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PROJECT

**25B Range Renovation
Regina, Saskatchewan**

PROJECT No.
23/2015

SET No.

DATE
2016-01-13

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END OF SECTION

Part 1 General

1.1 WORK COVERED BY CONTRACT DOCUMENTS

- .1 Work of this Contract comprises of renovating approximately 960 m² of ceiling baffles and ceiling space of an existing firing range, wall protection upgrades, 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 “25B Range Renovation, Regina, SK”.
- .2 During demolition and construction the Contractor will be responsible for protection of all existing items (electronics, bullet trap, carrier system, glazing, furniture, casework, etc.) that remain in the work area during demolition and construction.
- .3 The Owner, under separate contract, will be performing lead abatement throughout the renovation area, prior to commencement of this contract. 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 Departmental Representative 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.

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

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 – 02:00, 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 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 signed in daily at start of work shift and provided with pass, which must be worn at all times. Pass must be returned at end of work shift and personnel checked out.
- .3 Security documents are attached at the end of the Section.

1.5 SECURITY ESCORT

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

1.6 BUILDING SMOKING ENVIRONMENT

- .1 Comply with smoking restrictions. No smoking will be allowed in or around the building. Smoking is allowed only in areas indicated by Departmental Representative.
- .2 Turn off vehicles when they are parked next to building.

1.7 OCCUPIED SPACES

- .1 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.

1.8 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.

1.9 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

CONTRACTORS / CONSULTANTS TO COMPLETE

Contractors/Consultants to provide the requested information below.

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

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

1. Your Complete Legal Name: <i>(First/Middle or "no Middle Name"/ Last Name)</i>	
2. Name of Company That You Work For:	
3. Company Telephone Number:	
4. Project That You Are Working On: <i>(Name of Project/Building/City/Province)</i>	Depot B Blck-WindowReplacement-Construction SRCL #2013-11122229 RCMP Project Manager: Allan Currie, NPDO
5. Access Period (Start & End Dates): <i>(If exact dates unknown, estimate start & end dates)</i>	

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 1) _____ Number _____
PROVIDED: 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):

CONTRACTORS/CONSULTANTS MUST PROVIDE PHOTOCOPIES OF:	
I HAVE ATTACHED THE FOLLOWING DOCUMENTS TO THE ABOVE NOTED FORMS:	YES / NO
1. Driver's License (a clear copy of both the front and back of the document on the same page, certified to be a true copy by their supervisor or colleague). <i>Note:</i> <ol style="list-style-type: none"> 1. If you do not have a Driver's License, please provide other government issued photo identification (passport, treaty card). 2. The photo must be clear. 	
2. Birth Certificate (a clear copy of both the front and back of the document on one page, certified to be a true copy by their supervisor or colleague). <i>Note:</i> <ol style="list-style-type: none"> 1. If you do not have a Birth Certificate, please provide other government issued identification (ie. Health Card Card, passport, treaty card). 	

RCMP Reliability Status (RRS) clearance Applicants:

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

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

CONTRACTORS/CONSULTANTS MUST PROVIDE PHOTOCOPIES OF:	
I HAVE ATTACHED THE FOLLOWING DOCUMENTS TO THE ABOVE NOTED FORMS:	YES / NO
1. Driver's License (a clear copy of both the front and back of the document on the same page, certified to be a true copