transmission system in building.
  - .5 Field control devices.
  - .6 Software/Hardware complete with full documentation.
  - .7 Complete operating and maintenance manuals.
  - .8 Training of personnel.
  - .9 Acceptance tests, technical support during commissioning, full documentation.
  - .10 Wiring interface co-ordination of equipment supplied by others.
  - .11 Miscellaneous work as specified in these sections and as indicated.
- .3 Design Requirements:
  - .1 Design and provide conduit and wiring linking elements of system. As stated under 1.5.1.9.1, suitable existing wiring and conduit may be utilized in design and reused.

- .2 Supply sufficient programmable controllers of types to meet project requirements. Quantity and points contents as reviewed by Departmental Representative prior to installation.
  - .3 Location of controllers as reviewed by Departmental Representative prior to installation.
  - .4 Provide utility power to EMCS where available.
  - .5 Metric references: in accordance with CAN/CSA Z234.1.
- .4 Language Operating Requirements:
- .1 Provide English operator selectable access codes.
  - .2 Use non-linguistic symbols for displays on graphic terminals wherever possible. Other information to be in English.
  - .3 Operating system executive: provide primary hardware-to-software interface specified as part of hardware purchase with associated documentation to be in English.
  - .4 System manager software: include in English system definition point database, additions, deletions or modifications, control loop statements, use of high level programming languages, report generator utility and other OS utilities used for maintaining optimal operating efficiency.
  - .5 Include, in English:
    - .1 Input and output commands and messages from operator-initiated functions, 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-definitions).
    - .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 All electrical low-voltage control wiring, including interlock wiring, required for the equipment supplied by Division 22, 23 and 25, except where otherwise noted, shall be supplied and installed by the Control Supplier. This includes all equipment being installed under the Chiller and Humidification Installation Package and all additional equipment being installed under this tender.
- .2 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.
- .3 All mechanical control wiring installed by the control supplier shall conform with the requirements of the local electrical authority and the specifications Division 26 Electrical.
- .4 Electrical Contractor: Electrical shall provide the following:
  - .1 All power wiring to equipment.
  - .2 Existing 15 amp, 120V/60/1 phase fused power supply to each DDC control panel. It is assumed that except for the controls on new equipment, additional controls will be powered from existing system. If additional power is required, contractor shall allow for cost.
  - .3 Electrical Contractor shall be responsible for wiring of inline control devices on 120 Vac as indicated on drawings (including line voltage thermostats and line voltage valves).

## 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,
- .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.

## 1.9 EXISTING CONDITIONS - CONTROL COMPONENTS

- .1 Utilize existing control wiring and conduit where possible.
- .2 Inspect and test existing devices intended for re-use within 30 days of award of contract, and prior to installation of new devices.
  - .1 Furnish test report within 40 days of award of contract listing each component to be re-used and indicating whether it is in good order or requires repair.
  - .2 Failure to produce test report will constitute acceptance of existing devices by Contractor.
- .3 Non-functioning items:
  - .1 Provide with report specification sheets or written functional requirements to support findings.
  - .2 Departmental Representative will repair or replace existing items judged defective yet deemed necessary for EMCS.
- .4 Submit written request for permission to disconnect controls and to obtain equipment downtime before proceeding with Work.

- .5 Assume responsibility for controls to be incorporated into EMCS after written receipt of approval from Departmental Representative.
  - .1 Be responsible for items repaired or replaced by Departmental Representative.
  - .2 Be responsible for repair costs due to negligence or abuse of equipment.
  - .3 Responsibility for existing devices terminates upon final acceptance of EMCS.
- .6 Remove existing controls not re-used or not required. Place in approved storage for disposition as directed.

## **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.

## **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 10 hard copies 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 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.

### **3.2 EXISTING PANELS**

- .1 Correct existing nameplates and legends to reflect changes made during Work.
- .2 Label all existing to specified standard.

**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<sup>TM</sup>-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.
- .5 Connections to Owner supplied single mode fibre using TCP/IP - ethernet.

## **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: BacNet.
  - .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 (inside building): shielded twisted cable, or fibre optic cable compatible with network protocol to be used within buildings.
  - .2 Network medium (from building to central Heating Plant): Utilize Owner supplied single mode fibre and TCP/IP communication.

## **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 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.
- .4 Public Works and Government Services Canada (PWGSC)/Real Property Branch/Architectural and Engineering Services.
  - .1 MD13800-September 2000, Energy Management and Control Systems (EMCS) Design Manual. English: <ftp://ftp.pwgsc.gc.ca/rps/docentre/mechanical/me214-e.pdf>

### **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 to support building systems and associated sequence(s) of operations as detailed in these specifications.
  - .1 Provide sufficient controllers to meet intents and requirements of this section.
  - .2 Controller quantity, and point contents to be approved by Departmental Representative at time of preliminary design review.
- .2 Controllers: stand-alone intelligent Control Units.
  - .1 Incorporate programmable microprocessor, non-volatile program memory, RAM, power supplies, as required to perform specified functions.
  - .2 Incorporate communication interface ports for communication to LANs to exchange information with other Controllers.
  - .3 Capable of interfacing with operator interface device.
  - .4 Execute its logic and control using primary inputs and outputs connected directly to its onboard input/output field terminations or slave devices, and without need to interact with other controller. Secondary input used for reset such as outdoor air temperature may be located in other Controller(s).
    - .1 Secondary input used for reset such as outdoor air temperature may be located in other Controller(s).

## 1.5 DESIGN REQUIREMENTS

- .1 To include:
  - .1 Scanning of AI and DI connected inputs for detection of change of value and processing detection of alarm conditions.
  - .2 Perform On-Off digital control of connected points, including resulting required states generated through programmable logic output.
  - .3 Perform Analog control using programmable logic, (including PID) with adjustable dead bands and deviation alarms.
  - .4 Control of systems as described in sequence of operations.
  - .5 Execution of optimization routines as listed in this section.
  
- .2 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.
- .3 Controllers and associated hardware and software: operate in conditions of 0 degrees C to 44 degrees C and 20% to 90% non-condensing RH.
- .4 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 Departmental Representative for ceiling mounting.
- .5 Cabinets to provide protection from water dripping from above, while allowing sufficient airflow to prevent internal overheating.
- .6 Provide surge and low voltage protection for interconnecting wiring connections.

## **1.6 SUBMITTALS**

- .1 Make submittals in accordance with Section 01 33 00 - Submittal Procedures and Section 25 05 02 - EMCS: Shop Drawings, Product Data and Review Process.
  - .1 Submit product data sheets for each product item proposed for this project.

## **1.7 MAINTENANCE PROCEDURES**

- .1 Provide manufacturers recommended maintenance procedures for insertion into Manuals.

## **2 Products**

### **2.1 MASTER CONTROL UNIT (MCU)**

- .1 Existing to be modified as required to suit required controls.

### **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.
- .5 Contractor may utilize spare points on existing LCUs.

### **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 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 Departmental Representative.
- .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 Event and Alarm management: 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.

- .8 Energy management programs: include specific summarizing reports, with date stamp indicating sensor details which activated and or terminated feature.
  - .1 MCU in coordination with subordinate LCU, TCU, ECU to provide for the following energy management routines:
    - .1 Time of day scheduling (Occupied and Unoccupied).
    - .2 Calendar based scheduling.
    - .3 Holiday scheduling.
    - .4 Temporary schedule overrides.
    - .5 Optimal start stop.
    - .6 Night setback control.
    - .7 Differential Enthalpy (economizer) switchover.
    - .8 Fan speed/flow rate control..
  - .2 Programs to be executed automatically without need for operator intervention and be flexible enough to allow customization.
  - .3 Apply programs to equipment and systems as specified or requested by the Departmental Representative.
- .9 Function/Event Totalization: features to provide predefined reports which show daily, weekly, and monthly accumulating totals and which include high rate (time stamped) and low rate (time stamped) and accumulation to date for month.
  - .1 MCUs to accumulate and store automatically run-time for binary input and output points.
  - .2 MCU to automatically sample, calculate and store consumption totals on daily, weekly or monthly basis for user-selected analog or binary pulse input-type points.
  - .3 MCU to automatically count events (number of times pump is cycled off and on) daily, weekly or monthly basis.
  - .4 Totalization routine to have sampling resolution of 1 min or less for analog inputs.
  - .5 Totalization to provide calculations and storage of accumulations up to 99,999.9 units (eg. kWh, litres, tonnes, etc.).
  - .6 Store event totalization records with minimum of 9,999,999 events before reset.
  - .7 User to be able to define warning limit and generate user-specified messages when limit reached.

## 2.5 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.

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## **2.6 POINT NAME SUPPORT**

- .1 Controllers (MCU, LCU) to support PWGSC 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 Departmental Representative.

### **3.2 INSTALLATION**

- .1 Install Controllers in secure locking enclosures as indicated and as directed by Departmental Representative.
- .2 Provide necessary power from local 120 V 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 coordinating 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): transmitters, sensors, controls, meters, switches, transducers, dampers, damper operators, valves, valve actuators, and low voltage current transformers.

### **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 02 - EMCS: Submittals and Review Process.
- .2 Pre-Installation Tests.
  - .1 Submit samples at random from equipment shipped, as requested by Departmental Representative, for testing before installation. Replace devices not meeting specified performance and accuracy.
- .3 Manufacturer's Instructions:
  - .1 Submit manufacturer's installation instructions for specified equipment and devices.

### **1.5 EXISTING CONDITIONS**

- .1 Cutting and Patching: in accordance with Section 01 73 03 - Execution Requirements supplemented as specified herein.
- .2 Repair surfaces damaged during execution of Work.
- .3 Turn over to Departmental Representative existing materials removed from Work not identified for re-use.

## **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, 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 and pressure, as indicated in I/O summary in Section 25 90 01 - EMCS: Site Requirements, Applications and System Sequences of Operation.

### **2.2 TEMPERATURE SENSORS**

- .1 General: except for room sensors to be resistance or thermocouple type to following requirements:
  - .1 RTD's: 100 or 1000 ohm at 0 degrees C (plus or minus 0.2 ohms) platinum element with strain minimizing construction, 3 integral anchored leadwires. Coefficient of resistivity: 0.00385 ohms/ohm degrees C.
  - .2 Sensing element: hermetically sealed.
  - .3 Stem and tip construction: copper or type 304 stainless steel.
  - .4 Time constant response: less than 3 seconds to temperature change of 10 deg.C.
  - .5 Immersion wells: NPS 1/2, stainless steel spring loaded construction, with heat transfer compound compatible with sensor. Insertion length as indicated.
- .2 Room temperature sensors and display wall modules.
  - .1 Temperature sensing and display wall module.
    - .1 LCD display to show space temperature and temperature setpoint.
    - .2 Buttons for occupant selection of temperature setpoint.
    - .3 Button for occupancy override to switch to occupied mode outside occupied hours of operation for EMCS controlled period of time.
    - .4 Jack connection for plugging in laptop personal computer contractor supplied zone terminal unit and/or contractor supplied palm compatible handheld device for access to zone bus.
    - .5 Integral thermistor sensing element 10,000 ohm at 24 degrees.
    - .6 Accuracy 0.2 degrees C over range of 0 to 70 degrees C.
    - .7 Stability 0.02 degrees C drift per year.
    - .8 Separate mounting base for ease of installation.

- .3 Duct temperature sensors:
  - .1 General purpose duct type: suitable for insertion into ducts at various orientations, insertion length 460 mm or as indicated.
  - .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.
- .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 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, 100 or 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 into 500 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/50 degrees 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.

## 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.

## 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: 37 Pa 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 ELECTROMECHANICAL RELAYS

- .1 Requirements:
  - .1 Double voltage, DPDT, plug-in type with termination base.
  - .2 Coils: rated for 120V AC or 24V DC. Other voltage: provide transformer.
  - .3 Contacts: rated at 5 amps at 120 V AC.
  - .4 Relay to have visual status indication

## 2.12 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.

## 2.13 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.

#### **2.14 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.

#### **2.15 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 50:1 minimum.
  
- .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 100:1 minimum.
  
- .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.

## **2.16 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.

## 2.17 PANELS

- .1 Free-standing or wall mounted 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 Departmental Representative without adding additional cabinets.
- .3 Panels to be lockable with same key.

## 2.18 WIRING

- .1 In accordance with Section 26 27 10 - Modular Wiring System, 26 27 26 - Wiring Devices.
- .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 stranded twisted pair.
  - .2 Analog input and output: shielded #18 stranded twisted pair.

## 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 Section 07 84 00 - Firestopping. Maintain fire rating integrity.
- .6 Electrical:
  - .1 Complete installation in accordance with Section 26 05 01 - Common Work Results - Electrical.
  - .2 Modify existing starters to provide for EMCS as indicated in I/O Summaries and as indicated.
  - .3 Refer to electrical control schematics included as part of control design schematics in Section 25 90 01 - EMCS: Site Requirements Applications and Systems Sequences of Operation. Trace existing control wiring installation and provide updated wiring schematics including additions, deletions to control circuits for review by Departmental Representative before beginning Work.

- .4 Terminate wires with screw terminal type connectors suitable for wire size, and number of terminations.
- .5 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.
- .6 Do not run exposed conduits in normally occupied spaces unless otherwise indicated or unless impossible to do otherwise. Departmental Representative to review before starting Work. Wiring in mechanical rooms, wiring in service rooms and exposed wiring must be in conduit.

### 3.2 TEMPERATURE SENSORS

- .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 Reuse existing wells.
  - .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 IDENTIFICATION**

- .1 Identify field devices in accordance with Section 25 05 54 - EMCS: Identification.

**3.5 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**

## Part 1 - General

### 1.1 SUMMARY

- .1 Section Includes:
  - 1. Sequence of Operation for each system, which the EMCS must accomplish in full.

### 1.2 REFERENCES

- .1 Public Works and Government Services Canada (PWGSC) / Real Property Branch / Architectural and Engineering Services.
  - 1. MD13800-September 2000, Energy Management and Control Systems (EMCS) Design Manual. English:  
<ftp://ftp.pwgsc.gc.ca/rps/docentre/mechanical/me214-e.pdf>

### 1.3 SEQUENCING

- .1 Present sequencing of operations for systems, in accordance with MD13800 - Energy Management and Control Systems (EMCS) Design Manual.

## Part 2 - Products

### 2.1 NOT USED

- .1 Not Used.

## Part 3 – Execution – Sequence of Operation

### 3.1 ROOM 102 CABINET UNIT HEATERS

- .1 EMCS shall monitor room temperature and differential pressure.
- .2 Temperature Control:
  - .1 Make-up air unit to be controlled from packaged controls, refer to make-up air unit sequence.
  - .2 CUH-1 and CUH-2 shall operate from local line voltage thermostats.
- .3 Cabinet Unit Heater Control:
  - .1 Thermostat shall cycle fan and line voltage two-position three way valve to meet setpoint.
  - .2 Temperature setpoint to be fixed at setting determined on site with Departmental Representative, assumed to be 17.5 Deg.C. with one degree offset (heat initiates at 16.5 and disables at 17.5 – which assumes target space temperature of 18 Deg.c when MUA is running)
- .4 Operator Work Station: the operator will be able to view and/or modify the following:
  - .1 Not Applicable (refer to make-up air sequence)
- .5 Alarm Conditions: The following alarms will not shut the system down:
  - .1 Not Applicable (refer to make-up air sequence)

### 3.2 RANGE EXHAUST AND MAKE-UP AIR

- .1 System control
  - .1 Make-up air and exhaust shall operate from packaged controller supplied with equipment complete with remote interface. Remote interface to be installed in range, refer to drawings.
  - .2 Unit controls to be factory wired on equipment with the following field installed devices/wiring: remote control panel (includes space temperature sensor), interlocks (from panel to each unit), differential pressure sensors, differential pressure switches.
  - .3 EMCS shall interface with packaged system controls through BacNet to obtain monitoring points indicated.
  - .4 EMCS shall control run-around heat reclaim, as specified, when mechanical heating or cooling is required.
  - .5 EMCS shall monitor space temperature independently of packaged control.
  
- .2 Fan Control:
  - .1 When system is off, outside intake damper and exhaust discharge dampers shall be closed.
  - .2 System shall operate when initiated from local control panel.
  - .3 Upon initiation, dampers shall open and be proven.
  - .4 When dampers prove, supply and exhaust fans shall start and ramp VFDs slowly to setpoint, while maintaining exhaust differential. There shall be no delay on starting exhaust and supply fans. Fans shall ramp independently with supply air ramp lagging exhaust air ramp as required to meet pressure offset. Ramp speed shall also ensure heating can maintain discharge air temperature during extreme conditions without tripping freeze-stat
  - .5 Once at setpoint, exhaust fan shall modulate to maintain constant exhaust volume as filters load.
  - .6 Supply fan shall track exhaust to maintain differential negative pressure setpoint, throughout entire operation.
  - .7 Air volume shall be measured with packaged system for both S/A and E/A.
  - .8 Differential pressure for control shall be measured between room 102 and ambient.
  - .9 A pressure switch, hard wired into system, shall shut down system if space becomes positive to outside.
  - .10 A pressure switch, hard wired into system, shall shut down system if space becomes too negative to outside. Setting shall be determined on site when differential pressure during operation is established and shall be greater than control setting.
  - .11 Balancer shall balance system to ensure space is negative, flow offset to be determined on site.
  - .12 EMCS shall monitor space pressure relative to corridor 198 and ambient pressure from dedicated EMCS sensors.
  
- .3 Temperature Control:
  - .1 Packaged controller shall reset discharge air temperature to suit space setpoint, as set by occupant through remote interface. System shall control heating and cooling to meet required discharge air temperature.
  - .2 On a call for heat, the packaged controller shall modulate the gas-valve to control system to required discharge air temperature. Heating shall be disabled when cooling is operating.
  - .3 When the outside air temperature is above an adjustable setpoint initially set at 10 deg.C, the mechanical cooling shall be enabled, below this setting cooling shall be disabled.

- .4 When cooling is enabled, on a call for cooling the packaged controller shall cycle the compressors to maintain discharge air temperature.
- .5 Provide a low discharge temperature freeze-stat that will de-energize the fans, close the inlet/outlet dampers, and send an alarm message should a low temperature condition prevail for more than an adjustable time period, initially set to 2 minutes.
- .6 EMCS shall monitor space temperature from a dedicated stainless steel sensor.
- .4 Energy Reclaim Control:
  - .1 EMCS shall control the runaround heat reclaim pump and three way valve to reduce mechanical heatin and cooling requirements of system. System shall only operate when fans are on and mechanical heating or cooling is required, all other times it shall be disabled except when circulating water for freeze protection.
  - .2 EMCS shall monitor supply air temperature to space, exhaust air temperature from space and outside air temperature.
  - .3 For mechanical cooling: when the outside air temperature is above the supply air discharge temperature and the exhaust air discharge temperature is above the supply air discharge temperature by an adjustable offset, initially 2 deg.c, the reclaim pump shall energize.
  - .4 For mechanical heating: when the outside air temperature is below the supply air discharge temperature by an adjustable offset, initially 2 deg.c, and the system is in heating the reclaim pump shall energize.
  - .5 EMCS shall monitor exhaust discharge air temperature and modulate three-way valve to maintain exhaust temperature above freezing for defrost control.
  - .6 When ambient temperature is below low temperature setpoint, initially -25 Deg.C, the pump shall operate continuously.
- .5 Service Monitoring:
  - .1 EMCS shall monitor supply and exhaust fan VFD speed.
  - .2 An adjustable supply speed high limit shall initiate a service call to review filter loading.
  - .3 An adjustable exhaust speed high limit shall initiate a service call to review filter loading.
- .6 The following are to be part of Packaged Controller and be viewable on Operator Work Station:
  - .1 Supply air discharge temperature (to space, after all tempering devices)
  - .2 Exhaust air discharge temperature (from space before all tempering devices).
  - .3 Exhaust air discharge from unit (after reclaim coil).
  - .4 Outside air temperature.
  - .5 Supply fan speed
  - .6 Exhaust fan speed
  - .7 System alarm
  - .8 Space temperature (from packaged sensor)
  - .9 Positive pressure switch (field installed, hard wired interlock)
  - .10 Negative pressure switch (field installed, hard wired interlock)
  - .11 Damper end switch/position for S/A and E/A.
  - .12 S/A air flow volume
  - .13 E/A air flow volume
- .7 Operator Work Station: the operator will be able to view and/or modify the following:
  - .1 Pump P-1 start, stop, status, alarm.
  - .2 Exhaust reclaim coil water temperatures (inlet and outlet)
  - .3 Supply reclaim coil water temperatures (inlet and outlet)

- .4 Supply fan speed high limit setpoint (adjustable to be estimated during airbalance)
  - .5 Exhaust fan speed high limit setpoint (adjustable to be estimated during airbalance)
  - .6 Space temperature (from EMCS sensor)
  - .7 Low temperature alarm setpoint, initially 10 Deg.C.
  - .8 Differential pressure – room 102 to room 198.
  - .9 Differential pressure – room 102 to ambient.
- .8 Alarm Conditions:
- .1 The following alarms will not shut the system down:
    - .1 Refer to sequence for Room 102 for temperature and pressure alarm.
    - .2 Supply fan speed high limit: 5 minute delay
    - .3 Exhaust fan speed high limit: 5 minute delay.
    - .4 Reclaim pump alarm: 1 minute delay.
    - .5 EMCS Positive Differential Pressure alarm – Room 102 becomes positive to 198 when MUA/Exhaust is on: 1 minute delay.
    - .6 EMCS Positive Differential Pressure alarm – Room 102 becomes positive to ambient when MUA/Exhaust is on: 1 minute delay.
    - .7 EMCS Negative Differential Pressure alarm – Room 102 becomes too negative to 198 when MUA/Exhaust is on: 1 minute delay. (setting to be confirmed, assume to be double operating negative pressure, confirm with Departmental Representative when operating negative pressure is determined)
    - .8 EMCS Negative Differential Pressure alarm – Room 102 becomes too negative to outside when MUA/Exhaust is on: 1 minute delay. (setting to be confirmed, assume to be triple operating negative pressure, confirm with Departmental Representative when operating negative pressure is determined)
  - .2 The following alarms will shut the system indicated down:
    - .1 Pressure Switch space high pressure alarm (positive to ambient) will shut down entire system and require manual restart – 1 minute delay (adjustable). This shall be a hard wired fail safe and not require communication.
    - .2 Pressure switch space low pressure alarm (too negative to ambient, to be determined once operate pressure is established) will shut down entire system and require manual restart – 1 minute delay (adjustable). This shall be a hard wired fail safe and not require communication.
    - .3 Freeze-stat protection – 1 minute delay (adjustable). Shall shut down entire system and require manual restart.
    - .4 Supply Fan Failure – 1 minute delay (adjustable). Shall shut down entire system and require manual restart.
    - .5 Exhaust Fan Failure – 1 minute delay (adjustable). Shall shut down entire system and require manual restart.

### 3.3 COMMISSIONING

- .1 Point to Point verification:
  - .1 EMCS Contractor in conjunction with equipment manufacturer shall prepare a check sheet that includes all points for all functions of the EMCS and packaged control. Check sheet shall include sensor calibration.
  - .2 The Contractor shall complete the check sheet for all items and functions, including failure modes, of the CMS. Once complete, each page shall be signed and dated by the person responsible for conducting the point to point verification. Modifications following initial documentation shall be signed and dated individually. Submit to Department Representative for review one month prior to Performance Verification testing.



- .2 Provide all necessary specialist labour, materials and tools to demonstrate to the Departmental Representative that the EMCS has been commissioned and is operating in compliance with the contract, including verifying sequence of operation as specified with all approved modifications during construction.
- .3 PV forms shall be used for checks, running dynamic tests and adjustments carried out on equipment and systems to ensure correct operation and that they operate efficiently and function independently and interactively with other systems as intended with project requirements. Sample Performance Verification Forms are attached for review. The Contractor will develop the required final project-specific commissioning forms in electronic format with the Departmental Representative. Final forms will include any and all modifications to sequence of operation as a result of site conditions and/or accepted modifications during construction.
- .4 The Contractor shall verify the operation of each and every system. The Departmental Representative and the Contractor shall retest a sampling of systems and components to verify commissioning testing and associated documentation is complete and accurate. Provide manpower and instrumentation to re-verify based on the following sampling rate:
  1. 100% of reported results.

**END OF SECTION**

## General

### 1.1 SECTION INCLUDES

- .1 This Section covers items common to Sections of Electrical Contractor. This section supplements requirements of Division 00 – Procurement and Contracting Requirements, Division 01 – General Requirements, Division 02 – Existing Conditions.
- .2 Provide complete and fully operational electrical systems with facilities and services to meet requirements described herein, as shown on the drawings, and in complete accord with applicable codes and ordinances.
- .3 Only those items that are specifically indicated as not in contract (N.I.C.) will be omitted.
- .4 Contract documents of Divisions 26, 27, and 28 are diagrammatic and approximately to scale, unless detailed otherwise. They establish scope, material and installation quality, and are not detailed installation instructions.
- .5 Follow manufacturers' recommended installation details and procedures for equipment supplemented by details given herein and on plans subject to approval of the Consultant.
- .6 Examine all drawings to ensure that work under this Division can be properly installed without interference.
- .7 Where discrepancies, ambiguities, obvious omissions or errors have been made in drawings and specifications, it shall be the responsibility of the contractor to clarify same prior to tender closing. No allowance will be made after contract award for any expense incurred by him for having to adjust his work to properly conform.

### 1.2 REFERENCES

- .1 The Electrical Contractor shall be bound by industry standards, as interpreted by the Consultant, whether or not specifically referenced in this document. Comply with Electrical Protection Act and rules and regulations made pursuant thereto, including the Canadian Electrical Code. Also, comply with applicable standards of the following:
  - .1 CSA C22.1-2015, Canadian Electrical Code, Part 1.
  - .2 Electrical and Electronic Manufacturers Association of Canada (EEMAC).
  - .3 National Electrical Manufacturers Association (NEMA).
  - .4 National Building Code 2010 (NBC 2010)
  - .5 National Fire Protection Association (NFPA)
  - .6 Institute of Electrical and Electronic Engineers (IEEE).
  - .7 Audio Engineering Society (AES).
  - .8 Other Applicable CSA and UL approvals.

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**1.3 CODES AND STANDARDS**

- .1 The electrical installation shall comply with all SaskPower requirements and regulations.
- .2 In the event of any inspection authority requesting deviation from the design, notify the Consultant and obtain approval before proceeding with any change.
- .3 In no instance, shall the standard established by the drawings and specification be reduced by any code or ordinance. All references to codes and standards shall be to the latest edition.

**1.4 CARE, OPERATION AND START-UP**

- .1 Instruct operating personnel in the operation, care and maintenance of systems, system equipment and components.
- .2 Connect to equipment furnished in other Divisions and by Owner including start-up and test.
- .3 Arrange and pay for services of manufacturer's factory service engineer to supervise start-up of installation, check, adjust, balance and calibrate components and instruct operating personnel.
- .4 Provide these services for such period, and for as many visits as necessary to put equipment in operation, and ensure that operating personnel are conversant with all aspects of its care and operation.

**1.5 VOLTAGE RATINGS**

- .1 Operating voltages: to CAN3-C235-83
- .2 Motors, electric heating, control and distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits established by above standard. Equipment to operate in extreme operating conditions established in above standard without damage to equipment.

**1.6 PERMITS, FEES AND INSPECTION**

- .1 Submit to SaskPower necessary number of drawings and specifications for examination and approval prior to commencement of work.
- .2 Pay associated fees.
- .3 Notify Consultant of changes required by Electrical Inspection Department prior to making changes.
- .4 Furnish Certificates of Acceptance from Electrical Inspection Department and authorities having jurisdiction on completion of work to Consultant.

**1.7 MATERIALS AND EQUIPMENT**

- .1 Provide materials and equipment in accordance with Section 01 61 00 - Common Product Requirements.

- .2 All goods and materials shall be new and carry CSA approval seal. Equipment and material shall be CSA certified. Where there is no alternative to supplying equipment which is not CSA certified, obtain special approval from the Consultant and the Electrical Inspection Department.
- .3 All fire alarm equipment shall carry ULC approval seal.
- .4 No deviation from specified materials shall be allowed, except where alternative materials have been specifically accepted in writing.
- .5 Where materials are not directly specified by catalogue number and manufacturer's name, a high industry specification grade product shall be provided. The Consultant shall be the sole judge of whether this standard is being met.
- .6 All references to known standard specifications shall mean and intend the latest edition of such specifications.
- .7 Each major component of equipment shall have manufacturer's name, address, catalogue and serial number in a conspicuous place.
- .8 Upon request, provide a complete list of all materials and their manufacture. The contractor will be required to use the materials indicated. Changes in manufactures at a future date will not be acceptable.
- .9 Factory assemble panels and component assemblies.

## **1.8 WORKMANSHIP**

- .1 All work under this Division shall be executed in a workmanlike and substantial manner, neat in its mechanical appearance and arrangement.
- .2 A competent representative shall constantly supervise the work of this Division from beginning to completion and final acceptance. So far as possible, the same supervisor and workmen shall be employed throughout the project's duration.
- .3 Material and workmanship not meeting the standard intended and required by this specification shall, upon instruction from the Consultant, be properly replaced without further charge or consideration.

## **1.9 ELECTRICAL DRAWINGS**

- .1 They indicate the general location and route of conduit and cable to be installed. Conduit shall be installed in coordination with other services. These include both new and existing services. Prior to excavation anywhere on site, arrange to have all existing services marked. Where space is indicated for future equipment or plant use, leave space clear.
- .2 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 the satisfaction of the Consultant at no extra cost.

- .3 Ceiling and floor outlet symbols are scaled to centre line of symbol; symbol does not indicate the size or shape. Mounting height shall be measured to the lowest point on ceiling mounted equipments, and above finished surface for wall mounted equipment.
- .4 Wall outlets are scaled to the perpendicular centre line of the symbol. Mounting heights for all wall mounted outlets shall be measured to the horizontal centre line.
- .5 Where outlets are mounted in masonry walls, outlets should be mounted to the nearest coursing line.

**1.10 WORK PROVIDED FOR OTHER DIVISIONS**

- .1 Provide information as to exact size and location of all required concrete bases, housekeeping pads and curbs required for the installation of equipment of Divisions 26, 27, and 28.
- .2 Provide information as to the location and exact size of all openings through floors and walls.
- .3 Provide information as to the location and exact size of all equipment supports required within walls, and roof support structure.
- .4 Provide electrical connections, circuit protection and disconnect devices for all equipment supplied by other Divisions, including the Owners. Provide motor starters, disconnect switches, thermal switches, etc., for motors supplied by mechanical contractor. Special control equipment being supplied by mechanical contractor shall be installed and wired by that contractor.

**1.11 WORK PROVIDED BY OTHER DIVISIONS**

- .1 All concrete bases, housekeeping pads and curbs required for the installation of equipment of Divisions 26, 27, and 28.
- .2 Installation and framing of all openings in walls or floors larger than 150 mm diameter, or rectangular, with one dimension greater than 150 mm.
- .3 Openings in millwork for electrical outlets and conduits.
- .4 Painting of all panelboard and communication panel trims to match colour scheme where exposed in finished areas.
- .5 Firestopping shall be the responsibility of the General Contractor.

**1.12 WORK NOT PROVIDED BY THIS DIVISION**

- .1 Control wiring below 50V for Mechanical Contractor equipment beyond terminal section of each motor control centre, unless specifically indicated otherwise.

**1.13 COORDINATION WITH OTHER DIVISIONS**

- .1 Cooperate fully with the Consultant and other trades of electrically operated equipment to ensure proper arrangement of and provision for all electrical equipment.

- .2 Where outlets or equipment may affect architectural or site treatment desired, contact Consultant and for instructions or detailed drawings.
- .3 Refer to other Divisions including mechanical, millwork, kitchen equipment, owner supplied equipment, etc, for electrical work in connection with these drawings and specifications.
- .4 Location of lighting outlets and receptacles in mechanical or equipment rooms and similar areas shall be finalized during construction to give optimum arrangement. The Consultant shall approve final location before installation.
- .5 Supply and install all motor connections, including starters and overload protection and disconnecting devices at motors where required. All motor driven equipment shall be provided with a lockable disconnecting device within line of site of the motor to be disconnected.
- .6 Supply and install complete wiring requirements for full voltage in-line devices on single phase equipment such as thermostats, multi-speed switches for unit heaters, force flows, cabinet heaters, etc.
- .7 Cutting of openings for electrical outlets in millwork and other similar types of custom-made equipment shall be done by the supplier of this equipment.
- .8 Check other Divisions to ensure that suitable provisions have been provided for all motors. It is possible that some motors may vary in size, numbers and characteristics, depending on the equipment manufacturer's specific requirements. Any variations in this regard will not constitute cause for further consideration. The mechanical coordination schedule supplied on the drawings shall be updated with nameplate specifications.
- .9 Assume full responsibility for layout of this work and for any damage caused the Owner or other Divisions by improper location or carrying out of this work.
- .10 Before commencing work, examine the work of other Divisions, and report at once any defects or interference affecting the work under this Division, or the guarantee of same.
- .11 Location of lighting outlets and receptacles in mechanical or equipment rooms and similar areas shall be finalized during construction to give optimum arrangement. The Consultant shall approve final location before installation.
- .12 Allow for all hoisting and setting of material and equipment.

**1.14 OWNER SUPPLIED EQUIPMENT**

- .1 Connect all electrically operated equipment supplied by the Owner, as designated on the drawings.
- .2 Reconnect all existing electrical services from new and existing electrical sources modified by the work of this contract.

**1.15 INSPECTION AND TESTING**

- .1 During construction and up to final acceptance, make accessible any equipment or wiring for inspection purposes.
- .2 All electrically operating equipment shall be left as a complete installation in perfect operating condition, and receive final test in the presence of the Consultant.
- .3 Ensure that all power circuitry is properly tested and meets the CSA Ground Resistance Requirements. For any 600 volt systems, a 600 volt megger or hi-pot procedures shall be used for all such tests. Provide documentation for each test within maintenance/commissioning manuals.
- .4 On the request of the Consultant, a staff supervisor shall be made available to assist in this inspection work.
- .5 At the completion of the installation, voltage tests shall be conducted in the presence of the Consultant. Transformer taps shall be adjusted, and any other corrective measures implemented to assure the proper operation of all electrical equipment. Provide documentation for each test within maintenance/commissioning manuals.
- .6 Acceptance tests and commissioning shall be conducted for systems and/or equipment where indicated in the specifications and other standards referenced herein. Acceptance tests shall include, but not be limited to, the following Sections.
  - .1 26 09 24 – Low Voltage Lighting System
  - .2 26 50 00 – Lighting
  - .3 27 51 17 – Sound Enhancement System
  - .4 28 23 00 – Video Surveillance
- .7 Acceptance tests shall meet requirements as required by manufacturer, as outlined in ANSI – NETA 2007 and additional requirements described on drawings and specified herein. All tests shall be documented as per ANSI – NETA 2007 standards and shall include testing results, testing date, testing technician and representative present.
- .8 Acceptance tests shall be made up of the following:
  - .1 Shop Drawing Information Sheets
  - .2 Static Review Check Sheets
  - .3 Performance Verifications Sheets
  - .4 Manufacturer Commissioning and Report
  - .5 Manufacturer Test Reports, Factory and On Site where required
  - .6 Test Results not forming part of the Static Review Checks Sheets
  - .7 Owner / Consultant Demonstration Sheets
  - .8 Training
- .9 Certification of all acceptance tests and commissioning shall be submitted to the Consultant for approval. Tests not conducted to the satisfaction of the Consultant shall be repeated, and no further costs will be considered. Written documentation bearing name and signature of Contractor, Consultant and Owner’s personnel present during acceptance tests shall be

included in certification reports. Provide for a minimum of twelve (12) hours across three (3) separate meetings with Consultant and Owner for review of acceptance test sheets.

## **1.16 SHOP DRAWINGS**

- .1 Submit shop drawings, where specifically called for, or as requested. Shop drawings shall show detailed dimensional and technical information, and shall properly describe each piece of equipment. Where applicable, shop drawings shall include complete schematics and wiring diagrams. These shop drawings shall be sufficiently detailed to permit the Owner's technicians to trouble-shoot and repair the equipment. Equipment shall not be ordered and/or fabricated until shop drawings have been reviewed by the Consultant. Shop Drawings shall include, but not be limited to the following Sections on systems and equipment:
  - .1 26 09 24 – Low Voltage Lighting System
  - .1 26 24 17 - Panelboards Breaker Type
  - .2 26 50 00 – Lighting
  - .3 27 05 14 – Communication Cables Inside Buildings
  - .4 27 11 19 – Communications, Termination Blocks & Patch Panels
  - .5 27 51 17 – Sound Enhancement System
  - .6 28 23 00 – Video Surveillance
- .2 Review of shop drawings shall be for general design, arrangement and appearance only. This Division shall check and correct, if necessary, all manufacturer's drawings before submitting, and shall so indicate on each copy, along with a dated approval stamp. All shop drawings must bear an approval stamp and be signed by the Contractor. This review does not relieve this Division from the responsibility for the final installation being correct in all detail, and fully acceptable to the Consultant. Refer to each section for further shop drawing information.
- .3 Refer to General Conditions of the Contract.
- .4 Provide nine (9) printed copies and one PDF copy for each Section. Each shop drawing shall be complete with a cover page with the following information:
  - .1 Specification Section and name
  - .2 Project name, Owner's name and address
  - .3 Number of pages in submittal
  - .4 Contractor and Supplier's name and contact information
  - .5 Approval stamps with room for Consultant's stamp
- .5 Shop drawings for complementary systems and/or equipment shall be submitted at the same time. Partial submittals of related equipment will be rejected or held until all other related shop drawing information has been submitted (i.e. submit all shop drawings for power equipment at the same time). Submittals of shop drawings that are incomplete will be rejected.

## **1.17 CHANGES**

- .1 Refer to General and Supplemental Conditions.



- .2 Submit complete itemized breakdowns of all extras, deletions, and changes to the Consultant. Breakdown shall include quantities, unit costs and extensions. If requested, support claim by certified copies of supplier's invoices.
- .3 The right is reserved to move equipment 3000 mm from location shown without further charge or consideration, provided that such re-location is requested prior to finish being applied.

#### **1.18 CONSULTANT PRICES**

- .1 Electrical progress claims shall be made on Contractor Progress Report #ES110 provided by the Consultant. A copy of this Progress Report is attached for reference. The Electrical contract price shall be broken down into thirteen (13) parts to facilitate assessment of work done and material supplied. This progress claim shall be submitted simultaneously to the General Contractor and the Consultant, the latter case in duplicate. Refer to General Conditions.
- .2 The breakdown shall indicate labour and material to the nearest dollar. Overhead, profit and job expense shall be apportioned to all parts. The breakdown shall be as follows:
  - .1 Distribution/Panels
  - .2 Conduit and boxes
  - .3 Wire and cable
  - .4 Wiring devices
  - .5 Lighting fixtures and lamps
  - .6 Lighting control devices
  - .7 Communications systems
  - .8 Security Systems
  - .9 Specials
  - .10 Miscellaneous - 8% maximum
  - .11 Extras and credits. (Extras in excess of \$1,000 shall be broken down into the above points on a separate ES110 sheet)

#### **1.19 OPERATING INSTRUCTIONS AND SERVICE MANUALS**

- .1 Upon completion of the installation, provide complete and comprehensive identical sets of operating and maintenance manuals.
- .2 The Consultant shall review the operating and maintenance manuals and approve same prior to the manuals being sent to the Owner.
- .3 The operating and maintenance manuals shall include but not be limited to the following information when applicable in the project:
  - .1 Certification reports.
  - .2 Documentation indicating Owner's receipt of operating instructions.
  - .3 Complete list of all materials turned over to the Owner c/w receipts for same.
  - .4 Shop drawings properly indexed and contained in suitably sized binders.
  - .5 Schematic drawings for all systems indexed and contained in suitably sized envelopes or attached efficiently in the above binders.
  - .6 Catalogue brochures for light fixtures, panelboards, switches, receptacles, fuses, etc.
  - .7 All final settings of equipment that has user adjustable settings.
  - .8 Overcurrent coordination and arc fault study and documentation of associated tests.

- .9 Phase rotation confirmation by the Contractor.
- .10 Certificate of Owner's training.
- .11 Acceptance Testing and Commissioning reports.
- .12 Listing of any spare devices turned over to Owner

The above information shall be bound in binders as noted in specifications. Incomplete or poorly reproduced manuals will be rejected.

- .4 Maintain, on a daily basis, a complete set of marked-up prints as as-built drawings that show in complete detail the final arrangement and location of all electrical components and the interconnecting wiring.
- .5 All riser conduits (size and routing), panel feeds (size and routing), conduit runs (size and routing) and main communications (size and routing) shall be marked on plans. These are to be maintained in a neat and substantial manner, so as to properly and fully illustrate the way in which the installation has been completed.
- .6 All equipment locations such as fire alarm signal boosters, cable termination boxes, signal amplifiers, network switches, door controllers, etc shall be identified on the drawings as to their location and quantity (if more than one exists at that particular location).
- .7 Periodic checks on site will be carried out to verify that the Contractor as built drawings are being kept up-to-date.
- .8 The Owner's personnel shall be instructed in the operation and maintenance of the following equipment to the satisfaction of the Owner as per the standards referenced herein.

<u>Section No.</u>	<u>Description</u>	<u>Hours</u>
26 09 24	Lighting Control Devices - Low Voltage	12
26 50 00	Lighting	4
27 51 17	Sound Enhancement System	6
28 23 00	Video Surveillance	6

- .9 The above instructions shall be given by personnel experienced in the operation of the particular system or equipment. Each item or type of equipment, and all controls, shall be operated in the presence of the Owner's personnel to ensure their understanding of equipment function and individual working parts. The Owner reserves the right to set the period or periods during which the instruction shall be given. The contractor shall submit a program of instruction for approval by the Owner.
- .10 Operating and maintenance manuals shall include written documentation bearing name and signature of Owner's personnel who received the above instructions. Contractor shall allow for all training to be completed in a minimum of two sessions. One session at substantial completion, and one session within three months of turning over the system.
- .11 Operating and maintenance manuals, as well as all Owner instructions, shall be complete before substantial completion (as outlined by the Builders' Lien Act) will be considered. Also, preliminary maintenance manuals must be submitted prior to 70% completion. No further progress payments will be permitted until these preliminary maintenance manuals have been submitted and approved.

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**1.20 STORAGE AND PROTECTION**

- .1 Maintain and protect all work provided under this Division. Store all materials within a protected enclosure to prevent exposure to weather or construction dirt.
- .2 Protect all finished and unfinished work of this and other divisions from damage during the course of construction. Cover floors and other surfaces, if necessary. Any damaged work or finishes shall be repaired or replaced without further charge to the Owner.

**1.21 WARRANTY**

- .1 All materials and workmanship shall be guaranteed for a period of one year from date of substantial completion.
- .2 Properly repair and replace all defective work and other work which becomes defective during the term of warranty.
- .3 Service on equipment or systems critical to the Owner's operation shall be provided on an emergency basis which may necessitate overtime and service outside of normal working hours. The contractor shall ensure that all suppliers comply with this requirement.

**1.22 ELECTRIC MOTORS, EQUIPMENT AND CONTROLS**

- .1 Supplier and installer responsibility is indicated in Motor, Control and Equipment Schedule on electrical drawings and related mechanical responsibility is indicated on Mechanical Equipment Schedule on mechanical drawings.
- .2 Control wiring and conduit is provided by the Electrical Contractor except for conduit, wiring and connections below 50 V which are related to control systems specified in Division 15 and shown on mechanical drawings.

**1.23 FINISHES**

- .1 Shop finish metal enclosure surfaces by application of rust resistant primer inside and outside, and at least two coats of finish enamel.
  - .1 Paint indoor switchboards and distribution enclosures light grey ASA 61.
- .2 Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint.
- .3 Clean and prime exposed non-galvanized hangers, racks and fastenings to prevent rusting.

**1.24 ABBREVIATIONS**

- .1 Abbreviations used in this specification are common to and in general use within the related trades.

**1.25 EQUIPMENT IDENTIFICATION**

- .1 Nameplates shall be provided on each new piece of electrical equipment, including, power panels, distribution panels, lighting panels, transformers, disconnect switches, contactors, telephone panels, miscellaneous systems and panels.
- .2 Nameplates for each new electrical panel shall indicate panel designation, mains voltage and panel and circuit number from which this panel is fed.
- .3 Nameplates for new disconnects and contactors shall indicate equipment being controlled, and voltage.
- .4 Nameplates for new terminal cabinets shall indicate system and voltage and load of area served.
- .5 Nameplates for Normal Power Equipment shall be made from black-white-black Lamecoid with bevelled edges and white engraved letters. Nameplates shall be fastened with self tapping metal screws to equipment in a conspicuous location. Flush mounted panels shall have nameplate located on front of panel behind hinged door.
- .6 Typical identification standards shall be used for new equipment throughout the project as follows:

- .1 Lighting, receptacle and power panels shall each be identified with an engraved Lamecoid plate secured to top interior trim as:

Panel 202	10 mm high lettering
120/208 volts	6 mm high lettering
Fed from	6 mm high lettering

- .2 Each panel shall be supplied with a directory card holder welded to inside of door, complete with a neatly typewritten list showing information as follows:

Panelboard name	202
Panel voltage	120/208 volts

<u>Circuit Number</u>	<u>Description</u>	<u>Load</u>
1	Lighting Room 200 (Main Area)	1200W
2	Receptacles Room 200 (Main Area)	6-15A
3	Room 220	1/3 H.P. Fan

Spaces and spares shall be left blank so as to facilitate future description. Also, existing panels where adjustments have been made in the circuitry shall be field checked in their entirety and new directory cards shall be provided.

- .3 List shall be covered with a 1 mm thick clear plastic sheet to protect it.

- .4 Other cabinets and plywood back boards for low voltage systems, such as signals and communications, shall be identified as panelboards with a directory showing circuit numbers and room locations, plus a blank for "Remarks", as well as a Lamecoid plate designation panel name.  
EXAMPLE: if cabinet is for telephone  
.....TP - 2nd floor
- .5 Equipment not listed above, such as incoming service cables, communicating cables, switchgear, transformers, disconnects, motors, instruments, fire alarm and control panels, shall be identified in a similar manner, showing name and number of the equipment, voltage and load information.
- .7 Feeder pull boxes and junction boxes shall be identified with waterproof ink, showing feeder or system concerned. Conduit entering junction boxes for communications systems shall be identified with the room number that each conduit serves.
- .8 A small dab of paint shall be applied to inside of each outlet box, pull box and panel as it is installed, using colour code as follows:
- |        |  |
|--------|--|
| Red    | - Fire Alarm Systems                   |
| Yellow | - Security, Alarm Systems, Card Access |
| Green  | - Telephone/IT Computer Systems        |
- The outside of the box shall also be identified in this way so as to readily determine the system within the conduit system. The cover of each junction box for branch circuits shall describe the voltage being used by means of a waterproof ink.
- .9 No colour code is required for regular lighting and power circuits, but voltage class shall be displayed on all pull boxes and panels.
- .10 Junction boxes in furred ceilings shall be colour identified on both inside and outside.
- .11 Connections in equipment shall be made Phase 'A', 'B', 'C', from left to right when viewing wiring from front or accessible direction.
- .12 Colour coding shall be carried through from incoming utility supply down to and including panels, and shall be as follows:
- .1 Incoming utility service lines shall be identified by Red - Phase 'A'; Black - Phase 'B'; Blue - Phase 'C'; with colour coded PVC tape.
- .2 Switchgear buswork in each switchboard and unit substation cubicle shall be banded with 3M tape identified in accordance with service lines colour coding. In addition, where neutral bus is introduced, it shall be banded white. Ground bus shall be banded green.
- .3 Feeder and sub-feeder bus or conductors shall be banded as above.
- .4 Lighting and power panels shall conform to the Canadian Electrical Code, and shall have main bus banded with tape as follows:

Red	-	Phase 'A'
Black	-	Phase 'B'
Blue	-	Phase 'C'
White	-	Neutral
Green	-	Ground

- .13 All plug-in type receptacles on all levels shall be identified by means of a self laminated, self adhesive label. The cover plates for all receptacles designated on the drawings for housekeeping purposes shall also contain the wording "Housekeeping". The cover plates for all receptacles fed from the ground fault interrupters shall also contain the wording "G.F.I."
- .14 The circuits controlled by all light switches shall be neatly printed with waterproof ink on the side of the switch outlet box so that the panel and circuit number are clearly legible when the coverplate is removed. It shall not be necessary to remove the switch from the outlet box in order to read the panel or circuit number.

**1.26 WIRING IDENTIFICATION**

- .1 Identify wiring with permanent indelible identifying markings, either numbered or coloured plastic tapes, on both ends of phase conductors of feeders and branch circuit wiring.
- .2 Maintain phase sequence and colour coding throughout.
- .3 Colour code: to CSA C22.1.
- .4 Use colour coded wires in communication cables, matched throughout system.
- .5 All data cables and data jumper cables (minimum 23 gauge), jacks and connector boots installed as part of this project used for Security Systems, whether CAT 5e or fibre optic, shall be BRIGHT GREEN in colour.
- .6 All communication and signal cables shall be FT6 rated.
- .7 All patch cables are to be stranded cable with RJ45 connectors. RJ45 connectors shall not be attached to solid conductor cable.
- .8 All installed runs of CAT5e cable are to be solid copper conductor cable and terminated into patch panels in equipment racks or faceplates in other locations.
- .9 An installed cable is any cable that is run through a conduit, run from one area in a building to another area or any cable that travels farther than the adjacent equipment cabinet in a series of cabinets. Note: Equipment cabinets must be abutting without side panels to open connection to be considered adjacent.

**1.27 CONDUIT AND CABLE IDENTIFICATION**

- .1 Colour code conduits, boxes and metallic sheathed cables.

**1.28 WIRING TERMINATIONS**

- .1 Lugs, terminals, screws used for termination of wiring to be suitable for either copper or aluminum conductors.

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**1.29 MANUFACTURERS AND CSA LABELS**

- .1 Visible and legible, after equipment is installed.

**1.30 WARNING SIGNS**

- .1 As specified and to meet requirements of Electrical Inspection Department and Owner.
- .2 Decal signs, minimum size 175 x 250 mm.

**1.31 LOCATION OF OUTLETS**

- .1 Locate outlets in accordance with drawings and specifications.
- .2 Do not install outlets back-to-back in wall; allow minimum 150 mm horizontal clearance between boxes.
- .3 Change location of outlets at no extra cost or credit, providing distance does not exceed 3000 mm, and information is given before installation.
- .4 Locate light switches on latch side of doors. Locate disconnect devices in mechanical and electrical on latch side of door.

**1.32 MOUNTING HEIGHTS**

- .1 Mounting height of equipment is from finished floor to centreline of equipment unless specified or indicated otherwise.
- .2 If mounting height of equipment is not specified or indicated, verify before proceeding with installation.
- .3 Install electrical equipment at following heights unless indicated otherwise or as noted on drawings.
  - .1 Local switches: 1200 mm.
  - .2 Wall receptacles:
    - .1 General: 450 mm.
    - .2 Above top of counters or counter splash backs: 150 mm.
    - .3 In mechanical rooms: 1400 mm.
  - .3 Fire alarm stations: 1200 mm.
  - .4 Fire alarm horn/strobe: 2100 mm.

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**1.33 LOAD BALANCE**

- .1 All lighting panels, distribution centres, motor control centres and main switchboards shall be load balanced such that the maximum variation between the two worst phases does not exceed 5%.
- .2 Measure phase current to panelboards with normal loads (lighting) operating at time of acceptance. Adjust branch circuit connections as required to obtain best balance of current between phases and record changes.
- .3 Measure phase voltages at loads and adjust transformer taps to within 2% of rated voltage of equipment.
- .4 Submit, at completion of work, report listing phase and neutral currents on panelboards, dry-core transformers and motor control centres, operating under normal load. State hour and date on which each load was measured, and voltage at time of test.

**1.34 CONDUIT AND CABLE INSTALLATION**

- .1 Install conduit and sleeves prior to pouring of concrete. Sleeves through concrete: plastic, sized for free passage of conduit, and protruding 50 mm.
- .2 If plastic sleeves are used in fire rated walls or floors, remove before conduit installation.
- .3 Install cables, conduits and fittings to be embedded or plastered over, neatly and close to building structure so furring can be kept to minimum.
- .4 All conduit and tray sealing shall be the responsibility of the Electrical Contractor.

**1.35 TEMPORARY AND TRIAL USAGE**

- .1 Temporary and trial usage by the Owner, or the Contractor, of any of the electrical apparatus or equipment, or any work or materials supplied under this Division before final completion and written acceptance, is not to be construed as evidence of acceptance of same by the Owner.
- .2 Temporary and trial usage may be made as soon as this Division deems the work sufficiently advanced for making a complete and thorough test of same, and that no claim may be made for the injury to or the breaking of any part of such work which may be so used, whether caused by weakness or inaccuracy of structural parts, or by defective material or workmanship of any kind.
- .3 Lighting shall not be used for temporary or trial usage without prior approval of the owner and consultant sign off. If temporary lighting is required for the duration of the project, only construction lamps marked with a permanent ink on the lamp may be used. Evidence of marking will be requested by the consultant. Any fixtures used for temporary or trail usage shall be relamped and cleaned. Evidence of cleaning and relamping will be required by the consultant.



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**1.36 EXCAVATION AND BACKFILL**

- .1 Any excavation and backfilling work that is necessary to accommodate the work under this Division shall be the responsibility of Divisions 26, 27, and 28, in accordance with the requirements of Division 31.

**1.37 TEMPORARY LIGHT AND POWER**

- .1 The General Contractor shall be responsible for all temporary light and power provisions. Refer to General Conditions.

**1.38 MATERIAL TO BE TURNED OVER TO THE OWNER**

- .1 All equipment that is being removed or replaced shall be stockpiled as per Owner's request. The owner may deem that the equipment shall be disposed. All disposal and removal is the responsibility of the contractor.
- .2 Materials as indicated in various sections of this specification shall be turned over to the Owner. These materials shall include, but not be limited to the following:
  - .1 Obtain a signed receipt for each item turned over to the Owner. Include receipts in the operating and maintenance manuals.
  - .2 One set of three fuses for each fuse type and size for each switchboard distribution centre and motor control centre.
  - .3 One set of contacts and one holding coil for each size and type of FVNR motor starter.
  - .4 Spare lighting fixtures.
  - .5 Spare Fire Alarm Devices.
  - .6 Data patch cables.

**1.39 SITE EXAMINATION**

- .1 The contractor shall visit the existing site during the tendering period to familiarize himself with the construction conditions and electrical work provided to date. The contractor shall thoroughly satisfy himself that the work contained in these drawings and specifications can be carried out and that all costs have been included in the tender submitted.

**1.40 SITE WORK**

- .1 The electrical contractor shall be responsible for all necessary trenching and backfilling for all exterior work in connection with underground feeders. All trenches shall be a minimum 900 mm deep. Care must be exercised to ensure a proper grade line is used, and that suitable drainage has been provided.
- .2 All excavated material shall be removed from the site.
- .3 Trenches shall be filled with granular fill and compacted to 95% proctor. Prior to backfilling, all trenches must be inspected by the Consultant.

- .4 Supply and install all cable and conduit in trenches, as described herein or detailed on the drawings.
- .5 Electrical contractor shall be responsible for all concrete and reinforcing in connection with site lighting and car parking pedestals. All concrete and reinforcing on the project shall be in accordance with the quality required for reinforced concrete and reinforcing as specified under Division 3, and as detailed on the drawings.

#### **1.41 CUTTING AND PATCHING**

- .1 Should any cutting or repairing of either unfinished or finished work be required, the contractor shall employ the particular trade whose work is involved, to do such cutting and patching, and shall pay for any resulting costs.
- .2 All holes within buildings shall be fire stopped when penetrating a fire rated structure.

#### **1.42 PAINTING**

- .1 All iron or steel structures fabricated and installed by Divisions 26, 27, and 28 for supporting panels, starters, conduit or other equipment, shall be wire brushed and given one coat of lead chromate paint primer before being set into place. After all equipment is installed and piping complete, this iron work shall be given two coats of ASA #61 enamel to match the panel or structure being supported or in the colour specified for the product.
- .2 All pull boxes, wireways, gutters, etc., fabricated for Divisions 26, 27, and 28, shall be given a coat of lead chromate primer and two coats of ASA #61 enamel before installation to match equipment finish.
- .3 All panels and pull boxes that are set in finished walls or ceilings shall have approved flush covers that shall be prime coated with lead chromate paint, and left for the painting division to paint in with the surrounding wall or ceiling finishes. Panel trims and pull box covers to be painted with the cover removed from the wall so that it can be easily installed or removed without damaging the surrounding paint finish.
- .4 All electrical equipment shall be finished with an ASA #61 enamel, the colour of which shall be grey, unless otherwise specified.
- .5 When installation is complete, all scratches and defects to the paint finishes shall be properly touched up, and where necessary, entire paint surfaces shall be re-done.

#### **1.43 MATERIAL SAFETY DATA AND HAZARDOUS MATERIALS**

- .1 The Contractor shall provide material safety data sheets on all materials prior to shipping materials to site. These data sheets shall be submitted in triplicate to the Owner.
- .2 The Contractor shall coordinate and provide necessary information for the Owner's "Work Place Hazardous Material Information System".

#### **1.44 SCHEDULING OF WORK AND DEMOLITION**

- .1 Refer to Division 1 specifications.

- .2 The contractor shall make a thorough study of the facility site and the affected electrical systems to ensure the method required to maintain all existing building services during the construction period. All changeovers shall be done during off hours, and coordinated with the general contractor and the owner.
- .3 All outages shall be less than eight (8) hours in duration. The contractor shall submit the method and procedure of all changeovers for approval by the Consultant and the Owner a minimum of twenty one (21) working days in advance.
- .4 The existing fire alarm system shall be maintained in a fully operational state while modifications and additions to the system are installed.
- .5 All fire alarm outages shall be carried out at dates and times approved by the Owner. Provide at least three (3) weeks advance notice to the Owner for approval.
- .6 All salvaged materials shall remain the property of the Owner, unless otherwise noted, and shall be stockpiled as per the Owner's instructions.
- .7 Refer to the overall project schedule for further scheduling requirements.

**Part 2 Products**

**2.1 NOT USED**

- .1 Not Used.

**Part 3 Execution**

**3.1 NOT USED**

- .1 Not Used.

**END OF SECTION**

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**Part 1            General**

**1.1                GENERAL REQUIREMENTS**

- .1        The General Conditions of Contract, Division 01 General Requirements and all Addenda thereto form an integral part of and must be read in conjunction with the requirements of this Section.
- .2        Cooperate and coordinate with the requirements of other units of work specified in other Sections.

**1.2                REFERENCES**

- .1        The Electrical Contractor shall be bound by industry standards, as interpreted by the Consultant, whether or not specifically referenced in this document. Comply with Electrical Protection Act and rules and regulations made pursuant thereto, including the Canadian Electrical Code. Also, comply with applicable standards of the following:
  - .1        CSA C22.1-2015, Canadian Electrical Code, Part 1.
  - .2        Electrical and Electronic Manufacturers Association of Canada (EEMAC).
  - .3        National Electrical Manufacturers Association (NEMA).
  - .4        National Building Code 2010 (NBC 2010)
  - .5        National Fire Protection Association (NFPA)
  - .6        Institute of Electrical and Electronic Engineers (IEEE).
  - .7        Audio Engineering Society (AES).
  - .8        Other Applicable CSA and UL approvals.

**1.3                SHOP DRAWINGS AND PRODUCT DATA**

- .1        Submit shop drawings in accordance with:
  - .1        Section 01 33 00 - Submittal Procedures
  - .2        26 05 01 – Common Work Results
- .2        Shop drawings shall include but not be limited to device types, cable types, and special mounting details.

**1.2                WASTE MANAGEMENT AND DISPOSAL**

- .1        Meet requirements of Section 01 74 19 - Waste Management and Disposal.
- .2        Collect and separate waste for reuse, recycling, and other waste diversion strategies in accordance with Waste Management Plan.

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**Part 2**      **Products**

**2.1**      **MATERIALS**

- .1      Pressure type wire connectors: with current carrying parts of copper sized to fit copper conductors as required.
- .2      Fixture type splicing connectors: with current carrying parts of copper sized to fit copper conductors #10 AWG or less.
- .3      Bushing stud connectors: to EEMAC 1Y-2 to consist of:
  - .1      Connector body and stud clamp for round copper conductors.
  - .2      Clamp for round copper conductors.
  - .3      Stud clamp bolts.
  - .4      Sized for conductors as indicated.
- .4      Clamps or connectors for armoured cable, aluminum sheathed cable, mineral insulated cable, flexible conduit, non-metallic sheathed cable as required.

**Part 3**      **Execution**

**3.1**      **INSTALLATION**

- .1      Remove insulation carefully from ends of conductors and:
  - .1      Apply coat of zinc joint compound on aluminum conductors prior to installation of connectors.
  - .2      Install mechanical pressure type connectors and tighten screws with appropriate compression tool recommended by manufacturer. Installation shall meet secureness tests in accordance with CSA C22.2No.65.
  - .3      Install fixture type connectors and tighten. Replace insulating cap.
  - .4      Install bushing stud connectors in accordance with NEMA.

**END OF SECTION**

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**Part 1            General**

**1.1                GENERAL REQUIREMENTS**

- .1        The General Conditions of Contract, Division 01 General Requirements and all Addenda thereto form an integral part of and must be read in conjunction with the requirements of this Section.
- .2        Cooperate and coordinate with the requirements of other units of work specified in other Sections.

**1.2                REFERENCES**

- .1        The Electrical Contractor shall be bound by industry standards, as interpreted by the Consultant, whether or not specifically referenced in this document. Comply with Electrical Protection Act and rules and regulations made pursuant thereto, including the Canadian Electrical Code. Also, comply with applicable standards of the following:
  - .1        CSA C22.1-2015, Canadian Electrical Code, Part 1.
  - .2        Electrical and Electronic Manufacturers Association of Canada (EEMAC).
  - .3        National Electrical Manufacturers Association (NEMA).
  - .4        National Building Code 2010 (NBC 2010)
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  - .8        Other Applicable CSA and UL approvals.

**1.3                SHOP DRAWINGS AND PRODUCT DATA**

- .1        Submit shop drawings in accordance with:
  - .1        Section 01 33 00 - Submittal Procedures
  - .2        26 05 01 – Common Work Results
- .2        Shop drawings shall include but not be limited to speakers, riser diagram, cable types, and special mounting details.

**1.4                PRODUCT APPROVALS**

- .1        Manufacturers' and model numbers named in these specifications indicate an acceptable technical standard of performance and are not intended to be exclusive. Products submitted as alternates must result in a control system that meets or exceeds all technical performance criteria as described.
- .2        Products proposed as alternatives to those specified, shall only be considered if submitted for approval no later than 15 working days before tender close. Submit alternates, for approval,

as one complete listing. Provide complete product specification sheets with request for approval.

- .3 The Bidder must provide a complete list of primary system products offered with their bid.

## **1.5 WASTE MANAGEMENT AND DISPOSAL**

- .1 Meet requirements of Section 01 74 19 - Waste Management and Disposal.
- .2 Collect and separate waste for reuse, recycling, and other waste diversion strategies in accordance with Waste Management Plan.

## **Part 2 Products**

### **2.1 BUILDING WIRES**

- .1 All conductors shall be copper, minimum No. 12 gauge, unless specifically noted otherwise.
- .2 All conductors # 12 AWG to # 8 AWG shall be rated for minimum 600V RW-90 XLPE. Conductors # 6 AWG and larger shall be rated for minimum 1000V RW-90 XLPE. All conductor for motor feeds from variable frequency drives, shall be rated for minimum 1000V RW-90 XLPE. Wiring in channel back of fluorescent fixtures shall be 600 volt Type GTF or TEW. Size, grade of insulation, voltage and manufacturer's name shall be marked at regular intervals.
- .3 Wiring for major feeders may be NUAL aluminum and shall be installed only where specifically noted on the drawings.
- .4 Conductor utilized in conduit run under slab on grade or in conduit underground shall be Type 'RWU-90'.
- .5 Wire shall be as manufactured by Nexans, Alcan, Pirelli, BICC General Wire or Superior Essex.

### **2.2 TECK CABLE**

- .1 Cable: to CAN/CSA-C22.2 No. 131.
- .2 Conductors:
  - .1 Grounding conductor: copper.
  - .2 Circuit conductors: copper, size as indicated.
- .3 Insulation:
  - .1 Chemically cross-linked thermosetting polyethylene rated type RW90, 600V to 1000V as noted above.
- .4 Fastenings:

- .1 One hole steel straps to secure surface cables 50 mm and smaller. Two hole steel straps for cables larger than 50 mm.
- .2 Channel type supports for two or more cables.
- .3 Threaded rods: 6 mm dia. to support suspended channels.
- .5 Connectors:
  - .1 Watertight approved for TECK cable.

### **Part 3 Execution**

#### **3.1 CLOSEOUT SUBMITTALS**

- .1 Provide operation and maintenance information for the Intercom system for incorporation into manual specified in:
  - .1 Section 01 78 00 - Closeout Submittals
- .2 Include:
  - .1 Manufacture description sheet on each cable type

#### **3.2 INSTALLATION OF BUILDING WIRES**

- .1 Termination for #8 AWG and larger shall be by means of approved solderless connector lug. For parallel conductors, a common lug with separate termination for each conductor shall be employed.
- .2 Conductor splices shall be made in accordance with specifications. Provide sufficient length for joint remake, and no less than 200 mm spare length. On through wiring, leave 300 mm loop.
- .3 Wiring in cabinets, pull boxes, panels and junction boxes shall be neatly trained and held with nylon cable ties.
- .4 Conductors shall be tag identified where passing through junction boxes.

#### **3.3 INSTALLATION OF TECK CABLE 0 -1000 V**

- .1 Install cables.
  - .1 Group cables wherever possible on channels.
- .2 Terminate cables in accordance with Section 26 05 20- Wire and Box Connectors - 0-1000V.
- .3 All cables shall be terminated and spliced with suitable compression type connectors, as recommended by the cable manufacturer. The connectors shall satisfy the bonding and grounding requirements at the supply end.
- .4 All cables shall be single conductor and copper, unless otherwise specified.



- .5 All cable shall be rated for 1000 volts, insulated with cross-linked polyethylene and rated for operation at 90 degrees C. Cable shall have a FT4 rated outer jacket.
- .6 All cable shall meet the CSA requirements for cold bend and impact testing at minus 40 degrees C.
- .7 All cable shall be protected by a corrugated aluminum sheath or by interlocked aluminum armour. PVC jackets shall be required on all metallic sheathed cables.
- .8 The jackets shall meet the FT4 flame spread requirements and be identified on the P.V.C. jacket.
- .9 All cables shall be installed in accordance with the manufacturers recommendations, in suitable cable tray as specified within the specifications.
- .10 The cables shall be terminated at the supply end on a non-ferrous metallic plate and at the load end on a non-metallic rigid fibre board plate. The cable sheaths shall be bonded at the supply end only.
- .11 All cable installed in cable tray shall be installed at one diameter spacing.
- .12 When single conductor cables are direct earth buried they shall be spaced 150 mm apart.
- .13 Cables shall be manufactured by Nexans, Alcan, Superior Essex, General Wire or Pirelli.

### **3.4 INSTALLATION OF ARMOURED CABLES**

- .1 Group cables wherever possible.
- .2 Terminate cables in accordance with Section 26 05 20 - Wire and Box Connectors 0-1000 V.
- .3 Conductors: insulated, copper, size as indicated.
- .4 Type: AC90 - Armour: interlocking type fabricated from aluminum strip.
- .5 Type: ACWU90 - jacket over armour meeting requirements of Vertical Tray Fire Test of CSA C22.2 No. 0.3 with maximum flame travel of 1.2 m.
- .6 Connectors: as required.
- .7 Armoured cable shall be installed only where noted on plans.
- .8 Multi conductor cables shall be color coded during manufacture. Single conductor cables shall be color coded with adhesive colour coding tape. The tape shall be applied for a minimum of 75 mm at all terminations. Cables shall not be painted under any condition. Color coding shall be as follows:

Phase 'A' - Red

Neutral - White

Phase 'B' - Black

Ground - Green or Bare

Phase 'C' - Blue

**END OF SECTION**

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**Part 1            General**

**1.1                GENERAL REQUIREMENTS**

- .1        The General Conditions of Contract, Division 01 General Requirements and all Addenda thereto form an integral part of and must be read in conjunction with the requirements of this Section.
- .2        Cooperate and coordinate with the requirements of other units of work specified in other Sections.

**1.2                REFERENCES**

- .1        The Electrical Contractor shall be bound by industry standards, as interpreted by the Consultant, whether or not specifically referenced in this document. Comply with Electrical Protection Act and rules and regulations made pursuant thereto, including the 2012 Canadian Electrical Code. Also, comply with applicable standards of the following:
  - .1        CSA C22.1-2015, Canadian Electrical Code, Part 1.
  - .2        Electrical and Electronic Manufacturers Association of Canada (EEMAC).
  - .3        National Electrical Manufacturers Association (NEMA).
  - .4        National Building Code 2010 (NBC 2010)
  - .5        National Fire Protection Association (NFPA)
  - .6        Institute of Electrical and Electronic Engineers (IEEE).
  - .7        Audio Engineering Society (AES).
  - .8        Other Applicable CSA and UL approvals.

**1.3                SHOP DRAWINGS AND PRODUCT DATA**

- .1        Submit shop drawings in accordance with:
  - .1        Section 01 33 00 - Submittal Procedures
  - .2        Section 26 05 01 – Common Work Results
- .2        Shop drawings shall include but not be limited to connectors used, specialty ground bars, etc.

**1.4                PRODUCT APPROVALS**

- .1        Manufacturers' and model numbers named in these specifications indicate an acceptable technical standard of performance and are not intended to be exclusive. Products submitted as alternates must result in a control system that meets or exceeds all technical performance criteria as described.
- .2        Products proposed as alternatives to those specified, shall only be considered if submitted for approval no later than 15 working days before tender close. Submit alternates, for approval, as one complete listing. Provide complete product specification sheets with request for approval.

- .3 The Bidder must provide a complete list of primary system products offered with their bid.

## **1.5 WASTE MANAGEMENT AND DISPOSAL**

- .1 Meet requirements of Section 01 74 19 - Waste Management and Disposal.
- .2 Collect and separate waste for reuse, recycling, and other waste diversion strategies in accordance with Waste Management Plan.

## **Part 2 Products**

### **2.1 EQUIPMENT**

- .1 Clamps for grounding of conductor: size as required to electrically conductive underground water pipe.
- .2 All ground rods shall be 20 mm diameter by 3000 mm long, copper clad.
- .3 Grounding conductors: bare stranded copper.
- .4 Insulated grounding conductors: green
- .5 Ground bus: copper, complete with insulated supports, fastenings, connectors.
- .6 Non-corroding accessories necessary for grounding system, type, size, material as indicated, including but not necessarily limited to:
- .1 Grounding and bonding bushings.
  - .2 Protective type clamps.
  - .3 Bolted type conductor connectors.
  - .4 Thermit welded type conductor connectors.
  - .5 Bonding jumpers, straps.
  - .6 Pressure wire connectors.
- .7 All ground conductors shall be bare or insulated, stranded, medium hard drawn copper wire. All insulated ground wires shall be green.
- .8 Exposed copper shall be cleaned to a bright surface, and shall be finished with two coats of clean, insulating varnish.
- .9 Connect ground conductor to copper water pipe at least twice (minimum 40 mm diameter), utilizing a Burndy Type GAR pipe clamp. Provide jumper across water meter.
- .10 All connections to the ground bus or risers shall be thermowelded, or shall utilize the Burndy Hy-Ground compression connections. Clamp type connections shall only be allowed to individual pieces of equipment.

- .11 Where bonds are covered with soil, the conductors are to be coated with anti-corrosion compound "Kopr-Shield" (Thomas & Betts Co.) before compression connector is applied. All bonding shall be done with 'C' tap and lug compression connectors.

### **Part 3 Execution**

#### **3.1 INSTALLATION GENERAL**

- .1 Electrical equipment and wiring shall be grounded in accordance with the Canadian Electrical Code, and local inspection authority's rules and regulations.
- .2 All metallic raceways and conduits for communications, cable and conductors shall be grounded.
- .3 All motors with flexible connections shall have separate ground wire run bridging the flexible connections. This ground wire shall be run from the motor back to the nearest junction box or motor control centre where the termination can be readily inspected. Insulation for this wire shall be green.
- .4 Lay-in trays and feeder conduits shall be connected to the ground bus.
- .5 All panel feeds at 208 volt shall include a building network ground conductor.
- .6 All grounding conductors outside the electrical rooms and closets shall be insulated and installed in conduits, unless otherwise noted.
- .7 Install connectors in accordance with manufacturer's instructions.
- .8 Protect exposed grounding conductors from mechanical injury.
- .9 Use mechanical connectors for grounding connections to equipment provided with lugs.
- .10 Install bonding wire for flexible conduit, connected at both ends to grounding bushing, solderless lug, clamp or cup washer and screw. Neatly cleat bonding wire to exterior of flexible conduit.
- .11 Install flexible ground straps for bus duct enclosure joints, where such bonding is not inherently provided with equipment.
- .12 Structural steel and metal siding to ground by welding copper to steel.
- .13 Make grounding connections in radial configuration only, with connections terminating at single grounding point. Avoid loop connections unless indicated otherwise.
- .14 Use mechanical connectors for grounding connections to equipment provided with lugs.
- .15 Soldered joints not permitted.
- .16 Install separate ground conductor to outdoor lighting standards.
- .17 Make grounding connections in radial configuration only. Avoid loop connections.

- .18 Bond single conductor, metallic armored cables to cabinet at supply end, and provide non-metallic entry plate at load end.
- .19 All 120/208 volt and 347/600 volt wiring shall be run in rigid conduit, or may be run in EMT if a separate ground wire is run from the panel or switch to each piece of equipment. The ground conductor shall be connected to the housing of each piece of equipment and the outlet box. Where rigid conduit is employed, all terminations of these conduit runs are to be with double locknuts, grounding bushings with jumper wires run between the bushing lug and the box or panel enclosure. Care shall be taken in conduit runs to ensure that all rigid pipe couplings and fittings are wrench tight. Raceways and conduits shall not be used as bonds.

### **3.2 SYSTEM AND CIRCUIT GROUNDING**

- .1 Install system and circuit grounding connections to neutral of secondary systems.

### **3.3 EQUIPMENT GROUNDING**

- .1 Install grounding connections to typical equipment included in, but not necessarily limited to following list. Service equipment, duct systems, frames of motors, starters, control panels, structure steel work, and distribution panels.

### **3.4 COMMUNICATION SYSTEMS**

- .1 Install grounding connections for all communication and security systems as per manufacturer's recommendations

### **3.5 FIELD QUALITY CONTROL**

- .1 Perform tests in accordance with Section 26 05 01 - Common Work Results - Electrical.
- .2 Perform tests before energizing electrical system.
- .3 Disconnect ground fault indicator during tests.
- .4 All grounding conductors outside the electrical rooms and closets shall be insulated and installed in conduits, unless otherwise noted.
- .5 Connections to equipment shall be made with, bronze or copper bolts and connectors.
- .6 Equipment grounds shall be connected to the building grounding network. All non-current carrying metallic parts of equipment shall be connected to the ground network.

**END OF SECTION**

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**Part 1           General**

**1.1           GENERAL REQUIREMENTS**

- .1       The General Conditions of Contract, Division 01 General Requirements and all Addenda thereto form an integral part of and must be read in conjunction with the requirements of this Section.
- .2       Cooperate and coordinate with the requirements of other units of work specified in other Sections.

**1.2           REFERENCES**

- .1       The Electrical Contractor shall be bound by industry standards, as interpreted by the Consultant, whether or not specifically referenced in this document. Comply with Electrical Protection Act and rules and regulations made pursuant thereto, including the 2012 Canadian Electrical Code. Also, comply with applicable standards of the following:
  - .1       CSA C22.1-2015, Canadian Electrical Code, Part 1.
  - .2       Electrical and Electronic Manufacturers Association of Canada (EEMAC).
  - .3       National Electrical Manufacturers Association (NEMA).
  - .4       National Building Code 2010 (NBC 2010)
  - .5       National Fire Protection Association (NFPA)
  - .6       Institute of Electrical and Electronic Engineers (IEEE).
  - .7       Audio Engineering Society (AES).
  - .8       Other Applicable CSA and UL approvals.

**1.3           SHOP DRAWINGS AND PRODUCT DATA**

- .1       Submit shop drawings in accordance with:
  - .1       Section 01 33 00 - Submittal Procedures
  - .2       Section 26 05 01 – Common Work Results
- .2       Shop drawings shall include but not be limited to speakers, riser diagram, cable types, and special mounting details.

**1.4           PRODUCT APPROVALS**

- .1       Manufacturers' and model numbers named in these specifications indicate an acceptable technical standard of performance and are not intended to be exclusive. Products submitted as alternates must result in a control system that meets or exceeds all technical performance criteria as described.
- .2       Products proposed as alternatives to those specified, shall only be considered if submitted for approval no later than 15 working days before tender close. Submit alternates, for approval, as one complete listing. Provide complete product specification sheets with request for approval.

- .3 The Bidder must provide a complete list of primary system products offered with their bid.

## **1.5 WASTE MANAGEMENT AND DISPOSAL**

- .1 Meet requirements of Section 01 74 19 - Waste Management and Disposal.
- .2 Collect and separate waste for reuse, recycling, and other waste diversion strategies in accordance with Waste Management Plan.

## **Part 2 Products**

### **2.1 SUPPORT CHANNELS**

- .1 U shape, size 41 x 41 mm, 2.5 mm thick, surface mounted suspended or set in poured concrete walls and ceilings.

## **Part 3 Execution**

### **3.1 INSTALLATION**

- .1 Secure equipment to poured concrete with expandable inserts.
- .2 Secure equipment to hollow masonry walls or suspended ceilings with toggle bolts.
- .3 Secure surface mounted equipment with twist clip fasteners to inverted T bar ceilings. Ensure that T bars are adequately supported to carry weight of equipment specified before installation.
- .4 Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.
- .5 Fasten exposed conduit or cables to building construction or support system using straps.
  - .1 One-hole steel straps to secure surface conduits and cables 50 mm and smaller.
  - .2 Two-hole steel straps for conduits and cables larger than 50 mm.
  - .3 Beam clamps to secure conduit to exposed steel work.
- .6 Suspended support systems.
  - .1 Support individual cable or conduit runs with 6 mm dia threaded rods and spring clips.
  - .2 Support 2 or more cables or conduits on channels supported by 6 mm dia threaded rod hangers where direct fastening to building construction is impractical.
- .7 For surface mounting of two or more conduits, use channels spaced as required by C22.1.
- .8 Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.



- .9 Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.
- .10 Do not use wire lashing or perforated strap to support or secure raceways or cables.
- .11 Do not use supports or equipment installed for other trades for conduit or cable support except with permission of other trade and approval of Engineer.
- .12 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer's installation recommendations.

### **3.2 CLOSEOUT SUBMITTALS**

- .1 Provide operation and maintenance information for the Intercom system for incorporation into manual specified in:
  - .1 Section 01 78 00 - Closeout Submittals
- .2 Include:
  - .1 Operation instructions
  - .2 Description of system operation
  - .3 Description of each subsystem operation
  - .4 List specifying each piece of equipment in system or subsystem by its original manufacturer name and model number.
  - .5 Parts list specifying parts used in equipment by identification numbers that are standard to electronic industry.

### **3.3 WARRANTY**

- .1 The contractor must make available to the Owner a local service department of a duly authorized distributor of the equipment manufacturer, which shall stock the manufacturer's standard parts. The service department shall have at least one factory trained repair technician available to the Owner on 24 hours' notice.
- .2 Provide warranty of installation of equipment installed by this contractor to be free of defects for a period of (1) one year from date of Substantial Completion.
- .3 Provide during the warranty period, all service, maintenance, parts, etc., required for normal operation of the systems, such that Owner needs not purchase additional maintenance agreement or contracts. Upon request, the manufacturer and his agent shall provide direct to the Owner the following proposals:
  - .1 Continuation, after the warranty period, of full maintenance, including all service, labour, parts, etc. required to maintain the systems in a fully operational condition.

**END OF SECTION**

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**Part 1            General**

**1.1                GENERAL REQUIREMENTS**

- .1        The General Conditions of Contract, Division 01 General Requirements and all Addenda thereto form an integral part of and must be read in conjunction with the requirements of this Section.
- .2        Cooperate and coordinate with the requirements of other units of work specified in other Sections.

**1.2                REFERENCES**

- .1        The Electrical Contractor shall be bound by industry standards, as interpreted by the Consultant, whether or not specifically referenced in this document. Comply with Electrical Protection Act and rules and regulations made pursuant thereto, including the 2012 Canadian Electrical Code. Also, comply with applicable standards of the following:
  - .1        CSA C22.1-2015, Canadian Electrical Code, Part 1.
  - .2        Electrical and Electronic Manufacturers Association of Canada (EEMAC).
  - .3        National Electrical Manufacturers Association (NEMA).
  - .4        National Building Code 2010 (NBC 2010)
  - .5        National Fire Protection Association (NFPA)
  - .6        Institute of Electrical and Electronic Engineers (IEEE).
  - .7        Audio Engineering Society (AES).
  - .8        Other Applicable CSA and UL approvals.

**1.3                SHOP DRAWINGS AND PRODUCT DATA**

- .1        Submit shop drawings in accordance with:
  - .1        Section 01 33 00 - Submittal Procedures
  - .2        Section 26 05 01 – Common Work Results

**1.4                PRODUCT APPROVALS**

- .1        Manufacturers' and model numbers named in these specifications indicate an acceptable technical standard of performance and are not intended to be exclusive. Products submitted as alternates must result in a control system that meets or exceeds all technical performance criteria as described.
- .2        Products proposed as alternatives to those specified, shall only be considered if submitted for approval no later than 15 working days before tender close. Submit alternates, for approval, as one complete listing. Provide complete product specification sheets with request for approval.
- .3        The Bidder must provide a complete list of primary system products offered with their bid.

## **1.5 WASTE MANAGEMENT AND DISPOSAL**

- .1 Meet requirements of Section 01 74 19 - Waste Management and Disposal.
- .2 Collect and separate waste for reuse, recycling, and other waste diversion strategies in accordance with Waste Management Plan.

## **Part 2 Products**

### **2.1 SPLITTERS**

- .1 Sheet metal enclosure, welded corners and formed hinged cover suitable for locking in closed position.
- .2 Main and branch lugs to match required size and number of incoming and outgoing conductors as indicated.
- .3 At least three spare terminals on each set of lugs in splitters.

### **2.2 JUNCTION AND PULL BOXES**

- .1 Welded steel construction with screw-on flat covers for surface mounting.
- .2 Covers with 25 mm minimum extension all around, for flush-mounted pull and junction boxes.

### **2.3 CABINETS**

- .1 Sheet steel, hinged door and return flange overlapping sides, handle, lock and catch, for surface mounting.

## **Part 3 Execution**

### **3.1 CLOSEOUT SUBMITTALS**

- .1 Provide operation and maintenance information for incorporation into manual specified in:
  - .1 Section 01 78 00 - Closeout Submittals
- .2 Include:
  - .1 List specifying each piece of equipment in system or subsystem by its original manufacturer name and model number.
  - .2 Parts list specifying parts used in equipment by identification numbers that are standard to electronic industry.

### **3.2 SPLITTER INSTALLATION**

- .1 Install splitters and mount plumb, true and square to the building lines.
- .2 Extend splitters full length of equipment arrangement except where indicated otherwise.

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**3.3 JUNCTION, PULL BOXES AND CABINETS INSTALLATION**

- .1 Install pull boxes in inconspicuous but accessible locations.
- .2 Mount cabinets with top not higher than 2 m above finished floor.
- .3 Install terminal / bix block where indicated in cabinets.
- .4 Only main junction and pull boxes are indicated. Provide others as required by code. Install pull boxes so as not to exceed 30m of conduit run between pull boxes.

**3.4 IDENTIFICATION**

- .1 Provide equipment identification in accordance with Section 26 05 01 - Common Work Results - Electrical.
- .2 Install size 2 identification labels indicating system name, voltage and phase, Emergency, or Normal power.

**3.5 WARRANTY**

- .1 The contractor must make available to the Owner a local service department of a duly authorized distributor of the equipment manufacturer, which shall stock the manufacturer's standard parts. The service department shall have at least one factory trained repair technician available to the Owner on 24 hours' notice.
- .2 Provide warranty of installation of equipment installed by this contractor to be free of defects for a period of (1) one year from date of Substantial Completion.
- .3 Provide during the warranty period, all service, maintenance, parts, etc., required for normal operation of the systems, such that Owner needs not purchase additional maintenance agreement or contracts. Upon request, the manufacturer and his agent shall provide direct to the Owner the following proposals:
  - .1 Continuation, after the warranty period, of full maintenance, including all service, labour, parts, etc. required to maintain the systems in a fully operational condition.
- .4 During the warranty period, provide three (3) separate site visits of four (4) hours each on site for owner revisions and additional training.

**END OF SECTION**

**Part 1 General**

**1.1 GENERAL REQUIREMENTS**

- .1 The General Conditions of Contract, Division 01 General Requirements and all Addenda thereto form an integral part of and must be read in conjunction with the requirements of this Section.
- .2 Cooperate and coordinate with the requirements of other units of work specified in other Sections.

**1.2 REFERENCES**

- .1 The Electrical Contractor shall be bound by industry standards, as interpreted by the Consultant, whether or not specifically referenced in this document. Comply with Electrical Protection Act and rules and regulations made pursuant thereto, including the 2012 Canadian Electrical Code. Also, comply with applicable standards of the following:
  - .1 CSA C22.1-2015, Canadian Electrical Code, Part 1.
  - .2 Electrical and Electronic Manufacturers Association of Canada (EEMAC).
  - .3 National Electrical Manufacturers Association (NEMA).
  - .4 National Building Code 2010 (NBC 2010)
  - .5 National Fire Protection Association (NFPA)
  - .6 Institute of Electrical and Electronic Engineers (IEEE).
  - .7 Audio Engineering Society (AES).
  - .8 Other Applicable CSA and UL approvals.

**1.3 SHOP DRAWINGS AND PRODUCT DATA**

- .1 Submit shop drawings in accordance with:
  - .1 Section 01 33 00 - Submittal Procedures
  - .2 Section 26 05 01 – Common Work Results
- .2 Shop drawings shall include but not be limited to speakers, riser diagram, cable types, and special mounting details.

**1.4 PRODUCT APPROVALS**

- .1 Manufacturers' and model numbers named in these specifications indicate an acceptable technical standard of performance and are not intended to be exclusive. Products submitted as alternates must result in a control system that meets or exceeds all technical performance criteria as described.
- .2 Products proposed as alternatives to those specified, shall only be considered if submitted for approval no later than 15 working days before tender close. Submit alternates, for approval, as one complete listing. Provide complete product specification sheets with request for approval.

- .3 The Bidder must provide a complete list of primary system products offered with their bid.

## **1.5 WASTE MANAGEMENT AND DISPOSAL**

- .1 Meet requirements of Section 01 74 19 - Waste Management and Disposal.
- .2 Collect and separate waste for reuse, recycling, and other waste diversion strategies in accordance with Waste Management Plan.

## **Part 2 Products**

### **2.1 OUTLET AND CONDUIT BOXES GENERAL**

- .1 Size boxes in accordance with CSA C22.1.
- .2 102 mm square or larger outlet boxes as required for special devices.
- .3 Gang boxes where wiring devices are grouped.
- .4 Provide blank cover plates for boxes without wiring devices.
- .5 Provide combination boxes with barriers where outlets for more than one system are grouped.
- .6 Each outlet box installed in steel stud and gyproc walls shall be mounted on Caddy #BHA, series SGB or TSGB screw gun brackets. Wood strapping with steel studs shall not be utilized for supporting outlet boxes
- .7 Use condulets where 90° turn required on wall mounted conduit. They shall be of the type where cover screws do not enter the wire chamber and covers are left accessible.
- .8 Each outlet box installed in acoustic tile ceilings shall be mounted on double Caddy "Tee Bar Hanger" #512 in such a manner that the outlet box will not twist in any direction.
- .9 Where boxes are surface mounted in unfinished areas, such as furnace or boiler rooms, stamped galvanized steel 100 mm square box to accept #8300 series raised covers shall be used.
- .10 Where surface wiring methods are allowed and approved in finished areas, use Hubbell or Wiremold boxes as per drawings c/w suitable adapter for wireway entrance.
- .11 Outdoors or damp locations, boxes shall be cast Feraloy or aluminum type 'FS', with threaded hubs and vapourproof covers.
- .12 Indoors, stamped zinc cadmium plated steel boxes shall be provided and set for each fixture, switch, wall receptacle or other types of outlets, adapted to suit its respective location and designed to accept its particular components.
- .13 Standard octagon boxes shall be 100 mm diameter, 53 mm deep minimum. Increase depth where area fill requires. Equip each box used for fixture hanging with a fixture stud.
- .14 Two gang or larger shall be solid type with raised cover for tile, block or gyproc finish.

- .15 Wood strapping with steel studs shall not be utilized for supporting outlet boxes.
- .16 Set boxes plumb and level within 6 mm of finished surface. Mats not permitted.
- .17 Where required, provide voltage separation barriers.

## **2.2 SHEET STEEL OUTLET BOXES**

- .1 Electro-galvanized steel multi-gang flush device boxes for flush installation, minimum size 76 x 50 x 38 mm or as indicated. 102 mm square outlet boxes when more than one conduit enters one side with extension and plaster rings as required.
- .2 Standard octagon boxes shall be 100 mm diameter, 53 mm deep minimum. Increase depth where area fill requires. Equip each box used for fixture hanging with a fixture stud.
- .3 102 mm square outlet boxes with extension and plaster rings for flush mounting devices in finished walls.
- .4 102 mm square or octagonal outlet boxes for lighting fixture outlets.
- .5 102 mm square outlet boxes with extension and plaster rings for flush mounting devices in finished plaster walls.

## **2.3 MASONRY BOXES**

- .1 Electro-galvanized steel masonry single and multi-gang boxes for devices flush mounted in exposed block walls.

## **2.4 CONCRETE BOXES**

- .1 Electro-galvanized sheet steel concrete type boxes for flush mount in concrete with matching extension and plaster rings as required.

## **2.5 CONDUIT BOXES**

- .1 Outdoors or damp locations, boxes shall be cast Feraloy or aluminum type 'FS', with threaded hubs and vapourproof covers.
- .2 Indoors, stamped zinc cadmium plated steel boxes shall be provided and set for each fixture, switch, wall receptacle or other types of outlets, adapted to suit its respective location and designed to accept its particular components.
- .3 Standard octagon boxes shall be 100 mm diameter, 53 mm deep minimum. Increase depth where area fill requires. Equip each box used for fixture hanging with a fixture stud.
- .4 Two gang or larger shall be solid type with raised cover for tile, block or gyproc finish.
- .5 Wood strapping with steel studs shall not be utilized for supporting outlet boxes.
- .6 Set boxes plumb and level within 6 mm of finished surface. Mats not permitted.
- .7 Where required, provide voltage separation barriers.

## **2.6 FITTINGS - GENERAL**

- .1 Bushing and connectors with nylon insulated throats.
- .2 Knock-out fillers to prevent entry of debris.
- .3 Conduit outlet bodies for conduit up to 32 mm and pull boxes for larger conduits.
- .4 Double locknuts and insulated bushings on sheet metal boxes.

## **Part 3 Execution**

### **3.1 INSTALLATION**

- .1 Support boxes independently of connecting conduits.
- .2 Fill boxes with paper, sponges or foam or similar approved material to prevent entry of debris during construction. Remove upon completion of work.
- .3 For flush installations mount outlets flush with finished wall using plaster rings to permit wall finish to come within 6 mm of opening.
- .4 Provide correct size of openings in boxes for conduit, mineral insulated and armoured cable connections. Reducing washers are not allowed.
- .5 Outlet boxes shall be supported independently of conduit capable of supporting weight of fixture or other device. Conduit entering the back of a box shall not enter the centre knockout.
- .6 For recessed fixtures in suspended ceilings, outlet box shall be accessible when fixture is removed.
- .7 Flexible conduit to fixture shall be minimum 12 mm diameter, and shall not emanate from outlet box cover. Maximum length of flexible conduit from outlet box to fixture shall be 3000 mm. Outlet box for fixture shall not be located above ducts, pipes, etc. Outlet box shall be within 750 mm (vertically) of the fixture.
- .8 Provide and set all special communications type back boxes associated with systems specified under Electrical Divisions.
- .9 In placing outlets, allow for overhead pipes, ducts, etc., and for variation in wall and ceiling finishes, door and window trim, panelling, etc.
- .10 Location of receptacle outlets in equipment rooms shall be finalized during construction to give optimum arrangement. Consultant to approve locations before installation.
- .11 Multigang boxes for use with 347 volt switches shall have each gang fully barriered from the next, or multiple single gang boxes may be used, provided they are installed in a neat, orderly fashion. Barriers shall be steel and shall be firmly held in place.

Attention is directed to special outlet box locations for 347 volt switches requiring wider mount spacing rejection feature.



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**3.2 CLOSEOUT SUBMITTALS**

- .1 Provide operation and maintenance information for incorporation into manual specified in:
  - .1 Section 01 78 00 - Closeout Submittals
- .2 Include:
  - .1 Operation instructions
  - .2 Description of system operation
  - .3 Description of each subsystem operation
  - .4 List specifying each piece of equipment in system or subsystem by its original manufacturer name and model number.
  - .5 Parts list specifying parts used in equipment by identification numbers that are standard to electronic industry.

**3.3 WARRANTY**

- .1 The contractor must make available to the Owner a local service department of a duly authorized distributor of the equipment manufacturer, which shall stock the manufacturer's standard parts. The service department shall have at least one factory trained repair technician available to the Owner on 24 hours' notice.
- .2 Provide warranty of installation of equipment installed by this contractor to be free of defects for a period of (1) one year from date of Substantial Completion.
- .3 Provide during the warranty period, all service, maintenance, parts, etc., required for normal operation of the systems, such that Owner needs not purchase additional maintenance agreement or contracts. Upon request, the manufacturer and his agent shall provide direct to the Owner the following proposals:
  - .1 Continuation, after the warranty period, of full maintenance, including all service, labour, parts, etc. required to maintain the systems in a fully operational condition.

**END OF SECTION**

---

**Part 1            General**

**1.1                GENERAL REQUIREMENTS**

- .1        The General Conditions of Contract, Division 01 General Requirements and all Addenda thereto form an integral part of and must be read in conjunction with the requirements of this Section.
- .2        Cooperate and coordinate with the requirements of other units of work specified in other Sections.

**1.2                REFERENCES**

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  - .2        Electrical and Electronic Manufacturers Association of Canada (EEMAC).
  - .3        National Electrical Manufacturers Association (NEMA).
  - .4        National Building Code 2010 (NBC 2010)
  - .5        National Fire Protection Association (NFPA)
  - .6        Institute of Electrical and Electronic Engineers (IEEE).
  - .7        Audio Engineering Society (AES).
  - .8        Other Applicable CSA and UL approvals.

**1.3                SHOP DRAWINGS AND PRODUCT DATA**

- .1        Submit shop drawings in accordance with:
  - .1        Section 01 33 00 - Submittal Procedures
  - .2        Section 26 05 01 – Common Work Results
- .2        Shop drawings shall include but not be limited to speakers, riser diagram, cable types, and special mounting details.

**1.4                PRODUCT APPROVALS**

- .1        Manufacturers' and model numbers named in these specifications indicate an acceptable technical standard of performance and are not intended to be exclusive. Products submitted as alternates must result in a control system that meets or exceeds all technical performance criteria as described.
- .2        Products proposed as alternatives to those specified, shall only be considered if submitted for approval no later than 15 working days before tender close. Submit alternates, for approval,

as one complete listing. Provide complete product specification sheets with request for approval.

- .3 The Bidder must provide a complete list of primary system products offered with their bid.

## **1.5 WASTE MANAGEMENT AND DISPOSAL**

- .1 Meet requirements of Section 01 74 19 - Waste Management and Disposal.
- .2 Collect and separate waste for reuse, recycling, and other waste diversion strategies in accordance with Waste Management Plan.

## **Part 2 Products**

### **2.1 CONDUITS**

- .1 Electrical metallic tubing (EMT): to CSA C22.2 No. 83, with couplings.
- .2 Rigid PVC conduit: to CSA C22.2 No. 211.2.
- .3 Flexible metal conduit: to CSA C22.2 No. 56, liquid-tight flexible metal.
- .4 Flexible PVC conduit: to CAN/CSA-C22.2 No. 227.3
- .5 Conduit for use in corrosive atmospheres shall be rigid PVC or rigid steel with extruded PVC jacketed. Refer to drawings for areas requiring PVC.
- .6 Condulets shall be of a type wherein cover screws do not enter the wire chamber.
- .7 Flexible conduit connections to all mechanical equipment shall be of 'Sealtite' manufacture.
- .8 Flexible conduit connectors shall be of the insulated throat type.
- .9 Condulets with suitable covers shall be used where condulets are exposed. Each conduit fitting shall be of a type suitable to its particular use, and of a type which will allow installation of future conduits without blocking covers of existing condulets.
- .10 Expansion joints shall be installed with ground jumper.
- .11 All conduits shall be terminated with a suitable bushing.
- .12 Flexible conduit and Rigid conduit entering boxes or enclosures shall be terminated with nylon insulated steel threaded bushings, grounded type.

### **2.2 CONDUIT FASTENINGS**

- .1 One hole steel straps to secure surface conduits 50 mm and smaller. Two hole steel straps for conduits larger than 50 mm.
- .2 Beam clamps to secure conduits to exposed steel work.

- .3 Channel type supports for two or more conduits at 1.5 m oc.
- .4 Threaded rods, 6 mm dia., to support suspended channels.

### **2.3 CONDUIT FITTINGS**

- .1 Fittings: manufactured for use with conduit / raceway specified. Coating: same as conduit / raceway.
- .2 Factory "ells" where 90° bends are required for 25 mm and larger conduits / raceways.

### **2.4 EXPANSION FITTINGS FOR RIGID CONDUIT**

- .1 Weatherproof expansion fittings with internal bonding assembly suitable for 100 mm linear expansion.
- .2 Watertight expansion fittings with integral bonding jumper suitable for linear expansion and 19 mm deflection in all directions.
- .3 Weatherproof expansion fittings for linear expansion at entry to panel.

### **2.5 FISH CORD**

- .1 Polypropylene.

## **Part 3 Execution**

### **3.1 INSTALLATION**

- .1 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.
- .2 Conduits and cables shall be supported, at regular intervals, with corrosion resisting clamps. Lead anchors or expansion bolts shall be used to attach clamps to masonry walls.
- .3 Conduit and cables shall be installed to avoid proximity to water and heating pipes. They shall not run within 150 mm of such pipes, except where crossings are unavoidable, in which case they shall be kept at least 25 mm from covering of pipe crossed.
- .4 Cap ends of all conduits to prevent entrance of foreign matter during construction. Manufactured caps shall be employed.
- .5 Conduit shall be installed as close to building structure as possible so that where concealed, necessary furring can be kept to a minimum.
- .6 Empty conduits, installed under this Division but in which wiring will be installed by others, shall be swabbed out with "Jet Line" foam packs, and be c/w Polypropylene pull wire or polytwine.
- .7 Conduits shall be installed at right angles or parallel to building lines, accurate in line and level.

- .8 Conduit shall not be bent over sharp objects. Improperly formed bends and running threads will not be accepted. Bends and fittings shall not be used together. Proper supports of manufactured channels shall be provided where exposed conduits and cable runs are grouped.
- .9 Under no condition will EMT be allowed exposed within 1200 mm of floor, outdoors, or in areas where explosive, corrosive or moist atmosphere exists.
- .10 Not more than four (4) 90 degree bends or equivalent offsets will be permitted between pull boxes. When maximum number of bends are used, the total run between pull boxes shall not exceed 18000 mm.
- .11 PVC conduit shall not pass through a fire partition or floor separation. Where it is necessary for PVC conduits to pass through a fire barrier, a transition to rigid steel conduit shall be provided for 2000 mm on either side of the fire barrier.
- .12 Surface mount conduits except where noted otherwise.
- .13 Use rigid PVC conduit in corrosive areas or as indicated on plans.
- .14 Use flexible metal conduit or Teck90 for connection to motors.
- .15 Use liquid tight flexible metal conduit or Teck90 for connection to motors or vibrating equipment in damp, wet or corrosive locations.
- .16 Use explosion proof flexible connection for connection to explosion proof motors.
- .17 Minimum conduit size for lighting and power circuits: 21 mm.
- .18 Bend conduit cold. Replace conduit if kinked or flattened more than 1/10th of its original diameter. Mechanically bend steel conduit over 19 mm dia.
- .19 Field threads on rigid conduit must be of sufficient length to draw conduits up tight.
- .20 Install pulltwine in all empty conduits / raceways and conduits / raceways that are less than 40% filled.
- .21 Remove and replace blocked conduit sections. Do not use liquids to clean out conduits.
- .22 Dry conduits out before installing wire.
- .23 Conduits/Cabling/raceways are not to be run within concrete floors/ceilings. Any conduits/cabling/raceways required to be run along the concrete slabs shall be surface run and not recessed into the concrete. Any instances where cabling is required to be run vertically within concrete poured walls, coreline may be used as the raceway but it shall be transitioned to EMT or Rigid Steel (where required) with interfacing connectors or junction boxes being provided as required. This specification contains references to cast in place conduits. This is only applicable where specifically called for in certain locations within the documents.

### **3.2 SURFACE CONDUITS**

- .1 Run parallel or perpendicular to building lines.
- .2 Locate conduits behind infrared or gas fired heaters with 1.5 m clearance.

- .3 Run conduits in flanged portion of structural steel.
- .4 Group conduits wherever possible on surface channels.
- .5 Do not pass conduits through structural members except as indicated.
- .6 Do not locate conduits less than 75 mm parallel to steam or hot water lines with minimum of 25 mm at crossovers.

### **3.3 CONCEALED CONDUITS**

- .1 Run parallel or perpendicular to building lines.
- .2 Do not install horizontal runs in walls.
- .3 Do not install conduits in terrazzo or concrete toppings.

### **3.4 CONDUITS UNDERGROUND**

- .1 Slope conduits to provide drainage.
- .2 Waterproof joints (pvc excepted) with heavy coat of bituminous paint.

### **3.5 CLOSEOUT SUBMITTALS**

- .1 Provide operation and maintenance information for incorporation into manual specified in:
  - .1 Section 01 78 00 - Closeout Submittals
- .2 Include:
  - .1 List specifying each piece of equipment in system or subsystem by its original manufacturer name and model number.
  - .2 Parts list specifying parts used in equipment by identification numbers that are standard to electronic industry.

### **3.6 WARRANTY**

- .1 The contractor must make available to the Owner a local service department of a duly authorized distributor of the equipment manufacturer, which shall stock the manufacturer's standard parts. The service department shall have at least one factory trained repair technician available to the Owner on 24 hours' notice.
- .2 Provide warranty of installation of equipment installed by this contractor to be free of defects for a period of (1) one year from date of Substantial Completion.
- .3 Provide during the warranty period, all service, maintenance, parts, etc., required for normal operation of the systems, such that Owner needs not purchase additional maintenance agreement or contracts. Upon request, the manufacturer and his agent shall provide direct to the Owner the following proposals:

- .1 Continuation, after the warranty period, of full maintenance, including all service, labour, parts, etc. required to maintain the systems in a fully operational condition.

**END OF SECTION**

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**Part 1            General**

**1.1                GENERAL REQUIREMENTS**

- .1        The General Conditions of Contract, Division 01 General Requirements and all Addenda thereto form an integral part of and must be read in conjunction with the requirements of this Section.
- .2        Cooperate and coordinate with the requirements of other units of work specified in other Sections.

**1.2                REFERENCES**

- .1        The Electrical Contractor shall be bound by industry standards, as interpreted by the Consultant, whether or not specifically referenced in this document. Comply with Electrical Protection Act and rules and regulations made pursuant thereto, including the 2012 Canadian Electrical Code. Also, comply with applicable standards of the following:
  - .1        CSA C22.1-2015, Canadian Electrical Code, Part 1.
  - .2        CSAC22.2No.26, Construction and Test of Wireways, Auxiliary Gutters and Associated Fittings.
  - .3        Electrical and Electronic Manufacturers Association of Canada (EEMAC).
  - .4        National Electrical Manufacturers Association (NEMA).
  - .5        National Building Code 2010 (NBC 2010)
  - .6        National Fire Protection Association (NFPA)
  - .7        Institute of Electrical and Electronic Engineers (IEEE).
  - .8        Audio Engineering Society (AES).
  - .9        Other Applicable CSA and UL approvals.

**1.3                SHOP DRAWINGS AND PRODUCT DATA**

- .1        Submit shop drawings in accordance with:
  - .1        Section 01 33 00 - Submittal Procedures
  - .2        Section 26 05 01 – Common Work Results

**1.4                PRODUCT APPROVALS**

- .1        Manufacturers' and model numbers named in these specifications indicate an acceptable technical standard of performance and are not intended to be exclusive. Products submitted as alternates must result in a control system that meets or exceeds all technical performance criteria as described.
- .2        Products proposed as alternatives to those specified, shall only be considered if submitted for approval no later than 15 working days before tender close. Submit alternates, for approval,



as one complete listing. Provide complete product specification sheets with request for approval.

- .3 The Bidder must provide a complete list of primary system products offered with their bid.

## **1.5 WASTE MANAGEMENT AND DISPOSAL**

- .1 Meet requirements of Section 01 74 19 - Waste Management and Disposal.
- .2 Collect and separate waste for reuse, recycling, and other waste diversion strategies in accordance with Waste Management Plan.

## **Part 2 Products**

### **2.1 WIREWAYS**

- .1 Wireways and fittings: to CSA C22No.26.
- .2 Sheet steel with hinged cover to give uninterrupted access.
- .3 Finish: baked grey enamel.
- .4 Elbows, tees, couplings and hanger fittings manufactured as accessories to wireway supplied.

## **Part 3 Execution**

### **3.1 INSTALLATION**

- .1 Install wireways and auxiliary gutters.
- .2 Keep number of elbows, offsets, connections to minimum.
- .3 Install supports, elbows, tees, connectors, fittings.
- .4 Install barriers where required.
- .5 Install gutter to full length of equipment.

### **3.2 CLOSEOUT SUBMITTALS**

- .1 Provide operation and maintenance information for incorporation into manual specified in:
  - .1 Section 01 78 00 - Closeout Submittals
- .2 Include:
  - .1 List specifying each piece of equipment in system or subsystem by its original manufacturer name and model number.
  - .2 Parts list specifying parts used in equipment by identification numbers that are standard to electronic industry.

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**3.3 WARRANTY**

- .1 The contractor must make available to the Owner a local service department of a duly authorized distributor of the equipment manufacturer, which shall stock the manufacturer's standard parts. The service department shall have at least one factory trained repair technician available to the Owner on 24 hours' notice.
- .2 Provide warranty of installation of equipment installed by this contractor to be free of defects for a period of (1) one year from date of Substantial Completion.
- .3 Provide during the warranty period, all service, maintenance, parts, etc., required for normal operation of the systems, such that Owner needs not purchase additional maintenance agreement or contracts. Upon request, the manufacturer and his agent shall provide direct to the Owner the following proposals:
  - .1 Continuation, after the warranty period, of full maintenance, including all service, labour, parts, etc. required to maintain the systems in a fully operational condition.

**END OF SECTION**

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**Part 1            General**

**1.1                GENERAL REQUIREMENTS**

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- .2        Cooperate and coordinate with the requirements of other units of work specified in other Sections.

**1.2                REFERENCES**

- .1        The Electrical Contractor shall be bound by industry standards, as interpreted by the Consultant, whether or not specifically referenced in this document. Comply with Electrical Protection Act and rules and regulations made pursuant thereto, including the 2012 Canadian Electrical Code. Also, comply with applicable standards of the following:
  - .1        CSA C22.1-2015, Canadian Electrical Code, Part 1.
  - .2        Electrical and Electronic Manufacturers Association of Canada (EEMAC).
  - .3        National Electrical Manufacturers Association (NEMA).
  - .4        National Building Code 2010 (NBC 2010)
  - .5        National Fire Protection Association (NFPA)
  - .6        Institute of Electrical and Electronic Engineers (IEEE).

**1.3                SHOP DRAWINGS AND PRODUCT DATA**

- .1        Submit shop drawings in accordance with:
  - .1        Section 01 33 00 - Submittal Procedures
  - .2        Section 26 05 01 – Common Work Results
  - .3        Section 26 50 00 - Lighting
- .2        Shop drawings shall include but not be limited to speakers, riser diagram, cable types, and special mounting details.

**1.4                SUBMITTALS**

- .1        Submittals Package: Submit the shop drawings, and the product data specified below at the same time as a package.
- .2        Shop Drawings:
  - .1        Composite wiring and/or schematic diagram of each control circuit as proposed to be installed (standard diagrams will not be accepted).

.2 Scale drawing for each area showing exact location of each low voltage controller and digital switch.

.3 Product Data: Catalog sheets, specifications and installation instructions.

## **1.5 QUALITY ASSURANCE**

.1 Manufacturer: Minimum [10] years experience in manufacture of lighting controls.

## **1.6 PROJECT CONDITIONS**

.1 Do not install equipment until following conditions can be maintained in spaces to receive equipment:

.1 Ambient temperature: 0° to 40° C (32° to 104° F).

.2 Relative humidity: Maximum 90 percent, non-condensing.

## **1.7 SYSTEM DESCRIPTION**

.1 Provide a low voltage lighting control system capable of utilizing digitally addressed lighting fixtures and energizing a single fixture in multiple lighting scenes dependent on user input. User input is controlled through new gun range target control touchscreen.

.2 All components and programming required to allow the target control touchscreen to control the low voltage lighting system shall be included as part of this contract. Proposed system includes ASCII commands sent over RS-232 serial communications to the low voltage lighting system to transfer user commands from touchscreen. Contractor shall coordinate all requirements between low voltage lighting supplier and target control system supplier. It shall be the responsibility of the contractor to ensure that all necessary interconnecting wiring, programming, etc., are provided to result in a fully operational system.

.3 Provide all control panels, communications links, power supplies, and infrastructure for a fully operational low voltage lighting control system as herein specified.

## **1.8 PERFORMANCE PARAMETERS**

.1 The contractor shall be responsible to provide a low voltage lighting system capable of producing lighting scenes and controlling all lighting zones that are described by the drawings and specifications.

.2 Lighting control system shall be provided such that it is capable of responding from commands from target control touchscreen without stutter or lag (<0.5s for all commands, dimming, etc.)

.3 Contractor shall utilize dimming capabilities of fixtures to create consistent light levels on target faces at High-Med-Low-Night dimming levels at different shooting distances. Use intersection of 1,200mm A.F.F. and center of target horizontally as reference point. This is required due to inconsistent distances from target faces to light locations at

different shooting distances. Coordinate target lighting levels with Consultant prior to programming on site.

- .4 HMI shall communicate dimming levels to low voltage lighting system with high-medium-low-night settings. Only fixture type 'BB' require the night dimming setting. All 4 dimming level settings shall be adjusted to Owner and Consultant's requirements on site.
- .5 Lighting control system shall be built with commercial off-the-shelf components such that any future requested changes or additions can be accommodated for without changing the existing system's components. Any future zoning or scene changes shall be accomplished with programming only.
- .6 Provide connection from UPS located in CCTV/Audio network rack to low voltage lighting system head-end. Low voltage lighting system shall operate for minimum 30 minutes during power outage.
- .7 Low voltage lighting system shall allow the user control of light fixtures denoted as emergency ('EM' on drawings) under normal operation. Upon loss of power, low voltage lighting system shall energize these 'EM' fixtures to 100% light output and lockout any user input. Upon resuming normal operation control shall be given back to the user.
- .8 System shall be capable of resuming normal operation on return of power without requiring input from the user.

## **1.9 WARRANTY**

- .1 Provide a one year limited manufacturer's warranty on all lighting control components.

## **1.10 MAINTENANCE**

- .1 Provide 5% spare devices for digitally addressed drivers or external dimming power packs.

## **Part 2 Products**

### **2.1 MANUFACTURERS**

- .1 Acceptable Manufacturers:
  - .1 Strand Lighting
  - .2 Lutron
- .2 Substitutions:
  - .1 All proposed substitutions (clearly delineated as such) must be submitted in writing for approval by the design professional a minimum of 10 working days prior to the bid date and must be made available to all bidders. Proposed

substitutes must be accompanied by a review of the specification noting compliance on a line-by-line basis. Proposed substitutions shall include complete low voltage lighting system diagrams and communication drawings.

- .2 By using pre-approved substitutions, the contractor accepts responsibility and associated costs for all required modifications to circuitry, devices, and wiring. The contractor shall provide complete engineered shop drawings (including power and control wiring) with deviations from the original design highlighted in an alternate color to the engineer for review and approval prior to rough-in.

## **2.2 DIGITAL WALL SWITCHES**

- .1 Local and remote switches shall be multi-button digital switches, white with pilot light.
- .2 Provide stainless steel wall plates with the low voltage switches. Ganged wall plates shall be provided where the switches are grouped together at one location. All switches shall be labelled.
- .3 Lighting sensors and occupancy sensor shall operate in a “slave” mode unless noted otherwise. Switches shall operate in “slave” mode unless noted otherwise. Any touchscreen control commands shall take precedence over any local switch control.

## **2.3 DIGITALLY ADDRESSED LIGHT FIXTURES**

- .1 All fixtures type ‘BB’ shown on drawings shall be capable of multiple scene control through digital addressing.
- .2 External addressed dimming power packs and integral addressed dimming drivers are both acceptable solutions.
- .3 A separate drawing noting all fixture addresses shall be submitted by the contractor in conjunction with other as-built drawing submittals. Shall be submitted in hard copy as well as AutoCAD .dwg files.
- .4 All external LED dimming power packs and integral dimming drivers shall adhere to all relevant specifications as described in 26 50 00 section 2.3 LED Lighting – Lamp Modules and Drivers.

## **2.4 ZONE CONTROLLERS**

- .1 Zone controllers shall provide interface between incoming power from electrical panel and incoming data cabling carrying scene information.
- .2 Simple replacement – A zone controller may be replaced with an off-the-shelf unit without requiring any configuration or setup.
- .3 System shall be capable of adding new zone controllers daisy-chained to existing zone controllers without requiring the alteration of any other system hardware.
- .4 120-277V, 60Hz input

- .5 All cabling utilized for powering lighting shall be sized according to 2015 CEC requirements for voltage drop. All output cabling from zone controllers to light fixtures shall be run in conduit.

## **2.5 UNINTERRUPTABLE POWER SUPPLY**

- .1 Provide rack mounted 1.5kVA UPS in CCTV/audio rack for connection to the low voltage lighting system head-end.
- .2 Provide minimum 1 x rack mounted external battery cabinet.
- .3 UPS shall have the following requirements:
  - .1 120VAC nominal
  - .2 Valve-regulated, non-spillable, lead acid batteries
  - .3 Shall be Liebert GXT 4 series.

## **2.6 CABLE**

- .1 Any data grade, class 1, or class 2 wiring required from electrical room to gun range for lighting control is permitted to be run in cable tray installed in this contract. If cable tray is utilized, contractor shall provide barriers in tray to separate from space for video surveillance cabling. If tray is not utilized all cabling shall be run in dedicated conduit.

## **Part 3 Execution**

### **3.1 INSTALLATION**

- .1 Provide wire specifications and wire colors to simplify contactor termination requirements
- .2 The contractor must make available to the Owner, a service department of a duly authorized distributor of the equipment manufacturer, which shall stock the manufacturer's standard parts. The service department shall have at least one factory trained repairman available to the Owner on 24 hours notice. The system shall be guaranteed for a period of one year of substantial.
- .3 Cable and conduit necessary to make the system operable shall be provided and installed as instructed by the manufacturer of the system. The overall system co-ordination shall be the responsibility of the contractor, and they shall ensure that all of the necessary system components are installed to result in a complete, workable system.
- .4 All wiring installed in conduit shall be with a maximum conduit fill of 40%. Increase indicated conduit sizes, if necessary, to accommodate manufacturer's cable requirements.
- .5 All Luminaire wiring from the dimmer controller to Luminaires shall have separate neutrals. Sharing of neutrals shall not be permitted.

- .6 The system shall be installed in full compliance with the manufacturer's recommendations and these specifications. On completion, a technical representative from the manufacturer shall fully inspect and test the system and make necessary adjustments to ensure 100% operation.
- .7 The system shall be checked for:
  - .1 Verification of color codes with respect to interconnections as recommended by manufacturer
  - .2 Verification of color codes with respect to drawings and maintenance manuals
  - .3 Inspection of wiring and methods of termination in junction boxes and back boxes
  - .4 Designation of junction box covers and references with respect to these boxes on electrical drawings
- .8 The system shall be tested for:
  - .1 Grounds
  - .2 100 per cent load on each dimming circuit
  - .3 Operation of system shall be checked step by step as described in user's manual;
- .9 Certification of these tests, upon completion, shall be issued in writing to the consultant by the manufacturer's representative.
- .10 Provide three (3) copies of operating instructions and service manuals complete with parts list, wiring diagrams and shop drawings.
- .11 The contractor must make available to the Owner, a service department of a duly authorized distributor of the equipment manufacturer, which shall stock the manufacturer's standard parts. The service department shall have at least one factory trained repairman available to the Owner on 24 hours notice. The system shall be guaranteed for a period of one year.

### **3.2 COMMISSIONING AND TESTING**

- .1 The Owner's operating and maintenance personnel shall be instructed in the operating and maintenance of the Lighting System. Both the supplier and a manufacturer representative shall be present during commissioning.
- .2 Commissioning of the system with the consultant and owner representative shall be completed prior to substantial completion. Contractor is responsible to complete product information and performance verification forms supplied to the contractor from the consultant. These forms must be completed by the contractor and submitted minimum 3 weeks prior to commissioning date.



- .3 The contractor shall be responsible to record all owner training sessions with both audio and video. The training session recordings shall then be submitted on USB to the Owner.
- .4 Initial owner training shall occur prior to substantial completion. Training session shall be approximately 4 hours long for operational training, and 4 hours long for maintenance training. Written documentation bearing name and signature of Owner's personnel who received the above instructions shall be included in the operation and service manuals. During this time any scene settings and programming adjustments required by the owner shall be made and confirmed with the owner.
- .5 The second training and final commissioning session shall be approximately 4 hours long approximately 2 months after Owner occupancy. This session is provided for any final clarifications required by the Owner on the operation of the system.

**END OF SECTION**

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**Part 1            General**

**1.1                GENERAL REQUIREMENTS**

- .1        The General Conditions of Contract, Division 01 General Requirements and all Addenda thereto form an integral part of and must be read in conjunction with the requirements of this Section.
- .2        Cooperate and coordinate with the requirements of other units of work specified in other Sections.

**1.2                REFERENCES**

- .1        The Electrical Contractor shall be bound by industry standards, as interpreted by the Consultant, whether or not specifically referenced in this document. Comply with Electrical Protection Act and rules and regulations made pursuant thereto, including the 2012 Canadian Electrical Code. Also, comply with applicable standards of the following:
  - .1        CSA C22.1-2015, Canadian Electrical Code, Part 1.
  - .2        Electrical and Electronic Manufacturers Association of Canada (EEMAC).
  - .3        National Electrical Manufacturers Association (NEMA).
  - .4        National Building Code 2010 (NBC 2010)
  - .5        National Fire Protection Association (NFPA)
  - .6        Institute of Electrical and Electronic Engineers (IEEE).
  - .7        CSA C22.2No.29-M1989(R2000), Panelboards and enclosed Panelboards.
  - .8        Other Applicable CSA and UL approvals.

**1.3                SHOP DRAWINGS AND PRODUCT DATA**

- .1        Submit shop drawings in accordance with:
  - .1        Section 01 33 00 - Submittal Procedures
  - .2        Section 26 05 01 – Common Work Results
- .2        Drawings to include electrical detail of panel, branch breaker type, quantity, ampacity and enclosure dimension.
- .3        Include time-current characteristic curves for breakers with ampacity of 50 A and over and with interrupting capacity of 18,000 A symmetrical (rms) or greater.

**1.4                PRODUCT APPROVALS**

- .1        Manufacturers' and model numbers named in these specifications indicate an acceptable technical standard of performance and are not intended to be exclusive. Products submitted as alternates must result in a control system that meets or exceeds all technical performance criteria as described.

- .2 Products proposed as alternatives to those specified, shall only be considered if submitted for approval no later than 15 working days before tender close. Submit alternates, for approval, as one complete listing. Provide complete product specification sheets with request for approval.
- .3 The Bidder must provide a complete list of primary system products offered with their bid.

## **1.5 WASTE MANAGEMENT AND DISPOSAL**

- .1 Meet requirements of Section 01 74 19 - Waste Management and Disposal.
- .2 Collect and separate waste for reuse, recycling, and other waste diversion strategies in accordance with Waste Management Plan.

## **Part 2 Products**

### **2.1 PANELBOARDS**

- .1 All panels shall be of the dead front, molded case circuit breaker type, as shown, sized and located on the drawings.
- .2 Panel trim shall be furnished for flush or surface mounting as indicated on the drawings. Panel trim shall be removed for painting, and allowed to dry before final placement.
- .3 Surface mounted panels shall have manufacturer's standard trim, and shall be finished with two coats of grey ASA #61.
- .4 Panels shall be equipped with a flush type combination lock-latch. Two keys shall be provided for each panel, and all locks shall be keyed alike.
- .5 Panels shall have mains of voltage and capacity and shall be complete with branch breakers, spares and spaces, as shown on the drawings. "Spaces" shall be understood to include necessary bus work such that Owners, at a later date, need buy only breakers.
- .6 Panelboards: to CSA C22.2No.29 and product of one manufacturer.
  - .1 Install circuit breakers in panelboards before shipment.
  - .2 In addition to CSA requirements manufacturer's nameplate must show fault current that panel including breakers has been built to withstand.
- .7 Sequence phase bussing with odd numbered breakers on left and even on right, with each breaker identified by permanent number identification as to circuit number and phase.
- .8 Each panel shall be complete with a typed directory, which shall be mounted inside the door in a metal frame with clear plastic cover.
- .9 Flush panels shall have concealed hinges and flush type combination lock-latch. Doors shall open minimum 135 degrees. Trims shall have fasteners concealed.
- .10 Cabinets shall be fabricated of code gauge steel, with ample wiring gutters for all wiring connections.

- .11 All panels shall have main bus bar equipped with solderless lug and be capable of accepting any arrangement of single, two or three pole breakers.
- .12 Branch circuit breaker shall have quick-make, quick-break toggle mechanism with single, two or three pole common trip thermal magnetic units in ampere ratings as designated on the drawings. Breaker handles shall have three positions: 'on', 'off' and 'tripped'. All circuit breakers and panel bus shall have an interrupting capacity of 10,000 amps symmetrical.
- .13 Panels for 120/208 volt, 3 phase, 4 wire systems, shall be complete with bolt-in type breakers, with a minimum nominal width of 20 mm per pole, and a bus of sufficient capacity to feed the number of branch circuit breakers indicated.
- .14 Panels for 347/600 volt, 3 phase, 4 wire systems shall be complete with bolt-in type breakers, and a bus of sufficient capacity to feed the number of branch circuit breakers indicated.
- .15 All panels shall be specification grade and of the same manufacture. Load centres are not acceptable.
- .16 All branch circuit spaces shall be fitted with filler plates.
- .17 All panels serving bedrooms shall be equipped with arc fault circuit interrupters where shown on the drawings.
- .18 Each panel shall be equipped with a ground bus suitable for terminating one ground conductor per load circuit.
- .19 Panels shall be General Electric, Cutler Hammer, Schneider Electric or Siemens.
- .20 Refer to attached breaker panel schematic detail sheets attached at the end of this specification section.

## **2.2 BREAKERS**

- .1 Breakers: to Section 26 28 21 - Moulded Case Circuit Breakers.
- .2 Lock-on devices for fire alarm circuits.

## **2.3 EQUIPMENT IDENTIFICATION**

- .1 Provide equipment identification in accordance with Section 26 05 01 - Common Work Results – Electrical.
- .2 Nameplate for each panelboard size 4 engraved as indicated.
- .3 Nameplate for each circuit in distribution panelboards size 2 engraved.
- .4 Complete circuit directory with typewritten legend showing location and load of each circuit.

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**Part 3 Execution**

**3.1 INSTALLATION**

- .1 Locate panelboards as indicated and mount securely, plumb, true and square, to adjoining surfaces.
- .2 Install surface mounted panelboards on painted plywood backboards Where practical, group panelboards on common backboard.
- .3 Electrical panels shall, where possible, be mounted with top of trim at uniform height of 2000 mm.
- .4 Panels, shown adjacent to other panels, shall have adjacent edges of different panels mounted parallel to each other with a gap of 75 mm.
- .5 For panels recessed in a finished wall, provide for every six branch circuit spaces and spares, or fractions thereof, one 20 mm empty conduit up to furred ceiling space, and one (1) 20 mm empty conduit down to ceiling space of floor below, and cap for future wiring.
- .6 Connect neutral conductors to common neutral bus.

**3.2 WARRANTY**

- .1 The contractor must make available to the Owner a local service department of a duly authorized distributor of the equipment manufacturer, which shall stock the manufacturer's standard parts. The service department shall have at least one factory trained repair technician available to the Owner on 24 hours' notice.
- .2 Provide warranty of installation of equipment installed by this contractor to be free of defects for a period of (1) one year from date of Substantial Completion.
- .3 Provide during the warranty period, all service, maintenance, parts, etc., required for normal operation of the systems, such that Owner needs not purchase additional maintenance agreement or contracts. Upon request, the manufacturer and his agent shall provide direct to the Owner the following proposals:
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**END OF SECTION**

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**Part 1            General**

**1.1                GENERAL REQUIREMENTS**

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  - .3        National Electrical Manufacturers Association (NEMA).
  - .4        National Building Code 2010 (NBC 2010)
  - .5        National Fire Protection Association (NFPA)
  - .6        Institute of Electrical and Electronic Engineers (IEEE).
  - .7        CSA-C22.2 No.42, General Use Receptacles, Attachment Plugs and Similar Devices.
  - .8        CSA-C22.2 No.42.1, Cover Plates for Flush-Mounted Wiring Devices (Bi-national standard, with UL 514D).
  - .9        CSA-C22.2 No.55, Special Use Switches.
  - .10      CSA-C22.2 No.111, General-Use Snap Switches (Bi-national standard, with UL 20, twelfth edition).

**1.3                SHOP DRAWINGS AND PRODUCT DATA**

- .1        Submit shop drawings in accordance with:
  - .1        Section 01 33 00 - Submittal Procedures
  - .2        Section 26 05 01 – Common Work Results

**1.4                PRODUCT APPROVALS**

- .1        Manufacturers' and model numbers named in these specifications indicate an acceptable technical standard of performance and are not intended to be exclusive. Products submitted as alternates must result in a control system that meets or exceeds all technical performance criteria as described.

- .2 Products proposed as alternatives to those specified, shall only be considered if submitted for approval no later than 15 working days before tender close. Submit alternates, for approval, as one complete listing. Provide complete product specification sheets with request for approval.
- .3 The Bidder must provide a complete list of primary system products offered with their bid.

## **1.5 WASTE MANAGEMENT AND DISPOSAL**

- .1 Meet requirements of Section 01 74 19 - Waste Management and Disposal.
- .2 Collect and separate waste for reuse, recycling, and other waste diversion strategies in accordance with Waste Management Plan.

## **Part 2 Products**

### **2.1 SWITCHES**

- .1 15 A, 120 V, single pole, three-way switches where required on drawings.
- .2 Manually-operated general purpose ac switches with following features:
  - .1 Terminal holes approved for No. 10 AWG wire.
  - .2 Silver alloy contacts.
  - .3 Urea or melamine molding for parts subject to carbon tracking.
  - .4 Suitable for back and side wiring.
  - .5 Ivory toggle.
- .3 Toggle operated fully rated for tungsten filament and fluorescent lamps.
- .4 All wiring devices specified shall be of the same manufacture throughout the project.
- .5 Switches controlling motors shall be K.W. (H.P.) rated and approved for motor control service.
- .6 Set switches flush in all finished areas, or in surface box where conduit or wireway is exposed.
- .7 Refer to drawing symbol schedule for further requirements.
- .8 Switches and receptacles shall comply with requirements of CSA and NEMA Standards.
- .9 Switches shall be specification grade from one of the following manufacturers: Cooper, Leviton, Hubbell or Pass & Seymour.

### **2.2 RECEPTACLES**

- .1 Duplex receptacles, CSA type 5-15 R, 125 V, 15 A, U ground, with following features:
  - .1 Ivory high impact chemical resistant molded nylon or polycarbonate face.
  - .2 Suitable for No. 10 AWG for back and side wiring.

- .3 Break-off links for use as split receptacles.
  - .4 Eight back wired entrances, four side wiring screws.
  - .5 Triple wipe contacts and rivetted grounding contacts.
  - .6 Specification grade from one of the following manufacturers: Cooper, Leviton, Hubbell or Pass & Seymour.
- .2 Single receptacles CSA type 5-15 R, 125 V, 15 A, U ground with following features:
- .1 Ivory high impact chemical resistant molded nylon or polycarbonate face.
  - .2 Suitable for No. 10 AWG for back and side wiring.
  - .3 Four back wired entrances, 2 side wiring screws.
  - .4 Specification grade from one of the following manufacturers: Cooper, Leviton, Hubbell or Pass & Seymour.
- .3 Other receptacles with ampacity and voltage as indicated.
- .4 Receptacles of one manufacturer throughout project.
- .5 Set receptacles flush in all finished areas, or in surface box where conduit or wireway is exposed
- .6 Provide ten (10) 20 amp and ten (10) 15 amp specification grade receptacles c/w installation, 10 meters of wire and required raceway, etc for each of these receptacles so that they may be installed where required during the construction and commissioning stages of this project. .

### 2.3 SPECIAL WIRING DEVICES

- .1 **Ground Fault Circuit Interrupter** - shall have a nylon face and a thermoplastic backbody. They must have a feed-through capability for protecting receptacles downstream on the same circuit. They must be Class A rated with a 5 milliampere ground fault trip level and a 20 ampere feed through rating. GFCI receptacles shall have 'Safe Lock' protection such if critical components are damaged and ground fault protection is lost, power to the receptacle is disconnected. GFCI receptacles shall be equipped with LED trip indicator light, NEMA configuration 5-15R, side wired and one of the following manufacturers: Cooper #XGF15-V, Leviton #8599-I or Pass & Seymour #1594-I, Hubbell 'Autoguard' GFR Series
- .2 **Pilot Light Switches** - shall be quiet specification grade and rated 15A, 120 volts, back and side wiring with toggle lit red in the "ON" position, accepting up to #10 copper conductor and of one of the following manufacturers: Cooper, Leviton, Hubbell or Pass & Seymour.
- .3 **Fractional HP/KW Manual Starters** - to be non-reversing, toggle operated, suitable for mounting in a surface or flush box, single or two pole to suit 120 or 208 volt application, c/w pilot light and thermal overload to adequately protect motor. Flush mount to have stainless steel or ivory cover plates to match other flush mount wiring devices. To be of one of the following manufacturers: Cooper, Leviton, Hubbell or Pass & Seymour.
- .4 **Illuminated Switches** - shall be quiet specification grade, 120 volts, back and side wiring with toggle lit in the "OFF" position, accepting up to #10 copper conductor and of one of the following: Cooper, Leviton, Hubbell or Pass & Seymour.



- .5 **Fluorescent Dimmer Switches:** Dimmer switches for linear fluorescent and compact fluorescent lighting fixtures equipped with electronic dimming ballasts shall be specification grade, slide type control, load rated for 1200 VA (900 watts), 120-volt AC, with decora style screwless snap-on wall plate. Run separate neutral for dimmers and keep on one phase. Each dimmer shall be voltage compensated c/w positive RFI filtering. Fluorescent dimmer switches shall be of one of the following:

Leviton #26666-31, for use with Advance Mark X ballasts

Lutron #NF-10-WH, for use with Lutron Hi-Lume or Compact SE ballasts

- .6 **Wall Occupancy Sensors, 347-Volt:** Wall occupancy sensors shall be specification grade passive infrared (PIR) or dual technology (PIR/Microphonics) wall sensor switch, white finish. Manual ON/OFF switch with automatic time delay off operation (adjustable from 30 seconds to 30 minutes) after momentary occupancy. Adjustable PIR unit sensitivity from 20% to 100%. Coverage limited to 180° field of view, 900 square feet, rated for minimum 800 watt for ballast load at 347-volt. Wall occupancy sensor switch shall be compatible with all electronic fluorescent non-dimming ballasts and shall mount in a standard single 347-volt single gang switch box. Set delay off to 5 minutes after momentary occupancy. Wall occupancy sensors shall be of one of the following manufacturers:

Hubbell, Leviton, Sensorswitch, Wattstopper, Cooper

- .7 **Ceiling Occupancy Sensors, 347-Volt:** Ceiling occupancy sensors for controlling the room lighting shall be multi-technology occupancy sensor switch, passive infrared (PIR/Microphonics) and ultrasonic sensor (40kHz ultrasonic frequency), 360° coverage within a 92.9 square meter area. Occupancy sensors shall be provided with power pack for use with 347-volt operation where required by the manufacturer. Automatic ON/OFF control. For sensors designated 'OC1' in Parkade levels provide a time delay set at 30 minutes. For sensors designated 'OC2' provide a time delay set at 20 minutes. Occupancy sensors shall be of one of the following manufacturers:

Hubbell, Leviton, Sensorswitch, Wattstopper, Cooper

- .8 **Ceiling Occupancy Sensors, 120-Volt:** Designated as 'OC3' on drawings - Ceiling occupancy sensors for controlling the room lighting shall be multi-technology occupancy sensor switch, passive infrared (PIR/Microphonics) and ultrasonic sensor (40kHz ultrasonic frequency), 360° coverage within a 92.9 square meter area. Automatic ON/OFF control, with delay off set at 5 minutes after momentary occupancy.

Hubbell, Leviton, Sensorswitch, Wattstopper, Cooper

## 2.4 COVER PLATES

- .1 Cover plates for wiring devices.
- .2 Cover plates from one manufacturer throughout project.
- .3 Wall plates shall be designed and manufactured in accordance with performance and dimensional requirements of the following industry standards:

CSA Standard C22-2 No. 42

U.S. Federal Specification WP455

NEMA Standard WD-1

- .4 Wall plates shall be manufactured by one of the following:  
Cooper, Arrow Hart, Eagle, Hubbell, Leviton or Pass & Seymour.
- .5 Blank cover plates in finished ceiling areas shall be Columbia Electric #9002 baked white enamel for white ceilings, or painted to match colored finishes.
- .6 Unbreakable Nylon wall plates shall be provided for all switches, receptacles, blanks, telephone and special purpose outlets. The wall plates shall be of suitable configuration for the device for which it is to cover with color matched mounting screws. Use ganged plate where more than one device occur at one location. Any specific locations calling for Metal wall plates shall be stainless steel.
- .7 Where surface wiring methods need to be employed in a high finish area because of renovations to existing structure, wall plates shall be used in conjunction with Wiremold surface box to suit the device.
- .8 Where outlets occur in an unfinished area such as boiler or furnace room and surface conduit and boxes are specified, stamped galvanized steel wall plates shall be used to suit configuration.
- .9 Exterior outlets shall be fitted with weatherproof die cast aluminum cover plates to suit wiring device, c/w rubber gasket to provide positive seal. Duplex cover plates shall have two independent flaps. Weatherproof covers shall provide protection in wet and damp locations.

### **Part 3 Execution**

#### **3.1 INSTALLATION**

- .1 Switches:
  - .1 Install single throw switches with handle in "UP" position when switch closed.
  - .2 Install switches in gang type outlet box when more than one switch is required in one location.
  - .3 Switches shall be as located on the drawings, mounted up 1200 mm, and ganged where more than one occurs in the same location.
- .2 Receptacles:
  - .1 Install receptacles in gang type outlet box when more than one receptacle is required in one location.
  - .2 Convenience outlets shall be as located on the drawings, and mounted up 450 mm, unless otherwise noted.
  - .3 Where split receptacle has one portion switched, mount vertically and switch upper portion.

- .4 Outlets over counter tops shall be mounted 150 mm above counter, or immediately above backsplash. Co-ordinate with architectural drawings for location of all counter tops, millwork and feature walls, to ensure proper location and mounting height.
- .5 Coordinate with the location of all mechanical convectors and mount convenience outlets up 100 mm above heating convectors.
- .6 All convenience outlets shall meet tension tests as per CSA requirements, and will be subjected to 'on site' tests during final inspection.
- .3 All plug-in type receptacles shall be identified by means of a Lamecoid label on the cover plate. Self-laminated, self-adhesive labels are acceptable. Each cover plate shall contain the panel and circuit number. Those receptacles fed from ground fault interrupters shall have 'GFI' labeled adjacent to the panel and circuit number. Those receptacles designated for housekeeping purposes shall have 'HOUSEKEEPING' labeled adjacent to the panel and circuit number.
- .4 The circuits controlled by all switches on all levels, shall be neatly printed with waterproof ink on the side of the switch outlet box so that the panel and circuit number are clearly legible when the cover plate is removed. It shall not be necessary to remove the switch from the outlet box in order to read the panel or circuit number.
- .5 Cover plates:
  - .1 Protect cover plate finish with paper or plastic film until painting and other work is finished.
  - .2 Install suitable common cover plates where wiring devices are grouped.
  - .3 Do not use cover plates meant for flush outlet boxes on surface-mounted boxes.

### 3.2 WARRANTY

- .1 The contractor must make available to the Owner a local service department of a duly authorized distributor of the equipment manufacturer, which shall stock the manufacturer's standard parts. The service department shall have at least one factory trained repair technician available to the Owner on 24 hours' notice.
- .2 Provide warranty of installation of equipment installed by this contractor to be free of defects for a period of (1) one year from date of Substantial Completion.
- .3 Provide during the warranty period, all service, maintenance, parts, etc., required for normal operation of the systems, such that Owner needs not purchase additional maintenance agreement or contracts. Upon request, the manufacturer and his agent shall provide direct to the Owner the following proposals:
  - .1 Continuation, after the warranty period, of full maintenance, including all service, labour, parts, etc. required to maintain the systems in a fully operational condition.

**END OF SECTION**

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**Part 1            General**

**1.1                GENERAL REQUIREMENTS**

- .1        The General Conditions of Contract, Division 01 General Requirements and all Addenda thereto form an integral part of and must be read in conjunction with the requirements of this Section.
- .2        Cooperate and coordinate with the requirements of other units of work specified in other Sections.

**1.2                REFERENCES**

- .1        The Electrical Contractor shall be bound by industry standards, as interpreted by the Consultant, whether or not specifically referenced in this document. Comply with Electrical Protection Act and rules and regulations made pursuant thereto, including the 2015 Canadian Electrical Code. Also, comply with applicable standards of the following:
  - .1        CSA C22.1-2015, Canadian Electrical Code, Part 1.
  - .2        Electrical and Electronic Manufacturers Association of Canada (EEMAC).
  - .3        National Electrical Manufacturers Association (NEMA).
  - .4        National Building Code 2010 (NBC 2010)
  - .5        National Fire Protection Association (NFPA)
  - .6        Institute of Electrical and Electronic Engineers (IEEE).
  - .7        CSA-C22.2 No. 5-02, Moulded-Case Circuit Breakers, Moulded-Case Switches and Circuit-Breaker Enclosures (Tri-national standard with UL 489, tenth edition, and the second edition of NMX-J-266-ANCE).
  - .8        Other Applicable CSA and UL approvals.

**1.3                SHOP DRAWINGS AND PRODUCT DATA**

- .1        Submit shop drawings in accordance with:
  - .1        Section 01 33 00 - Submittal Procedures
  - .2        Section 26 05 01 – Common Work Results
- .2        Include time-current characteristic curves for breakers with ampacity of 50 A and over and with interrupting capacity of 22,000 A symmetrical (rms) and over at system voltage.

**1.4                PRODUCT APPROVALS**

- .1        Manufacturers' and model numbers named in these specifications indicate an acceptable technical standard of performance and are not intended to be exclusive. Products submitted as alternates must result in a control system that meets or exceeds all technical performance criteria as described.

- .2 Products proposed as alternatives to those specified, shall only be considered if submitted for approval no later than 15 working days before tender close. Submit alternates, for approval, as one complete listing. Provide complete product specification sheets with request for approval.
- .3 The Bidder must provide a complete list of primary system products offered with their bid.

## **1.5 WASTE MANAGEMENT AND DISPOSAL**

- .1 Meet requirements of Section 01 74 19 - Waste Management and Disposal.
- .2 Collect and separate waste for reuse, recycling, and other waste diversion strategies in accordance with Waste Management Plan.

## **Part 2 Products**

### **2.1 BREAKERS GENERAL**

- .1 Bolt-on moulded case circuit breaker: quick- make, quick-break type, for manual and automatic operation with temperature compensation for 40 deg C ambient.
- .2 Common-trip breakers: with single handle for multi-pole applications.
- .3 Magnetic instantaneous trip elements in circuit breakers to operate only when value of current reaches setting. Trip settings on breakers with adjustable trips.
- .4 Circuit breakers with interchangeable trips as indicated.
- .5 Circuit breakers to have minimum of 30,000 A symmetrical rms interrupting capacity rating in breaker panelboards.
- .6 Magnetic instantaneous trip elements in circuit breakers to operate only when value of current reaches setting.
  - .1 Trip settings on breakers to have adjustable trips.

### **2.2 THERMAL MAGNETIC BREAKERS**

- .1 Moulded case circuit breaker to operate automatically by means of thermal and magnetic tripping devices to provide inverse time current tripping and instantaneous tripping for short circuit protection.

### **2.3 SOLID STATE TRIP BREAKERS**

- .1 Moulded case circuit breaker to operate by means of solid-state trip unit with associated current monitors and self-powered shunt trip to provide inverse time current trip under overload condition, and long time, short time, instantaneous, tripping for ground fault short circuit protection.

- .2 The main service breakers for the fire pump and building main service and all breakers over 400 amps shall have solid state trip units. All other breakers shown shall be thermal magnetic breakers.

**Part 3 Execution**

**3.1 INSTALLATION**

- .1 Install circuit breakers as indicated.

**3.2 WARRANTY**

- .1 The contractor must make available to the Owner a local service department of a duly authorized distributor of the equipment manufacturer, which shall stock the manufacturer's standard parts. The service department shall have at least one factory trained repair technician available to the Owner on 24 hours' notice.
- .2 Provide warranty of installation of equipment installed by this contractor to be free of defects for a period of (1) one year from date of Substantial Completion.
- .3 Provide during the warranty period, all service, maintenance, parts, etc., required for normal operation of the systems, such that Owner needs not purchase additional maintenance agreement or contracts. Upon request, the manufacturer and his agent shall provide direct to the Owner the following proposals:
  - .1 Continuation, after the warranty period, of full maintenance, including all service, labour, parts, etc. required to maintain the systems in a fully operational condition.

**END OF SECTION**

**Part 1 General**

**1.1 GENERAL REQUIREMENTS**

- .1 The General Conditions of Contract, Division 01 General Requirements and all Addenda thereto form an integral part of and must be read in conjunction with the requirements of this Section.
- .2 Cooperate and coordinate with the requirements of other units of work specified in other Sections.

**1.2 REFERENCES**

- .1 The Electrical Contractor shall be bound by industry standards, as interpreted by the Consultant, whether or not specifically referenced in this document. Comply with Electrical Protection Act and rules and regulations made pursuant thereto, including the 2012 Canadian Electrical Code. Also, comply with applicable standards of the following:
  - .1 CSA C22.1-2015, Canadian Electrical Code, Part 1.
  - .2 Electrical and Electronic Manufacturers Association of Canada (EEMAC).
  - .3 National Electrical Manufacturers Association (NEMA).
  - .4 National Building Code 2010 (NBC 2010)
  - .5 National Fire Protection Association (NFPA)
  - .6 Institute of Electrical and Electronic Engineers (IEEE).
- .2 American National Standards Institute (ANSI)
  - .1 ANSI C82.1, Electric Lamp Ballasts-Line Frequency Fluorescent Lamp Ballast.
  - .2 American National Standards Institute/Institute of Electrical and Electronics Engineers (ANSI/IEEE)
  - .3 ANSI/IEEE C62.41, Surge Voltages in Low-Voltage AC Power Circuits.
  - .4 American Society for Testing and Materials (ASTM)
  - .5 ASTM F1137, Specification for Phosphate/Oil and Phosphate/Organic Corrosion Protective Coatings for Fasteners.
  - .6 United States of America, Federal Communications Commission (FCC)
  - .7 FCC (CFR47) EM and RF Interference Suppression.

**1.3 SHOP DRAWINGS AND PRODUCT DATA**

- .1 Submit shop drawings in accordance with:
  - .1 Section 01 33 00 - Submittal Procedures
  - .2 Section 26 05 01 – Common Work Results
- .2 Shop drawings for each fixture shall include but not be limited to, lamps, ballasts, fixture cuts, custom colors, and special mounting details. All pertinent information for each fixture shall be stapled separately from other fixtures.

## **1.4 PRODUCT APPROVALS**

- .1 Manufacturers' and model numbers named in these specifications indicate an acceptable technical standard of performance and are not intended to be exclusive. Products submitted as alternates must result in a control system that meets or exceeds all technical performance criteria as described.
- .2 Products proposed as alternatives to those specified, shall only be considered if submitted for approval no later than 10 working days before tender close. Submit alternates, for approval, as one complete listing. Provide complete product specification sheets with request for approval.
- .3 The Bidder must provide detailed lighting calculation drawings for fixtures that are submitted for approval for range targets, open areas, training rooms or as requested by the consultant. These shall be submitted no later than 10 working days before tender close.
- .4 The Bidder must provide a complete list of primary system products offered with their bid.

## **1.5 WASTE MANAGEMENT AND DISPOSAL**

- .1 Meet requirements of Section 01 74 19 - Waste Management and Disposal.
- .2 Collect and separate waste for reuse, recycling, and other waste diversion strategies in accordance with Waste Management Plan.

## **Part 2 Products**

### **2.1 LED LIGHTING – LAMP MODULES AND DRIVERS**

- .1 Solid-State Lighting (LED luminaires) shall comply with ENERGY STAR® SSL test standards for the following qualification requirements:
  - .1 Testing: SSL testing standards including IES LM-79-2008 and LM-80-2008 as performed by an independent test lab.
  - .2 Efficacy: The luminaire test data and submitted report shall demonstrate a minimum of 35 lumens per watt and 575 lumens for the least efficient LED for apertures 4.5" (345 lumens for apertures 4.5"), lowest efficient optic, and hottest luminaire configuration for the product group submitted for qualification.
  - .3 Colour: LED luminaire shall demonstrate colour uniformity across the aperture.
  - .4 Power: The driver/power supply must have a power factor of > 0.90 for all non-residential products, meet FCC requirements, sound rating of A and provide transient protection.
  - .5 Reliability: The LED luminaire shall demonstrate 70% lumen maintenance at 35,000 hours for non-residential products, as calculated using the DOE's linear extrapolation model.
- .2 Tight chromaticity specification and LED colour binning process shall ensure LED colour uniformity, sustainable Colour Rendering Index (CRI) and Correlated Colour Temperature



(CCT) consistency over the useful life of the LED. Consistent colour uniformity and tight colour control shall be maintained even during dimming.

- .3 LED modules shall be InGaN (Indium Gallium Nitride) semiconductor material, absent of UV and minimal IR wavelengths. The conglomeration of diodes covered with remote phosphor technology shall provide consistent colour uniformity and tight colour control.
- .4 LED Light Engine (Driver)
  - .1 Over-voltage, over-current and short-circuit protected
  - .2 Thermal management of the LED system shall be designed to yield 70% lumen maintenance after 50,000 hours of operation
  - .3 Total Harmonic Distortion: < 20% THD
- .5 LED fixtures where specified as dimmable, shall have a dimming range of 100% to 1% unless otherwise noted.
- .6 Warranty: The light engine and power components of LED luminaires installed for indoor applications shall be free from defects in material and workmanship for a minimum period of three (3) years from date of original purchase. Warranty shall cover only product failure due to defective material or workmanship, and does not include labour to remove or install fixtures. Defective LED's shall be considered if a minimum of 5% of LEDs per luminaire are non-operative in the fixture or module.
- .7 Minimum CRI of 0.85.

## 2.2 LUMINAIRES

- .1 Contractor is responsible for all required mounting details for all lighting fixtures. If mounting of fixture is uncertain, contractor shall confirm prior to finalising pricing.
- .2 Lighting fixtures shall be of the makes indicated. Similar types of fixtures shall be by one manufacturer.
- .3 Only clean luminaires and lamps will be accepted at time of final inspection.
- .4 Recessed fixtures shall generally be supplied complete with trim, plaster frame or ring and mounting brackets where installed in plaster, or without plaster frame in acoustic ceilings.
- .5 Fixtures shall bear appropriate CSA labels.
- .6 Cooperate with all other trades for the proper installation of all lighting fixtures.
- .7 Verify the quantity of fixtures before placing orders.
- .8 Verify all ceiling types with architectural drawings and the General Contractor before ordering fixtures.
- .9 Co-ordinate with drawings to ensure that all fluorescent fixtures are equipped with ballasts of a suitable voltage to match branch circuitry.

- .10 All fixtures specified as being installed in inverted T-bar ceilings shall be painted on bottom face of fixture to match the T-bar splines unless otherwise noted.
- .11 All fluorescent luminaires installed on branch circuits with voltages exceeding 150 volts-to-ground shall be provided with a disconnecting means integral with the luminaire that simultaneously opens all circuit conductors between the branch circuit conductors and the conductors supplying the ballast(s), and shall be marked in a conspicuous and permanent manner adjacent to the disconnecting means so as to identify the disconnect.
- .12 The new light fixture lamps shall not be used during construction. The contractor may use their own temporary lamps during construction at their own expense with the Owner's approval. The contractor shall replace temporary lamps with new lamps upon completion of work. All fixtures shall be cleaned inside and outside prior to substantial completion.
- .13 Provide lighting fixtures of type and quality as specified in the following schedule. Fixtures shall be complete with necessary accessories, lamps and drivers. The contractor shall advise of any restrictions on providing luminaire, lamp and driver as specified during tender period.
- .14 The lighting fixtures shall be as specified in the following schedule, and the manufacturer's numbers shown shall not reduce or amend the requirements as outlined under the description of each fixture type.

### 2.3 LUMINAIRE SCHEDULE

- .1 All fixtures requesting approval for equals must also submit lighting calculations completed showcasing a complete system including light levels on shooting targets in multiple lighting scenarios as required by the Consultant.
- .2 All proposed substitutions (clearly delineated as such) must be submitted in writing for approval by the design professional a minimum of 15 working days prior to the bid date and must be made available to all bidders. Proposed substitutes must be accompanied by a review of the specification noting compliance on a line-by-line basis.
- .3 All fixtures below shall be capable of being controlled by digitally addressed low voltage lighting control system. Refer to specifications sections 26 09 24 and 26 09 25 for further details.
- .4 **Fixture type 'AA'** – Surface mounted LED dimmable area light fixture, 1,200mm in length, max 7.5W/305mm minimum, 2,000 lumens minimum output, 4000k colour temperature, 80° x 80° minimum beam angle, tempered glass lens, extruded aluminum body, complete with adjustable fixture mounting angle. Integral driver/power supply shall be capable of being field replaced without requiring the replacement of the accompanying luminaire. Fixture shall be provided with mounting brackets to suit installation in baffle ceiling as described in detail drawings. Contractor shall confirm mounting locations on site prior to installation. Dimmable to 1% or lower.  
Lumenpulse Lumenfacade series  
GVA Lighting STR9 series
- .5 **Fixture type 'BB'** – Surface mounted LED dimmable directional target light, 1,200mm in length, 15W/305mm, 3,550 lumen minimum output, 4000k colour temperature, 30° x 30° beam angle, tempered glass lens, extruded aluminum body, complete with adjustable fixture

mounting angle. Fixture shall be dimmable to 0.3% or lower, integral driver/power supply shall be capable of being field replaced without requiring the replacement of the accompanying luminaire. Fixture shall be provided with mounting brackets to suit installation in baffle ceiling as described in detail drawings. Contractor shall confirm mounting locations on site prior to installation.

Lumenpulse Lumenfacade series

GVA Lighting STR9 series

- .6 **Fixture type 'CC'** – Recessed linear wall wash dimmable LED fixture suitable for mounting in t-bar ceilings, red lens, 1219mm length, minimum 3000 lumen output, 44 watt, 120 volt.

Engineered Lighting Products DWTB series

Lumenwerx Via 4 LED series

Or approved equal

- .7 **Fixture type 'DD'** – Recessed LED volumetric dimmable fixture suitable for mounting in t-bar ceilings, 610x610mm length x width, 4000k colour temperature, 120 volt, 3,000 lumen minimum output, frosted acrylic center diffuser with satin lens.

Focal Point Equation LED series

Axis Lighting LED Day series

Or approved equal

- .8 **Fixture type 'B'** – Recessed 6" round LED dimmable downlight fixture suitable for mounting in t-bar ceilings, red LED, 120 volt, 400 lumen minimum output, 45° wide beam angle reflector.

Liton Lighting 6 LED series

Senso Leto 3 series

- .9 **Emergency Lighting Power Supply (EMPS)** – The power supply shall provide uninterrupted power to emergency fixtures (type 'AA') denoted with 'EM' on drawings. The inverter shall be capable of maintaining the connected load for 30 minutes during a power failure. The inverter shall provide a pure sine wave output at 120 volts, with low input current distortion. The inverter shall include surge and transient protection, automatic self-diagnostic operation to warn of potential problems, display panel monitors and controls of all parameters. The input voltage to the inverter shall be 120 volt AC, output shall be 120 volt AC always on. Provide input and output wiring as required for a complete system. Confirm input circuit ampacities with manufacturer prior to installation. Each emergency lighting circuit shall have a separate neutral. Provide a wall mounted shelf to mount the power supplies in the locations shown on drawings. Output of always-on inverter shall pass through low voltage lighting control system dimming panel.

.1 Beghelli Nova UAC

.2 Emergi-Lite CHINII series

.3 StanPro SNV30 series

.4 AimLite NVTR series

.5 Or approved equal equal

**Part 3 Execution**

- .1 ADDITIONAL MATERIALS
- .2 In addition to the materials specified and the quantity of materials as determined on the plans, provide for the supply and installation of the following additional materials, which shall be turned over to the owner if not installed during construction:

**Fixtures:**

- Fixture type 'AA': 5 x additional fixtures
- Fixture type 'BB': 1 x additional fixtures
- Fixture type 'DD': 1 x additional fixtures
- Fixture type 'A': 1 x additional fixtures

**Part 4 Execution**

**4.1 INSTALLATION**

- .1 The contractor under this Division shall be responsible for expediting the delivery and installation of the fixtures to suite the construction schedule and the work of other trades.
- .2 Remove packing material and debris from the job site immediately after installation of fixtures and lamps. Debris shall not be allowed to accumulate more than a reasonable amount.
- .3 Lighting fixture diffusers are not to be installed until the area is completely finished in order to minimize the amount of dirt collection on these units.
- .4 Exit signs shall be wired in a separate conduit system.
- .5 Conduit installation shall conform to the specifications.
- .6 Emergency battery lighting units shall be connected to the room's 120-volt lighting circuit, non-switched leg.

**4.2 CLOSEOUT SUBMITTALS**

- .1 Provide operation and maintenance information
  - .1 Section 01 78 00 - Closeout Submittals
- .2 Include:
  - .1 Operation instructions
  - .2 Description of system operation
  - .3 Description of each subsystem operation
  - .4 List specifying each piece of equipment in system or subsystem by its original manufacturer name and model number.
  - .5 Parts list specifying parts used in equipment by identification numbers that are standard to electronic industry.

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**4.3 WIRING**

- .1 Each fixture shall be fed with a separate flex or AC-90 drop. Looping between fixtures or wiring rows through ballast channel will not be accepted.

**4.4 LUMINAIRE SUPPORTS**

- .1 Lighting fixtures shall be supported independent of plasterboard or acoustic tile. Support from structural members of the building or ceiling.
- .2 Fixtures installed in exposed ceilings may require plywood backing behind the acoustical panels. Confirm support requirements with manufacturer.

**4.5 LUMINAIRE ALIGNMENT**

- .1 Luminaires shown in continuous lines or rows shall be carefully aligned so that all rows appear as straight lines.
- .2 Fixtures shall be installed accurately in line and level. Any fixtures which are not installed properly shall be taken down and re-installed at no change to the contract sum. Plaster frames and rings required for recessed fixtures shall be supplied under this section, and installed under the lathing and plaster or acoustic ceiling divisions. The work of the electrical division shall include the necessary co-ordination with the above divisions in regard to the correct location and installation of the plaster frame and rings.

**4.6 WARRANTY**

- .1 The contractor must make available to the Owner a local service department of a duly authorized distributor of the equipment manufacturer, which shall stock the manufacturer's standard parts. The service department shall have at least one factory trained repair technician available to the Owner on 24 hours' notice.
- .2 Provide warranty of installation of equipment installed by this contractor to be free of defects for a period of (1) one year from date of Substantial Completion.
- .3 Provide during the warranty period, all service, maintenance, parts, etc., required for normal operation of the systems, such that Owner needs not purchase additional maintenance agreement or contracts. Upon request, the manufacturer and his agent shall provide direct to the Owner the following proposals:
  - .1 Continuation, after the warranty period, of full maintenance, including all service, labour, parts, etc. required to maintain the systems in a fully operational condition.

**4.7 VERIFICATION**

- .1 Perform tests in accordance with:
  - .1 Section 26 05 01 - Common Works Results - Electrical
- .2 The entire installation shall be performed under the supervision of the manufacturer. Upon completion of the installation, the manufacturer shall check and test the entire system. Certification of all tests shall be submitted in writing to the Consultant and shall certify the following:

- .1 That the system is complete in accordance with this specification
- .2 That the system is installed in accordance with the manufacturer's best recommendations
- .3 During the certification tests, the contractor shall provide one (1) electrician and (1) helper to assist the manufacturer's representative. The contractor shall also provide any required equipment such as ladders, scaffolding, etc.

**4.8 TRAINING**

- .1 Perform training in accordance with:
  - .1 Section 26 05 01 - Common Works Results - Electrical
- .2 Written documentation bearing name and signature of Owner's personnel who received the above instructions shall be included in the operating instructions and service manuals.

**END OF SECTION**

**Part 1 General**

**1.1 RELATED SECTIONS**

- .1 Section 26 05 01 - Common Work Results - Electrical.
- .2 Section 27 05 14 – Communication Cables Inside Buildings
- .3 Section 27 05 28 – Pathways for Communications Cabling
- .4 Section 27 11 19 – Communications Terminal Blocks and Patch Panels

**1.2 REFERENCES**

- .1 CSA C22.1-12, Canadian Electrical Code, Part 1, 2015
- .2 Canadian Standards Association, (CSA International)
  - .1 CSA-T529, Telecommunications Cabling Systems in Commercial Buildings (Adopted ANSI/EIA TIA 568A with modifications).
  - .2 CSA-C22.2 No. 214, Communications Cables (Bi-national Standard, with UL 444).
  - .3 CAN/CSA-C22.2 No. 182.4, Plugs, Receptacles, and Connectors for Communication Systems.
- .3 Telecommunications Industry Association (TIA)
  - .1 TIA/EIA/ANSI – 568B.1/2/3 latest revision Commercial Building Standards for Telecommunications Pathways and Spaces;
  - .2 TIA-568-C.0 Generic Telecommunications Cabling for Customer Premises;
  - .3 TIA-568-C Series Commercial Building Telecommunications Cabling Standard;
  - .4 TIA/EIA-569 Commercial Building Standard for Telecommunications Pathway and Spaces;
  - .5 TIA/EIA-606 The Administration Standard for the Telecommunications Infrastructure of Commercial Building;
  - .6 TIA/EIA-607 Commercial Building Ground (Earthing) and Bonding Requirements for Telecommunications;
  - .7 Category 5e system and testing as released by TIA/EIA/ANSI – latest revision
  - .8 TIA/EIA T568-A UTP wiring/pinout
- .4 The structured communication wiring system shall comply with Treasury Boards Information Technology Standard for wiring as described in the TBITS 6.9 document. TBITS 6.9 – Profile for the Telecommunications Wiring System in Government Owned and Leased Buildings – Technical Specifications) shall be as per Information and Technology Standards:  
<http://www.tbs-sct.gc.ca/it-ti/itp-pti/its-nit-eng.asp>

### **1.3 SYSTEM DESCRIPTION**

- .1 The data and voice cable installation, shall include all cable, connectors, patch panels, patch cords, racks, bix blocks, etc., as specified and shown on the drawings
- .2 The cabling system shall meet or exceed the minimum characteristics as outlined TIA Standards Category 5e. In addition, the testing method and parameters shall be as per the TIA recommendations.
- .3 The cabling system shall use matched components from a single manufacturer certified to deliver system performance over the lifetime of the applications which the cabling system was originally designed to support. The data system and components to be certified by the manufacturer and shall be guaranteed for a period of fifteen (15) years from the date of installation against defects in materials and workmanship.

### **1.4 SUBMITTALS**

- .1 Submit product data in accordance with Section 01 33 00 - Submittal Procedures and 26 05 01 – Common Work Results, Electrical.
- .2 Submit shop drawings for review prior to ordering equipment. Shop drawings shall include but not be limited to, photocopies of accredited installers, cabling, hardware and components, patch cords, tester information, and labeling.
- .3 Submit manufacturer’s certification documentation that guarantees installation techniques, cable and cabling components and carry a minimum 15 year certification from the manufacturer for the capability to support gigabit applications such as 1000 Base-T, 622MB/s and 2.4 Gb/s ATM and work case channel performance based on the values indicated. The term channel performance incorporates manufacturer certified patch cords.
- .4 Upon request and at no cost, the contractor shall provide a manufacturer’s technical representative to conduct an onsite visit to ensure complete technical compliance.
- .5 The manufacturer’s certification must guarantee that design or installation negligence on the part of the certified contractor will not negate or void any portion of the certified system. The manufacturer must guarantee that all material, components and labour are covered for the full certification period. It must also guarantee that in the event a contractor is no longer in business, the full certification remains valid.

### **1.5 CONTRACTOR QUALIFICATIONS**

- .1 The Installer (Firm and Employees) conducting the installation shall have full working knowledge of cabling low voltage applications such as, but not limited to data/voice communications cabling systems. The Installer shall have at least five years of continuous recent experience on similar projects. The Installer shall hold recent, up-to-date licenses, certifications and training certificates in the area the project is located and for the equipment to be installed. The Installer shall:
  - .1 Provide references of the type of installation provided for this specification;
  - .2 Have a knowledge of all applicable Telecommunication standards such as but not limited to CSA, TIA/EIA, IEEE and ANSI;
  - .3 Have a experience in the installation of pathways and support for horizontal and backbone cabling;



- .4 Be experienced in the installation and testing of telecommunication network cabling system, including the use of light meter and OTDR.
- .5 Provide proof of being a manufacturer certified installer for all cable network components being installed such as but not limited to cables, connectors and end termination equipment. The use of non-manufacture certified installer is not permitted.

## **1.6 PROJECT CLOSEOUT**

- .1 Submit product data in accordance with Section 01 33 00 - Submittal Procedures and 26 05 01 – Common Work Results, Electrical.
- .2 Operating and Maintenance Manuals at project closeout shall include
  - .1 List of cables, hardware and components;
  - .2 Copies of approved shop drawings;
  - .3 Record drawings.
  - .4 Warranty certification from the Manufacturer
  - .5 Receipts that include the listing of spare parts, materials and supplies, including patch cables and equipment cords.
  - .6 Test and verification reports (may be submitted on CD Disk inserted in an appropriate envelope page in the manual).

## **1.7 WARRANTY**

- .1 Testing and certification of the building network distribution cable installation shall be by the Installer and shall include the provision of a full Manufacturer's and Vendor's Warranty covering performance, products and installation. The Warranties shall cover the full repair and/or replacement of any component failing or failure to meet the design requirements within one (1) year. Warranties shall be delivered to the Project Manager with the Testing and Certification documentation.
- .2 Within ten (10) days after testing, the Installer shall submit the cable test results, and a marked up record drawing(s) of the as-built cable network. The record drawing(s) shall include the cable/jack identification at the outlet locations.

## **Part 2 Products**

### **2.1 COMMUNICATION CABLES, PATHWAYS AND TERMINATION BLOCKS**

- .1 Refer to Section 27 05 14 - Communication Cables Inside Buildings
- .2 Refer to Section 27 05 28 – Pathways for Communications Systems
- .3 Refer to Section 27 11 19 – Communications Termination Blocks

## **Part 3 Execution**

### **3.1 FIELD QUALITY CONTROL**

- .1 Perform tests in accordance with Section 26 05 01 - Common Work Results - Electrical.

- .2 The communications cabling system and testing shall comply with the following standards. All standards shall be as per the latest revision at the time of tendering this project.
  - .1 TIA/EIA/ANSI – 568C.1/2/3 latest revision
  - .2 Category 5e system and testing as released by TIA/EIA/ANSI – latest revision
  - .3 TIA/EIA T568-A UTP wiring/pinout
  - .4 BICSI, TDMM Telecommunications Distribution Methods Manual (latest edition)
  - .5 CAN/CSA-T529-M91
  - .6 CAN/CSA-T530-M90
  - .7 CAN/CSA-T527-94, EIA/TIA-607
  - .8 CAN/CSA-T528-93, EIA/TIA-606
  - .9 EIA/TIA-TSB 40-A
  - .10 EIA/TIA-TSB 67
  - .11 EIA/TIA-569
  - .12 EIA/TIA-606
- .3 The total installation shall be completed by the cable Installer who is certified by the manufacturer for Category 5e installations. The Installer shall submit photocopies of accreditation certificates with the shop drawings. Submit testing method and tester with shop drawings.
- .4 The contractor shall submit the verified test result on each cable, connector, and connection for the total installation, including back-bone and horizontal cabling. The model number and manufacturer of the Category 5e cable and fibre cable shall be documented. The type of tester used for testing the Category 5e cabling and fibre cabling must also be documented.
- .5 Test results shall be evaluated by the test equipment using the most up-to-date criteria from the TIA/EIA Standard. This information shall be supplied in electronic format.
  - .1 Room number of installation
  - .2 Wall plate ID
  - .3 Test Results with an identification of type of test used and whether the result was PASS or FAIL
- .6 Category 5e cable tests shall provide results for the following tests:
  - .1 Near End Crosstalk (NEXT)
  - .2 Attenuation
  - .3 Ambient Noise
  - .4 Attenuation to Crosstalk Ration (ACR)
  - .5 Far End Crosstalk (FEXT)
- .7 Provide with maintenance manuals, a marked set of prints illustrating the network drop name for each drop location. No other as-built information shall be provided on these prints unless it relates to the data or voice network.
- .8 The consultant will spot test this testing following test completion. Contractor shall provide the testing technician for (2) hours, and the completed test charts, for spot check verifications.

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**3.2 GROUNDING AND BONDING FOR COMMUNICATION SYSTEM**

- .1 Bonding Backbone shall consist of green jacketed stranded copper conductors and insulated ground bars.
- .2 Install a #6 AWG insulated ground connection directly to each equipment rack in LAN Rooms. Each ground connection shall be terminated at the existing building ground system.
- .3 Bus bars shall be an insulated pre-drilled, electro tin plated copper busbar, minimum 6mm thick x 100mm wide x 305mm long (or length that is determined by the number of required connections including space for additional bond connections). Mount up 300mm above finished floor near the equipment rack location.
- .4 Aluminum wires, clamps or terminal connectors will not be accepted for grounding and bonding.
- .5 Terminations to the telecommunication ground bus bars shall be installed without splices where possible. If splices are necessary, they shall be as few as possible. Use irreversible compression-type connectors, exothermic welding, or equivalent. The connection to the ground bus bar shall be done using 2-hole compression connectors.

**END OF SECTION**

**Part 1            General**

**1.1                RELATED SECTIONS**

- .1        Section 26 05 01 - Common Work Results - Electrical.
- .2        Section 27 00 00 – Communication Requirements
- .3        Section 27 05 28 – Pathways for Communications Cabling
- .4        Section 27 05 14 – Communications Terminations Blocks

**1.2                SYSTEM DESCRIPTION**

- .1        Install and test all vertical riser/backbone cabling (copper, fibre, coaxial) and horizontal communication building cable (copper, fibre, coaxial).
- .2        All cables as a minimum meet CSA Flame test 6 (FT6) CMP rating.

**Part 2            Products**

**2.1                COPPER VERTICAL RISER / BACKBONE CABLING**

- .1        All vertical riser cables for telephones shall be 100 ohm UTP, solid copper, 24 AWG Category 5E and shall be minimum 25 pair unless noted otherwise on drawings. All vertical riser cabling for telephones shall be grey.
- .2        Voice riser cabling shall be CMP/FT6 rated for use indoors.
- .3        All voice risers shall terminate on BIX1A/110 or equivalent blocks at the LAN Room BIX termination blocks; at 48-port Category 5E patch panel at the Lan Room equipment rack. Provide a 3 meter service loop prior to termination on each end.
- .4        All vertical riser data cables shall meet minimum Category 6 requirements as detailed in the latest TIA/EIA-568C revisions. Provide 3 meter service loop prior to termination on each end.

**2.2                HORIZONTAL COMMUNICATIONS BUILDING CABLE (CBC)**

- .1        All communication cable (data and voice) shall be unshielded twisted pair, Category 6. four (4) pair #23 AWG, CMP (FT6) rated and meet TIA/EIA/ANSI – 568-C.2, latest revision unless noted otherwise. All data cable shall be blue.
- .2        Each cable shall be equipped with connectors on each end at the wall jacks and patch panels at the data equipment racks.
- .3        The data cabling channel shall not exceed four (4) connections and overall length shall not exceed 90m. The maximum distance shall include an allowance of 3 meters from the outlet to the workstation and 6 meters for patch cords.
- .4        Data and voice may be installed in a common box.

- .5 A minimum of two Category 6 UTP cables shall be installed at each workstation unless otherwise noted on the drawings.

### **2.3 PATCH CORDS**

- .1 Pre-terminated, factory tested patch cords shall be of the same and shall be part of the certified system. Patch cables shall be labeled at both ends.
- .2 Patch cords for data and voice cables shall have stranded conductors and meets the requirements of TIA/EIA 568B (latest revision). Patch cords shall meet Category 6 criteria when tested with the components of the system. Patch cords at workstations shall be Category 6 cable terminated with 8 pin modular male jacks, TIA T568A pinout.
- .3 Provide patch cords for each cable drop located on the plans.
- .4 Provide cords in the following lengths: 50% (data total) shall be 1.2m length; 30% (data total) shall be 1.8m length; 20% (data total) shall be 2.1m length.
- .5 Fiber patch cords: All fibre cable shall be multimode tight buffered, multi-fibre building cable unless noted otherwise.

## **Part 3 Execution**

### **3.1 INSTALLATION OF COMMUNICATION CABLES**

- .1 All cable shall be pulled using proper wire grips. Pulling force and bend radius shall not exceed manufacturer's specifications.
- .2 Velcro straps shall be used in all locations, cable ties are unacceptable.

### **3.2 FIELD QUALITY CONTROL**

- .1 Perform tests in accordance with Section 26 05 01 - Common Work Results – Electrical and Section 27 00 00 – Communication Requirements.

**END OF SECTION**

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**Part 1            General**

**1.1                RELATED SECTIONS**

- .1        Section 26 05 31 - Splitters, Junction, Pull Boxes and Cabinets.
- .2        Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.
- .3        Section 27 00 00 – Communication Requirements
- .4        Section 27 05 14 – Communication Cables Inside Buildings
- .5        Section 27 11 198 – Communications Termination Blocks and Patch Panels

**1.2                SYSTEM DESCRIPTION**

- .1        Telecommunications raceways system consists of outlet boxes, cover plates, cabinets, conduits, cable troughs, pull boxes, sleeves and caps, fish wires, service poles, service fittings, concrete encased ducts.

**1.3                SHOP DRAWINGS**

- .1        Submit product data in accordance with Section 26 05 01 – Common Work Results, Electrical.
- .2        Submit shop drawings for review prior to ordering equipment. Shop drawings shall include but not be limited to, photocopies of accredited installers, outlets, coverplates, “water fall kits”, cable management.

**Part 2            Products**

**2.1                MATERIAL**

- .1        Conduits: in accordance with Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings
- .2        Cable troughs: type, in accordance with Section 26 05 36 - Cable Trays for Electrical Systems
- .3        Junction boxes, in accordance with Section 26 05 31 - Splitters, Junction, Pull Boxes and Cabinets

**2.2                OUTLET BOXES**

- .1        Outlet boxes shall be 100mm square boxes. Multiple boxes shall not be ganged unless noted otherwise.
- .2        Wall plates for communication cable systems shall have integral self labeling. The wall plates must support up to four (4) network drops and be run in a minimum of **27mm** conduit to the nearest equipment rack or stub at the basket tray in the accessible ceiling. Provide blank filler plates for unused drops.

- .3 Wall plates shall be modular and in 'Keystone' format opening to allow the possibility of changing connector types in the future without replacing the wall plate. Faceplates shall be equipped with small form factor terminating connectors to fit the individual outlet's requirements (RJ45 and or Dual LC and or CATV bulkheads).
- .4 Wall plates shall be equipped with a minimum of four (4) keystone openings. The installer shall equip the wall plate with the required amount of blank inserts as required. The minimum standard of acceptance for wallplates are Corning WLL-PL-AP or Panduit NK4VSFWH.

### **2.3 CABLE MANAGEMENT**

- .1 Velcro ties shall be used. Each cable type shall be bundled separately; that is data bundle, voice bundle, and fibre bundle. Cable ties wraps are unacceptable.

## **Part 3 Execution**

### **3.1 INSTALLATION**

- .1 All horizontal cables shall be run in conduit. All raceways shall be grounded. All conduit shall have suitable bushings.
- .2 Backbone/riser cables (fibre, copper) and horizontal cables shall be run in EMT conduit, minimum 27mm diameter unless otherwise noted on drawings. Maximum allowable percentage conduit fill shall not exceed 40%.
- .3 EMT conduit shall be reamed and bushed at both ends and bonded to the distribution system. Rigid PVC or flexible metallic or PVC conduits are not acceptable.
- .4 Inside radius bend in EMT conduit shall not be less than 6 times the internal diameter for conduit sizes up to 41mm inside diameter; 10 times the internal diameter for conduit sizes 53mm diameter and larger.
- .5 Pull boxes shall be installed in conduit runs where the total number bends exceed 180 degrees; where the overall length of the conduit run is more than 30m, or if there is a reverse bend in the run.
- .6 Pull boxes shall be installed in the straight sections of the conduit run and shall not be used lieu of a bend. Corresponding ends of conduit shall be aligned with each other. Conduit fittings shall not be used in place of pull boxes or bends.
- .7 Use of LL, LR and LL conduit fittings is not permitted.
- .8 The use of J-Hooks, brackets, cable ties and other attachments to support cabling **is not** permitted.
- .9 In all wall outlet boxes, the contractor shall leave 400mm length of cable in each box.
- .10 In all wall workstation drops, leave 300mm of cable slack before entering wall or workstation in suspended ceiling.

**END OF SECTION**



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**Part 1            General**

**1.1                RELATED SECTIONS**

- .1        Section 26 05 01 - Common Work Results - Electrical.
- .2        Section 27 05 28 – Pathways for Communications Cabling
- .3        Section 27 05 14 – Communication Cables Inside Buildings

**1.2                REFERENCES**

- .1        2015 Canadian Electrical Code
- .2        Canadian Standards Association (CSA) International
  - .1        CAN/CSA-C22.2 No.182.4, Plugs, Receptacles and Connectors for Communication Systems.
  - .2        CSA T529, Telecommunications Cabling Systems in Commercial Buildings (Adopted ANSI/EIA TIA 568a with modifications).
- .3        Electronic Industries Alliance (EIA) / Telecommunications Industries Association (TIA)
  - .1        TIA/EIA/ANSI – 568B.1/2/3 latest revision
  - .2        Category 5e system and testing as released by TIA/EIA/ANSI – latest revision
  - .3        TIA/EIA T568-A UTP wiring/pinout

**1.3                SYSTEM DESCRIPTION**

- .1        Termination, patch cords, and cross-connection equipment installed inside building for voice and data for telecommunications systems employing unshielded-twisted-pair (UTP), coaxial (CXC), and optical fibre (OFC) cables. Refer to drawings for special details.

**1.4                WASTE MANAGEMENT AND DISPOSAL**

- .1        Meet requirements of Section 01 74 19 - Waste Management and Disposal.
- .2        Collect and separate waste for reuse, recycling, and other waste diversion strategies in accordance with Waste Management Plan.

**1.5                SHOP DRAWINGS**

- .1        Submit product data in accordance with Section 01 33 00 - Submittal Procedures and 26 05 01 – Common Work Results, Electrical.
- .2        Submit shop drawings for review prior to ordering equipment. Shop drawings shall include but not be limited to, photocopies of accredited installers, copper patch panels, copper termination jacks, coax jacks, fibre patch panels, fibre terminations, communication racks, cable management, and sample labeling.

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**Part 2 Products**

**2.1 PATCH PANELS, CONNECTORS AND ADAPTORS**

- .1 Data and voice patch panels shall be minimum 48-port panels mounted in the communication equipment racks. A minimum of 12 ports shall be spare for future. Patch panels shall be compatible with Category 5e installations, and shall accept snap-in non keyed modular 8-pin jacks with T568A pinout.
- .2 Connectors shall be modular 8 PIN jacks, rated Category 5e –TIA/EIA T568-A UTP wiring/pinout. All data jacks shall be white and all voice jacks shall be blue.

**2.2 COMMUNICATION RACKS**

- .1 Refer to drawings for wall mounted communication rack details.
- .2 Provide a two-ring horizontal wiring management between each patch panel. The horizontal wire management shall occupy a maximum 2U rack space.
- .3 All racks shall be grounded with a minimum #6 AWG insulated ground wire connected to the building ground bus within the data/com room.

**Part 3 Execution**

**3.1 LABELLING**

- .1 Cable labels shall be self laminating labels as manufactured by Burndy or Panduit.
- .2 Cable labels shall be self laminating labels as manufactured by Burndy or Panduit.
- .3 Labeling shall be typewritten and be in accordance with TIA 660. Cabling shall be labeled with the drop ID number at both termination points. Cable labeling shall be a logical numbering system. Confirm if owner has special labeling system prior to installation. If owner has no set labeling system, confirm contractor suggested labeling with owner or consultant prior to any installation. The owner must sign off on labeling prior to installation; this sign-off shall be included in the maintenance manuals.
- .4 Bix Blocks, Patch panels, and wall plates shall have integral labeling; self-adhesive labels will not be acceptable. Wall plates shall have self-adhesive icons adjacent to each jack of either a telephone or workstation to illustrate type of jack.

**3.2 FIELD QUALITY CONTROL**

- .1 Perform tests in accordance with Section 26 05 01 - Common Work Results – Electrical and 27 05 14 - Communication Cables Inside Buildings.

**END OF SECTION**

**PART 1      General**

**1.1      RELATED SECTIONS**

- .1      Section 26 05 01 – Common Work Results – Electrical
- .2      Section 27 05 28 – Pathways for Communication Systems
- .3      Section 27 05 14 - Communication Cables Inside Buildings.

**1.2      REFERENCES**

- .1      The Electrical Contractor and Sound Enhancement System supplier shall be bound by industry standards, as interpreted by the Consultant, whether or not specifically referenced in this document. Comply with Electrical Protection Act and rules and regulations made pursuant thereto, including the Canadian Electrical Code. Also, comply with applicable standards of the following:
  - .1      Electrical and Electronic Manufacturers Association of Canada (EEMAC).
  - .2      National Electrical Manufacturers Association (NEMA).
  - .3      Institute of Electrical and Electronic Engineers (IEEE).
  - .4      Audio Engineering Society (AES).
  - .5      Applicable Electrical Safety Codes, 2015 Canadian Electrical Code.
  - .6      Applicable CSA and UL approvals.

**1.3      SHOP DRAWINGS AND PRODUCT DATA**

- .1      Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures and 26 05 01 – Common Work Results
- .2      Shop drawings shall include but not be limited to, Speakers, Amplifier and/or Mixers, Cable Types, Signal Processing Equipment, Rack Layout, Riser Diagram, and Special Mounting Details.

**1.4      WASTE MANAGEMENT AND DISPOSAL**

- .1      Meet requirements of Section 01 74 19 - Waste Management and Disposal.
- .2      Collect and separate waste for reuse, recycling, and other waste diversion strategies in accordance with Waste Management Plan.

**1.5      SYSTEM DESCRIPTION**

- .1      The Electrical Contractor shall provide the infrastructure for a fully operational Sound Enhancement System as herein specified. This specification shall be read in conjunction with specification section 27 05 28 – Pathways for Communication Systems.
- .2      It shall be the responsibility of the Electrical Contractor to ensure that all necessary interconnecting wiring, etc., are provided to result in a fully operational system. The Electrical Contractor shall be responsible for coordinating testing, schedule, rough-in, etc with the Sound Enhancement System supplier, and general contractor

- .3 The Electrical Contractor shall exercise caution, as necessary, to guard against electrostatic hum, and to install cabling as to provide maximum safety to non-technical operators.

## **1.6 SCOPE OF WORK AND REQUIREMENTS**

- .1 The intent of this document is to define operational requirements, specify scope of work and provide technical detail for equipment required for the Sound Enhancement System within the facility, as illustrated on the drawings.
- .2 Scope of the work shall include an independent sound system for use in the gun range with appropriate loudspeakers, audio amplifiers, DSP audio processing, wireless microphones and input wall jacks.
- .3 Audio amplifiers, DSP processing and other associated equipment shall be located in a fixed location. Refer to the drawings for location of equipment.
- .4 This sound system equipment shall be modular in design to facilitate technical access and maintenance.
- .5 The Electrical Contractor shall supply and install the sound equipment to assure ease of operation by non-technical staff.
- .6 Conduit, junction boxes, cabling, and speaker backboxes are provided by the Electrical Contractor. Coordinate with the Sound Enhancement System supplier to assure adequate conduit provisions for proposed sound system. No extras will be allowed, after the contract is award, for additional conduit or increased size to accommodate a particular system design. Coordinate with other work, including low tension cabling and wiring into common fixtures.
- .7 Wiring for the sound system shall be PVC insulated, twisted pair (or multi-conductor), as required. Provide shielded microphone cable and shielded program (line) level cable, as required. Isolate microphone, line level and speaker level cable runs, as required.
- .8 All wiring to be terminated in approved terminal panels, junction boxes, on suitable terminal strips or blocks, and to be neatly installed, laced and labelled where required. All connections in sound terminal panels and junction boxes to be made with solderless connectors to screw clamp type terminal blocks with separate terminal for each cable/conductor.
- .9 Cable gauge and type, selected at the sound system contractor's discretion, shall enable the system to perform to the specified technical requirements here in, and completed to the satisfaction of the Consultant.
- .10 All equipment provided shall be manufactured for commercial and professional sound reinforcement applications. Exceptions to this shall be approved by the consultant via the shop drawing process.
- .11 Submit shop drawings prior to equipment orders. These shall include, but not be limited to, detailed product specification sheets, custom panel layout and system schematic complete with interconnection details.

- .12 The bidder shall inspect the Electrical drawings to ensure all specified requirements will be met to their satisfaction. It shall be the responsibility of the bidder to ensure that all necessary equipment, components and accessories are provided to result in a fully operational audio system, as illustrated and specified.
- .13 The sound enhancement shall be provided by one qualified contractor that is able to supply, install and tune a system of this scope and technical performance. Selection of a compliant bid shall be made on the basis of quality and compatibility of equipment offered, current technical service capability, similar project experience, and past performance of the audio contractor.

## **1.7 CLOSEOUT SUBMITTALS**

- .1 Provide operation and maintenance data for public address system for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.
- .2 Include:
  - .1 Operation instructions.
  - .2 Description of system operation.
  - .3 Description of each subsystem operation.
  - .4 List specifying each piece of equipment in system or subsystem by its original manufacturer name and model number.
  - .5 Part list specifying parts used in equipment by identification numbers that are standard to electronic industry.

## **1.8 SYSTEM STARTUP**

- .1 Manufacturer's representative to instruct:
  - .1 Maintenance personnel in maintenance of system.
  - Operating personnel in use of system.

## **PART 2 Products**

### **2.1 TECHNICAL REQUIREMENTS**

- .1 Provide professional sound products and technical services to assure overall system performance, as specified herein.
- .2 Technical performance of the audio system and associated sub-systems must perform to the satisfaction of the Consultant. The system must be free of all mechanical noise, very low in harmonic distortion and cross-talk, free of low frequency 60 cycle hum, switching noise and/or higher harmonic noise or buzz. System hum and noise shall be less than -70 dBm (50 Hz to 16,000 Hz); overall system harmonic distortion shall be less than 2% measured at stated operating levels and specified frequency response.
- .3 Overhead loudspeakers shall provide even distribution of sound at the applicable associated firing line. Typical loudspeaker placements are illustrated for reference purposes only. Actual loudspeaker provision and placement shall assure uniform sound pressure levels, side-to-side, front-to-back, with  $\pm 2$  dB @ 2,000 Hz octave band. Typical

speech reinforcement levels shall be 85 dB SPL, plus 10 dB peaking factor without audible distortion, measured 1.2 meters from floor level.

- .4 Overall system shall provide adequate dynamic range to assure microphone speech clarity with voice levels from 60 dB SPL to 95 dB SPL with presenter at 12" from microphone.
- .5 Overall system frequency response shall not vary more than  $\pm 2$  dB (100 Hz – 15,000 Hz). The system shall provide music reproduction, as well as highly intelligible speech performance. High speech intelligibility is the primary feature.
- .6 Final tuning must be provided, including but not limited to audio gain, equalization.
- .7 Final system tuning and control shall be provided to ensure a minimum effort by the end user/owner to operate the audio system in a reliable and easy fashion with minimal adjustments.
- .8 The sound enhancement system shall provide an adequate dynamic range, system gain, and/or sound pressure levels that ensure intelligible speech without feedback. Overall microphones and line inputs gains shall be no less than 12 dB overall.
- .9 A DSP shall be employed to maximize speech articulation and provide adequate acoustic gain and be capable of provided but not limited to, audio level control, equalization (parametric and graphic equalization), delay, ducking, compression, input and output limiting, matrix routing, low pass filtering, high pass filtering and speaker zone delays.

## **2.2 PRODUCT APPROVALS**

- .1 Manufacturers' and model numbers named in these specifications indicate an acceptable technical standard of performance and are not intended to be exclusive. Products submitted as alternates must result in an audio system that meets or exceeds all technical performance criteria as described
- .2 Products proposed as alternatives to those specified, shall only be considered if submitted for approval no later than 15 working days before tender close. Submit alternates, for approval, as one complete listing. Provide complete product specification sheets with request for approval
- .3 The Bidder must provide a complete list of primary system products offered with their bid. Failure to do so will disqualify their bid. This shall include but not limited to, loudspeakers, amplifiers, audio processing, system control and program input products
- .4 Loudspeakers proposed as alternatives must be demonstrated to perform equally as the accepted technical standard. Demonstration of performance will included EASE modelling as proof submitted for final approval to the consultant as stated above.

## **2.3 AUDIO POWER AMPLIFIERS**

- .1 Provide high performance professional grade power amplifiers with power ratings and technical performance such that each loudspeaker shall achieve the overall audio system performance specification stated.
- .2 Technical specifications shall include:

- .1 Shall be modular power, two-channel x 500W each channel amplifiers as required.
  - .2 All amplifiers shall be rack mountable.
  - .3 Have non-linear switching power supplies.
  - .4 Cooled by forced air.
  - .5 Have electronically balanced XLR inputs with an input impedance of 10Kohms or greater.
  - .6 Provide full short circuit protection and power monitoring capabilities.
  - .7 Amplifiers shall be capable of driving 70V speakers.
  - .8 Provide adequate power capacity for all loudspeakers with added headroom of 3db SPL or greater for the specified loudspeakers.
- .3 Shall be Crown CDi 1000 or approved equal.

## **2.4 DSP / MATRIX ROUTING**

- .1 Provide one (1) DSP that shall provide the following.
- .2 Performance features and functions shall include but not limited to:
  - .1 Fully programmable, fully configurable DSP based audio signal processing and control via a programmable drag and drop interface.
  - .2 8 balanced analogue inputs and 8 balanced analogue outputs.
  - .3 24 bit A/D converters and 24 bit D/A converters utilizing software selectable sample rates of 44.1 kHz or 48 kHz, 64 kHz, 88.2 kHz or 96 kHz.
  - .4 Floating point DSP engine.
  - .5 All audio processing shall be accomplished via DSP methods. These processes shall include but not limited to the following: audio level control, equalization (parametric and graphical), speaker zone delays, zone control, gating, ducking, output limiting, matrix routing, low pass filtering, high pass filtering, and band pass filtering.
  - .6 Metering for audio signals within DSP.
  - .7 The host processor unit shall have non-volatile flash memory to be used as primary storage media and operating system root.
  - .8 Reconfigurable via site computer loaded software.
  - .9 Wireless zone and volume control via device through iOS application over local closed CCTV/Audio communication network.
- .3 Technical specifications shall include:
  - .1 Frequency response @ 20 Hz to 20 kHz;
  - .2 Total harmonic distortion no more than .02% from 20 Hz to 20 kHz.
  - .3 Dynamic range of not less than 107 dB unweighted;
  - .4 Input common mode rejection ratio (CMRR) greater than 75 dB @ 1KHz.
  - .5 Maximum input level without clipping shall be +20 dBu while maintaining CMRR;
  - .6 Maximum output level shall be +19 dBu;

.4 Shall be manufactured by Soundweb London or approved equal.

**2.5 ZONE AND VOLUME CONTROL PANEL (SHOWN AS AIP1)**

.1 Provide loudspeaker zone control panel to allow individual selection of inputs and volume control.

.2 The controller shall include one rotary volume control and eight zone control mute/unmute buttons.

.3 The rotary volume control shall be complete with LED display of current volume level.

.4 Zone control buttons shall have LED status display and customizable LED label.

.5 Controller shall communicate via Ethernet cable back to accompanying DSP.

.6 Black finish in double gang box.

.7 Locate control panel(s) as shown on drawings.

.8 Shall be Soundweb London EC-8BV or approved equal.

**2.6 AUDIO INPUT PANEL (SHOWN AS AIP2)**

.1 Audio input panel shall be suitable for connection to 1/8" auxiliary input.

.2 Provide single gang box complete with black coverplate. Located beside zone/volume control panel.

**2.7 FEEDBACK SUPPRESSOR**

.1 Provide one (1) dual channel automatic feedback suppressors.

.2 Technical features shall include:

- .1 Automatic feedback detection using FFT signal analysis for up to 24 filters per channel
- .2 Notch filters up to 1/80th octave
- .3 Automatic mode for continuous monitoring of mix signal
- .4 24-bit / 48kHz A/D and D/A converters
- .5 THD 0.003% or better
- .6 Frequency response 20Hz ~ 20kHz, +/- 0.5dB
- .7 DSP audio engine
- .8 Balanced input and servo-balanced outputs, XLR and 1/4" TRS connectors
- .9 Switch mode power supply

.3 Feedback suppression shall be the DBX AFS224 or approved equal.



## **2.8 SURFACE MOUNTED SPEAKERS**

- .1 Provide full-range, coaxial loudspeakers with integrated transformer. See drawings for speaker locations.
- .2 Specifications:
  - .1 Surface mounted 2-way coaxial full range speaker, C/W speaker back box and grill
  - .2 Beam width: 100°H x 100°W
  - .3 Frequency response: 70 Hz to 23 kHz or better
  - .4 Sensitivity @ 1 W/M: 87 dB SPL (min)
  - .5 Power rating: 60W, 30W, 15W, 7.5W @70V
  - .6 Color: Black
  - .7 Outdoor rated
  - .8 Provide adjustable mounting hardware to allow aiming of speaker after installation without the requirement of removing speaker from mounted location.
- .3 The technical standard of acceptance is JBL Control 25AV or approved equal.

## **2.9 CEILING MOUNTED SPEAKERS**

- .1 Provide speakers in T-bar ceiling locations as shown on the drawings. Exact locations of speakers shall be coordinated on site.
- .2 Specifications:
  - .1 Recessed ceiling mounted speakers shall be 3” co-axial bass reflex c/w back box/can and grill.
  - .2 Beam width: 130° Conical
  - .3 Frequency response: 70 Hz to 17 kHz or better
  - .4 Sensitivity @ 1 W/M: 90 dB SPL (min)
  - .5 Power rating: 15W, 7.5W, 3.8W, 1.9W @70V
  - .6 Color: Black grille
- .3 The technical standard of acceptance shall be the JBL Control 12C/T or approved equal.

## **2.10 POWER SEQUENCER**

- .1 Provide sequential power unit for all audio equipment in rack.
- .2 Delay interval of 0.2 to 10.0 seconds per step.
- .3 6 electrically isolated relay outputs.
- .4 Front panel status indication of all outputs on/off.
- .5 Rack mountable, occupies 1U of space.
- .6 Minimum of 3 delayed output groups:
  - .1 Effects equipment; feedback suppressor, mic mixer.
  - .2 DSP
  - .3 Amplifiers

- .7 Provide all low voltage wiring connections to AC power controller.
- .8 Unit shall be the Furman Powerlink Remote Sequencer or approved equal.

## **2.11 POWER CONDITIONER/AC POWER CONTROLLER**

- .1 Provide four power conditioner/AC power controllers for audio equipment in rack.
- .2 Specifications:
  - .1 Ability to control 20A circuit through remote switch closure provided by power sequencer.
  - .2 Units shall be rack mountable and two units shall be mounted in a single 1U space.
  - .3 Provide voltage/surge clamping, EMI/RFI filtering.
- .3 The four units shall be grouped as follows:
  - .1 Effects equipment; feedback suppressor, mic mixer.
  - .2 DSP
  - .3 Amplifiers 1 and 2
  - .4 Amplifier 3
- .4 Unit shall be the Furman Powerport AC Power Controller or approved equal.

## **PART 3 Execution**

### **3.1 INSTALLATION**

- .1 The Electrical Contractor shall coordinate all work with the Sound Enhancement System supplier. Electrical Contractor shall provide all conduit, panel boxes, and junction boxes as indicated and specified.
- .2 All wiring shall be in separate EMT conduit utilized solely for Sound Enhancement System, or within communication tray. Cabling shall be run in EMT conduit to within 305 mm of communication lay-in tray.
- .3 All audio equipment, except portable devices, shall be with fixed mounting. This shall include loudspeakers, input and output jacks, switches and interconnecting cable.
- .4 The exception to rigid mounting shall be for low frequency loudspeakers, which require resilient shock mounting for vibration isolation from structure.
- .5 All loudspeaker fastenings and supports shall be of appropriate type to support loads with a safety factor of eight times their weight.
- .6 Audio processing and amplifier components shall be mounted into a rack. Layout of equipment rack shall be coordinated, with the Consultant, by Shop Drawings process. Install equipment in accordance with manufacturer's instructions.
- .7 All wiring shall be executed with strict adherence to audio systems industry standards, with due consideration to consistent polarity, appropriate grounding and shielding practices.

- .8 No audio cable shall be installed adjacent to power cable or power conduit.
- .9 Racked equipment terminations shall be on appropriate terminal panels. Terminations shall allow easy connection of common circuits and easy isolation for testing and/or maintenance. Program level audio wiring shall be terminated directly to appropriate equipment plugs and jacks. Wiring cables shall be installed and terminated directly with no cable splices.
- .10 Sufficient cable slack shall be left on terminations to allow easy removal of panels for maintenance and rewiring if required. Slack cabling shall be neatly coiled.
- .11 Connect equipment to preserve correct operating levels, impedance matching and signal phasing, throughout this system. All program level cables shall be terminated directly onto supplied equipment. All speaker level wiring shall be terminated onto appropriate panel connectors.
- .12 Install all equipment in orderly fashion, in accordance with industry standards for professional sound systems. This shall apply to wiring, cable routing, dressing and termination. Bundle and dress cables in equipment cabinets, separately, according to audio signal category. Secure neatly with plastic cable ties.
- .13 All rack equipment components shall be bolt mounted to facilitate easy removed during maintenance and easy replaced in reassembly.
- .14 Isolate cable shields from conduit system and other shielded cable. Cable shields shall be continuous from source to input points. All cables shall be single ended grounds only. Ground cables at signal receiving end only.
- .15 Unless otherwise approved, all cable balancing shall be isolating transformers with no ground connection on line side. Electronic balancing will normally be acceptable for input circuits.
- .16 Absolute phasing of loudspeaker lines shall be maintained. The contractor must take such precautions, as are necessary, in a public building, and in this particular environment, to guard against electromagnetic interference and electrostatic hum, and radio frequency interference. Equipment shall be installed to provide maximum safety to operators.
- .17 All program level feeds between racks and panel location shall be balanced, floating and ground free.
- .18 All heat sensitive electronic components shall operate within the manufacturers' specified temperature range. Where necessary use additional quiet running cooling fans.
- .19 Exact locations of jacks, speakers and associated products, shall be done in consultation with the Consultant. Typical locations are as shown on the associated drawings.
- .20 Transformers, connectors, volume controls and other incidental items shall be provided and installed to provide fully operational sound systems, as illustrated and specified.
- .21 All switches, connectors, input and output jacks, controls, shall be clearly, logically, and permanently marked upon completion of installation. All markings, on operating panels of equipment, shall be embossed letter or engraved 'Lamacoid' plates. Stick-on type

labels are not acceptable. Permanently mark adjustable controls, illustrating 'normal' operating positions on operator panels, where applicable. Mark cable ends with neoprene or clear shrink number identification sleeves. Both wire number and destination shall be clearly marked and protected. Record wiring identifications on project record drawings.

- .22 All equipment shall be installed and operated in full compliance with the manufacturers' recommendations and these specifications. Upon completion, the contractor shall fully check, test, and tune the system, making necessary adjustments to ensure optimum operation. Test, adjust audio levels and tune all systems, prior to commissioning date. Provide qualified technical personnel to assist Consultant with final testing, tuning and commissioning of system.
- .23 Throughout period of commissioning all amplifiers, audio processing equipment, microphones and input devices shall be powered up simultaneously, to demonstrate a fully operational system, where no unintended interaction between the installed and portable components exists.

### **3.2 TESTS AND ADJUSTMENTS**

- .1 Upon completion of audio system installation, tests shall be conducted by the Sound Enhancement System supplier to determine system performance conformity with regards to system tuning and loudspeaker performance requirements of this specification. Provide preliminary verification test reports 7 days prior to final commissioning.
- .2 All equipment, wiring and tuning provided by contractor which prove to be defective, deficient, or operating improperly, as determined by the Consultant, shall be corrected or replaced promptly, at no additional cost to the Owner.

### **3.3 COMMISSIONING AND TESTING**

- .1 The Owner's operating and maintenance personnel shall be instructed in the operating and maintenance of the Sound Enhancement System for a minimum period of 6-hours. Training shall be completed in 2 parts. The first training shall be 3 hours and shall be completed prior to substantial completion. The second training session shall be two months following completion to ensure owner understands system and requirements. Written documentation bearing name and signature of Owner's personnel who received the above instructions shall be included in the operating instructions and service manuals.

**END OF SECTION**

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**Part 1            General**

**1.1                SECTION INCLUDES**

- .1      Video cameras.
- .2      Camera lens with field of view.
- .3      Video handling.
- .4      Transmission methods.

**1.2                RELATED SECTIONS**

- .1      Section 26 05 01 – Common Work Results – Electrical
- .2      Section 27 05 14 – Communication Cables Inside Buildings
- .3      Section 27 05 28 – Pathways for Communications Cabling
- .4      Section 27 11 19 – Communications Terminal Blocks and Patch Panels

**1.3                REFERENCE STANDARDS**

- .1      Canadian Standards Association (CSA International)
  - .1      CSA C22.1-06, Canadian Electrical Code, Part 1 (20th edition) Safety Standard for Electrical Installations.
- .2      Underwriters' Laboratories (UL)
  - .1      UL 294, Standard for Safety for Access Control System Units.
  - .2      UL 1076-1995, Standard for Safety for Proprietary Burglar Alarm Units and Systems.
- .3      Underwriters Laboratories of Canada (ULC)
  - .1      CAN/ULC-S301, Central and Monitoring Station Burglar Alarm Systems
  - .2      CAN/ULC-S317-1996, Installation and Classification of Closed Circuit Video Equipment (CCVC) Systems for Institutional and Commercial Security Systems.

**1.4                WASTE MANAGEMENT AND DISPOSAL**

- .1      Separate and recycle waste materials in accordance with Section 01 74 19 – Construction/Demolition Waste Management Disposal.
- .2      Collect and separate waste for reuse, recycling, and other waste diversion strategies in accordance with Waste Management Plan.

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**1.5 DEFINITIONS**

- .1 CCTV: Closed Circuit Television.
- .2 NVR: Network Video Recorder
- .3 FOV: Field of View.
- .4 PoE: Power over Ethernet
- .5 PTZ: Pan - Tilt – Zoom

**1.6 DESIGN PERFORMANCE REQUIREMENTS**

- .1 Provide a complete fully operational closed circuit video surveillance system as shown on the drawings and herein specified.
- .2 The video surveillance system shall be a network and IP video system complete with software that acts as a CCTV management tool. The software shall allow a computer to complete the following:
  - .1 Real time access to live camera feeds.
  - .2 Access to playback synchronized archived videos and ability for integration with synchronized audio playback with video feeds.
  - .3 Allow download of archived files to local media.
- .3 The Contractor shall include a license for each camera and device operated through the software system.
- .4 The recording of all video shall be completed by the network video recorder (NVR). Contractor to verify that the proposed CCTV system does not exceed the NVR's bandwidth limits.
- .5 Environment: All exterior equipment shall be capable of operating in the adverse weather conditions where this system is installed. Design video components and systems to operate with all specified requirements under following ambient temperatures:
  - .1 Indoor installations:
    - .1 Temperature: 0°C to 30°C.
    - .2 Humidity: 10 to 90%.
  - .2 Outdoor installations:
    - .1 Temperature: -40°C to 60°C.
    - .2 Humidity: 10 to 100%.

- .6 Monitoring and control equipment will be located as noted on the drawings. Where indicated, the equipment shall be rack mounted.
- .7 All equipment furnished by this Division shall be the standard products of a single manufacturer. Catalogue and model numbers indicate design, quality and type of materials, as well as required operating characteristics. Substitution of products will only be considered when submitted in advance for approval with detailed supporting literature accompanying the request for approval.

## 1.7 SUBMITTALS

- .1 Product Data: Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures and Section 26 05 01 – Common Work Results, Electrical.
- .2 Submit shop drawings for review prior to fabrication of the equipment. Shop drawings shall include:
  - .1 Indicate project layout, camera locations, point-to-point diagrams, cable schematics, risers, mounting details and identification labelling scheme including:
    - .1 Functional description of equipment.
    - .2 Technical data sheets of all devices.
    - .3 Device location plans and cable lists.
    - .4 Video camera lens selection with surveillance chart.
    - .5 Complete system circuit diagram which clearly illustrate how all components are interconnected. All cables and terminations to be clearly marked.
- .3 Quality Assurance Submittals: Submit the following in accordance with Section 01 33 00 - Submittal Procedures and Section 26 05 01 – Common Work Results, Electrical.
  - .1 Test Reports: Submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.
  - .2 Certificates: Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
  - .3 Instructions: Submit manufacturer's installation instructions.
  - .4 Manufacturer's Field Services: Submit copies of manufacturer's field reports.
  - .5 Verification of Owner's instructions.
  - .6 Name of person(s) to be contacted for service or concerns related to warranty.
  - .7 Provide (3) three copies of operating and service manuals that includes the above shop drawing information and instructions

- .4 Maintenance Data: Submit maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals and Section 26 05 01 – Common Work Results, Electrical. Include following:
  - .1 System configuration and equipment physical layout.
  - .2 Functional description of equipment.
  - .3 Individual factory issued manuals, containing all technical information for maintenance purposes of all equipment installed.
  - .4 Instructions on operation in non-technical language which includes adjustment and cleaning.
  - .5 Illustrations and diagrams to supplement procedures.
  - .6 Manufacturer's operation instructions
- .5 Provide (3) three copies of operating and service manuals that includes the above shop drawing information, quality assurance submittals and maintenance data noted above.

## **1.8 WARRANTY**

- .1 The Contractor must make available to the Owner a local service department of a duly authorized distributor of the equipment manufacturer, which shall stock the manufacturer's standard parts. The service department shall have at least one factory trained repairman available on 24 hours notice.
- .2 Project Warranty: The system shall be guaranteed for a period of one year from date of project substantial completion. Provide, during the guarantee period, all service, maintenance, parts, etc., required for the normal operation of the systems, such that the Owner need not purchase additional maintenance agreement or contracts. Upon request, the manufacturer and his agent shall provide, direct to the Owner, the following maintenance proposals:
  - .1 Continuation, after the project warranty period, of full maintenance, including all service, labour, parts, etc., required to maintain the system in a fully operational condition.
  - .2 Factory training of two of the Owner's electronic technicians, sufficiently detailed such that they will be able to maintain, trouble shoot and repair the system.
- .3 Manufacturer's Warranty: Submit, for Consultant's acceptance, manufacturer's standard warranty document executed by authorized company official.
- .4 All warranty statements shall be included in the Owner's Electrical Maintenance and Operating Manuals.



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**Part 2            Products**

**2.1                GENERAL**

- .1      All video cameras shall be provided complete with motion detection, complete with option to record video only if motion is detected.
  
- .2      Contractor shall provide all system components not specified herein that are required for the system to operate. This includes but is not limited to, power over Ethernet switches, CAT6A connection to IT network, circuit breakers, patch cables, etc.
  
- .3      All video cameras shall be ULC listed products as manufactured by one of the following manufactures:
  - .1      AXIS Communications
  - .2      PELCO
  - .3      Panasonic
  - .4      Bosh

**2.2                VIDEO COMPONENTS**

**.1                 VIDEO MANAGEMENT SOFTWARE**

- .1      Characteristics:
  - .1      Capable of minimum 32 IP camera inputs.
  - .2      Serve minimum 4 monitoring stations, with 2 monitors and 1 keyboard/mouse at each station.
  - .3      Capable of displaying 4 x cameras on CCTV monitors directly through CCTV network. This display shall be configurable from client station.
  - .4      Display minimum 4 cameras on each viewing monitor without dropping any live viewing frames, capable of configuring amount of camera displays shown on each viewing monitor.
  - .5      Monitoring station system video/camera access restrictions individually configurable.
  - .6      Capable for deployment on 'commercial off the shelf' hardware.
  - .7      Provide ability to create events based on motion detection.
  - .8      Support standard compression formats including h.264.
  - .9      Mobile device monitoring support.
  - .10     Capable of de-warping 180deg and 360deg camera views and splitting these views into separate viewable feeds.

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- .11 Capable of customizable schedules for individual cameras to continuously record or record on motion during different parts of the day.
  - .2 System shall be manufactured by Genetec, Pelco, OnSSI, Iomnis, or approved equal.
  - .2 **NETWORK VIDEO RECORDER**– Rack mounted network IP camera recorder
    - .1 Network Video Recorder Characteristics:
      - .1 Hot-swappable hard drive capability.
      - .2 Hard drives shall be 7200RPM, minimum 1TB, enterprise quality drives.
      - .3 Contractor shall provide hard drives as needed to store system video for 30 days (after (minimum) RAID 6x usage has been accounted for).
      - .4 All storage estimations shall assume each day contains 12 hours of continuous recording and 12 hours of recording on motion only. (Assume recording 30% of total time due to motion).
      - .5 Data export through USB 3.0 port.
      - .6 Contractor shall provide 1 week of video recording prior to commissioning in order to extrapolate the total number of days storage space available.
    - .3 **Camera Type “FIX”** – Indoor IP Fixed Dome Video Camera
      - .1 Characteristics:
        - .1 Colour Camera CMOS imaging, progressive scan.
        - .2 Video Transmission: Over Ethernet.
        - .3 Sensitivity: Minimum Illumination for useable colour video image, 0.2 LUX.
        - .4 Resolution: Colour resolution 1920 x 1080 @ 30fps.
        - .5 Horizontal angle of view: 100deg
        - .6 White Balance: Auto
        - .7 Automatic Gain Control: Yes
        - .8 Focus: Auto
        - .9 Audio input: N/A
        - .10 Mounting: Ceiling Mounted.

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- .11 Motion controllable frame rate and bandwidth
  - .12 Addition features: Backlight compensation.
  - .13 Image compression: h.264
  - .14 Operational voltage: PoE IEEE 802.3af Class 3
  - .15 Current consumption: 4.2 watts or less.
  - .16 Environment: Indoor
  - .2 Lens:
    - .1 Varifocal, remote focus and zoom, P-Iris control, IR corrected, megapixel resolution.
  - .3 As detailed above, camera shall be Axis P3365-V or approved equal. Any submitted alternate shall be of equal or greater performance.
  - .4 **CAMERA TYPE “EXT” – Outdoor Fixed Dome IP Camera**
    - .1 Characteristics:
      - .1 Colour Camera CMOS imaging, progressive scan.
      - .2 Video Transmission: Over Ethernet.
      - .3 Sensitivity: Minimum Illumination for useable colour video image, 0.8LUX.
      - .4 Resolution: Colour resolution 1920x1080 @ 30fps.
      - .5 White Balance: Auto
      - .6 Automatic Gain Control: Yes
      - .7 Focus: Auto
      - .8 Mounting: Wall Mounted, contractor to supply all necessary mounting hardware.
      - .9 Motion controllable frame rate and bandwidth
      - .10 Addition features: Backlight compensation.
      - .11 Image compression: h.264
      - .12 Operational voltage: PoE IEEE 802.3af class 2
      - .13 Environment: Outdoor/IP66 - unless otherwise noted.
      - .14 Weight: 1.2 lbs or less.

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- .15 Motion detection recording options
  - .2 Lens:
    - .1 Varifocal, remote focus and zoom, P-Iris control, IR corrected.
  - .3 Camera shall be pole mounted at 2440mm above finished floor unless otherwise specified on drawings. Provide all required mounting hardware for pole mount.
  - .4 As detailed above, camera shall be Axis M3025-VE or approved equal. Any submitted alternate shall be of equal or greater performance.
  - .5 **INFRARED FLOODLIGHT** – wall mounted infrared floodlight included to improve the low light performance of indoor cameras.
    - .1 IR Floodlight Characteristics:
      - .1 Infrared light output shall be 850nm in wavelength.
      - .2 Complete with wide angle diverging lens (120° horizontal x 25° vertical)
      - .3 Provide wall mounted photocell, floodlight shall be capable of operating on photocell with override-on control.
      - .4 Provide wall mount bracket, floodlight shall be mounted up 2440mm A.F.F.
  - .6 **CLIENT STATION** – Provide single client master station in office as shown on new power floorplan.
    - .1 Client viewing station shall have the following minimum requirements:
      - .1 Intel Xeon Processor 3.7GHz
      - .2 16GB DDR3 RAM
      - .3 500GB HDD SATAIII
      - .4 DVD +/- RW
      - .5 Nvidia Quadro M2000 Graphics Card
      - .6 HD Audio Realtek ALC221
      - .7 4 x USB 2.0 ports
      - .8 4 x USB 3.0 ports
      - .9 500W Power Supply
      - .10 Windows 7 Pro – 64 Bit
  - .7 **CLIENT STATION MONITOR** – Provide single desk monitor in office as shown on new power floorplan.
    - .1 Client station monitor shall have the following minimum requirements:
      - .1 23” IPS LED monitor
      - .2 1920 x 1080 resolution
      - .3 HDMI and DVI inputs
      - .4 Maximum 6ms response time
      - .5 Height adjustable

- .6 Manufactured by BENQ, Samsung, LG, or approved equal.
- .8 **CCTV MONITORS** – Provide wall mounted CCTV monitors in multiple locations in office area as shown on new power floorplan.
  - .1 CCTV monitors shall have the following minimum requirements:
    - .1 60” LED backlit screen
    - .2 120 Hz refresh rate
    - .3 1920 x 1080 resolution
    - .4 Black finish, black bezel
    - .5 2 HDMI inputs
    - .6 Shall be Sharp Aquos HD series or approved equal.
  - .2 Provide wall mount for CCTV monitor with the following minimum requirements:
    - .1 Vertical adjustment
    - .2 Solid heavy-gauge steel construction
    - .3 Supports 400lbs
    - .4 Maximum depth of back of TV from wall shall be 1.5”
- .9 **POWER OVER ETHERNET SWITCH** – Provide rack mounted PoE switch in CCTV rack.
  - .1 PoE switch shall have the following minimum requirements:
    - .1 24 PoE ports
    - .2 Power Over Ethernet standard power requirements shall meet minimum standards for cameras specified
    - .3 Mountable in 19” mounting rail racks
    - .4 Capable of requiring device authentication via software
    - .5 Inclusion of management GUI interface for maintaining and configuring equipment
    - .6 Redundant power supplies
    - .7 Redundant, modular, forced air cooling
    - .8 Supports IPv4 and IPv6 routing
    - .9 Shall be Cisco Catalyst series or approved equal.
- .10 **UNINTERRUPTABLE POWER SUPPLY** – Provide rack mounted 3kVA UPS in CCTV rack.
  - .1 Provide minimum 1 x rack mounted external battery cabinet.
  - .2 UPS shall provide power to all components of the CCTV system for a minimum of 30 minutes after power failure.
  - .3 Provide rack mounted TVSS protected 8 outlet power strip for UPS power connections.
  - .4 UPS shall have the following requirements:
    - .1 120VAC nominal
    - .2 Valve-regulated, nonspillable, lead acid batteries
    - .3 Shall be Liebert GXT4 series.

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**Part 3 Execution**

**3.1 MANUFACTURER'S INSTRUCTIONS**

- .1 Compliance: Comply with manufacturer's written data, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, and datasheet.

**3.2 INSTALLATION**

- .1 Prior to any rough-in and installation, the Contractor shall confirm with the Owner and Consultant on site the placement, site and FOV of all cameras.
- .2 Install video surveillance equipment and components in accordance with ULC-S317.
- .3 All termination points and cables within the system shall be labelled in a logical numbering sequence using decal type marking devices similar to Brady wire markers. Corresponding numbers shall appear on the circuit diagrams in the instruction manuals and shop drawings. Multi-conductor cables shall be given an overall identification. Individual conductors shall have individual labels, matching the terminal label.
- .4 All wiring shall be neatly harnessed or laced, or secured. Cable ties are unacceptable. Excessive loose lengths shall be avoided.
- .5 The video surveillance system with all components, cables and services shall be supplied and installed by an established and qualified video system contractor. All necessary components and services shall be provided, whether or not each and every item is necessarily mentioned in the specification or on the drawings.
- .6 Install cable, boxes, mounting hardware, brackets, video cameras and system components in accordance with manufacturer's written installation instructions.
- .7 Connect cameras to cabling in accordance with installation instructions.

**3.3 CABLE INSTALLATION**

- .1 All required communication cabling for camera installations were completed in a previous contract. Roughed-in locations for cameras are shown on drawings.

**3.4 VERIFICATION AND CERTIFICATION**

- .1 Perform tests in accordance with Section 26 05 01 – Common Work Results – Electrical.
- .2 The system shall be installed in full compliance with the manufacturer's recommendations and these specifications. On completion, a technical representative from the manufacturer shall fully check out and test the systems, and make necessary adjustments to ensure perfect operation. The manufacturer and the Contractor shall provide all necessary personnel, and test equipment. The Owner may wish to observe the checkout, but will not provide assistance to either the manufacturer or the Contractor.
- .3 Perform verification inspections and tests in the presence of the Consultant.

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- .1 Provide all necessary tools, ladders and equipment.
  - .2 Ensure appropriate subcontractors and manufacturer's representatives are present for verification.
  - .4 Visual verification: Objective is to assess quality of installation and assembly and overall appearance to ensure compliance with Contract Documents. Visual inspection to include:
    - .1 Sturdiness of equipment fastening.
    - .2 Non-existence of installation related damages.
    - .3 Compliance of device locations with reviewed shop drawings.
    - .4 Compatibility of equipment installation with physical environment.
    - .5 Inclusion of all accessories.
    - .6 Device and cabling identification.
    - .7 Application and location of ULC approval decals.
  - .5 Technical verification: Purpose to ensure that all systems and devices are properly installed and free of defects and damage. Technical verification includes:
    - .1 Measurements of tension and power.
    - .2 Connecting joints and equipment fastening.
    - .3 Measurements of signals (dB, lux, baud rate, etc).
    - .4 Compliance with manufacturer's specification, product literature and installation instructions.
  - .6 Operational verification: Purpose to ensure that devices and systems' performance meet or exceed established functional requirements. Operational verification includes:
    - .1 Operation of each device individually and within its environment.
    - .2 Operation of each device in relation with programmable schedule and or/specific functions.
    - .3 Operation control of camera lens, pan, tilt and zoom.
    - .4 Switching of camera to any monitor.
    - .5 Switching of system video recorder to selective monitor.
    - .6 Set dwell times.
    - .7 Demonstrate:
      - .1 Sequence viewing of cameras on each monitor.

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- .2 Bypass capability.
  - .3 Display of stored image to cardholder.
  - .7 Certification of these tests, upon completion, shall be issued in writing to the Consultant by the manufacturer's representative. Copies of the test results shall be included in the Electrical Operating Instructions and Service Manuals.
  - .8 The Owner's operating personnel shall be instructed in the operation of the systems for a minimum period of three 2-hour sessions for a total of (6) six hours. The Owner's personnel shall be instructed for a minimum of 2-hours in the maintenance of the system and its components. Written documentation bearing name and signature of Owner's personnel who received the above instructions shall be included in the Electrical Operating Instructions and Service Manuals.

### **3.5 CLEANING AND ADJUSTING**

- .1 Remove protective coverings from cameras and components.
- .2 Adjust cameras for correct function.
- .3 Clean camera housing, system components and lens, free from marks, packing tape, and finger prints, in accordance with manufacturer's written cleaning recommendations.

END OF SECTION





**3.2 INSTALLATION**

- .1 Prior to installation, ensure all underground services have been located, marked and identified by the proper authorities.
- .2 Using hydraulic drill head, install helical screw piles to depths, torques and positions as indicated on drawings or specifications.
- .3 Provide torque monitoring device as part of the installation unit, or as a separate in-line device capable of recording torque or line pressure. Calibrated torque monitoring data should be made available for review by the Engineer. Torque should be monitored during the entire installation.
- .4 All helical screw piles should have identification, finish, torque, finish depth and pile description recorded on an installation summary page.
- .5 Torque head should be used that will install the piles without exceeding the maximum allowable torque of the pile shaft as indicated in the table below:

Pile Shaft Diameter (mm)	Wall Thickness (mm)	Maximum Torque (kNm/FTlbs)
140	7.0	59 (43,600)

- .6 If obstructions present a problem, the obstruction must be removed or the pile relocated. Contact Engineer regarding the obstructions and pile relocations.
- .7 Helical screw piles that reach maximum torque rating before reaching minimum indicated depth shall be terminated at depth with written approval of the Engineer.
- .8 Minimum embedment length to be 4500 mm.
- .9 Fill steel pipe with concrete using methods to limit free fall and to prevent segregation. Ensure adequate vibration to completely fill cross section of pipe.
- .10 Install concrete in accordance with Section 03 30 00 "Cast-In-Place Concrete".
- .11 Set dowels in concrete in accordance with details as indicated on the drawings. Secure until concrete is set.

**3.3 WELDING**

- .1 Weld in accordance with CSA W59 and CSA W59.1.

**END OF SECTION**



- .6 One (1) additional test cylinder shall be taken during cold weather concreting, and be cured on job site under same conditions of concrete it represents.
- .7 One slump test and one air content test will be taken for each set of test cylinders taken.
- .8 Testing of concrete will be performed in accordance with CAN/CSA A23.2-14.

## **1.6 FIELD RECORDS/DRAWINGS**

- .1 Maintain accurate records of all piles poured. Records are to include the following incorporated on the Contractor's record drawings:
  - .1 Date and time of casting.
  - .2 Sizes, depths and location of piles.
  - .3 Sequence of placing.
  - .4 Final cut-off elevation.
  - .5 Reinforcement, size and length.
- .2 Submit three (3) copies of record drawings to the Consultant.
- .3 Drawing to be the same scale and line reference as the contract drawings.

## **Part 2 Products**

### **2.1 REINFORCING STEEL**

- .1 Reinforcing Steel: deformed steel bars conforming to requirements of CAN/CSA G30.18-09 (R2014); 400 MPa yield strength.
- .2 Reinforcement to conform to standards specified under Section 03 20 00 Concrete Reinforcement. Submit shop drawings of reinforcing steel to Consultant in accordance with the requirements of Section 03 20 00.
- .3 Length of reinforcement to be as shown on drawings.
- .4 No splicing in reinforcement permitted unless specifically shown on drawings or approved by Consultant. Where splices permitted length = 36 bar diameters minimum; adjacent splices staggered minimum full lap length.
- .5 Welding ties to main reinforcement not permitted.

### **2.2 CONCRETE MATERIALS**

- .1 *Cement:* Sulphate Resistant Symbol 50 Portland, conforming to CSA A3000-13.
- .2 *Coarse and Fine Aggregates:* Standard concrete type, conforming to CSA A23.1-14.
- .3 *Water:* Clean and free of injurious amounts of oil, alkali, organic matter of other deleterious material.

### **2.3 ADMIXTURES**

- .1 *Air Entrainment:* to ASTM C260-06 "Air Entraining Admixtures for Concrete."
- .2 *Chemicals:* to ASTM C494-08a - M78 "Chemical Admixtures for Concrete"; water reducing, strength increasing Type WN -normal setting.
- .3 *Pozzolanic Mineral:* to CSA A3000-13 "Supplementary Cementing Materials and Their Use in Concrete Construction." Type "C" or Type "F" fly ash permitted to a maximum to 15% by weight of cementitious materials.
- .4 Use of calcium chloride in concrete permitted only as approved by Consultant.

### **2.4 CONCRETE MIX**

- .1 Mix concrete in accordance with Section 03 30 00 Cast-In-Place Concrete.

### **2.5 CASING**

- .1 Removable steel protective casing adequate for its function.

## **Part 3 INSTALLATION**

### **3.1 LAYOUT**

- .1 Place piles accurately in locations as called for on drawings.
- .2 Maximum permissible error in location 40 mm in any direction. Place piles not more than 2% of their lengths out of plumb or batter called for on drawings. Elevation of top of piles to be within 25 mm of elevation called for on drawings. Reinforcing steel clearances within 15 mm of dimension called for on drawings.
- .3 Minimum pile diameter as per drawings.
- .4 Piles placed outside above tolerances may be rejected by the Consultant. Place additional piles and pile caps as directed by the Consultant to replace rejected piles entirely at the Contractor's expense.

### **3.2 PROCEDURE FOR BORING PILES**

- .1 Bore piles using power augers to suit diameters and lengths of piles indicated on drawings. Where called for on drawings, enlarge bottom of shaft using only personnel well experienced in this Trade. Provide to the Consultant on request experience record of personnel actually engaged in the work.
- .2 Boulders encountered in drilling shall be removed and pile continued to full depth. Should removal of boulders be impractical, consult with Consultant.

- .3 Casings shall be installed in shafts as required to prevent sloughing during drilling and for the retention of ground water. If casing is required, advise Engineer prior to placing concrete in shaft.
- .4 Provide de-watering as necessary before any concrete is placed.
- .5 Remove all tailings and debris from area of bore holes prior to casting concrete. Cover bore hole to prevent loose materials falling in during removal.
- .6 After hole drilled, place reinforcing steel and concrete. Do not drill any holes which cannot be reinforced and filled with concrete the same day as drilled.

### **3.3 PLACING REINFORCING STEEL**

- .1 Place reinforcing steel in such a manner to prevent loose earth and debris from falling into the hole.
- .2 Place reinforcing at proper elevation and hold during course of placing concrete. Placing of steel will not be allowed after concrete poured.

### **3.4 PLACING CONCRETE**

- .1 De-water holes, sleeves or not, before any concrete is placed.
- .2 Before commencing placing concrete obtain Consultant's approval of proposed method of transporting and placing concrete.
- .3 Form piles projecting above grade with removable steel sleeves or wax coated cardboard fibre forms.
- .4 Place concrete continuously to final cut-off elevation as soon as possible after hole drilled, cleaned out and reinforcing steel secured in position. Take every care to ensure that hole is completely filled with concrete. *CONCRETE MUST BE PLACED IN THE DRY. UNDER NO CIRCUMSTANCES WILL TREMIE CONCRETE BE PERMITTED.*
- .5 Where steel casings are used they shall be withdrawn as the concrete is deposited, keeping the concrete at a level above bottom of the sleeve.
- .6 Vibrate top 3 M of concrete in shaft.
- .7 Protect tops of piles against loss of moisture.
- .8 Cold weather provisions of CAN/CSA A23.1-14 shall apply. Protect tops of piles against freezing during curing period with adequate insulation and covering. Provide supplementary heat as temperatures dictate.
- .9 When concrete is being placed through a frozen ground surface, the diameter of the portion of the pile surface passing through the frozen ground shall be increased by 100 mm.

**3.5 CUTOFF AND LENGTH**

- .1 Length of friction piles indicated on drawings to be from cutoff elevation.

**END OF SECTION**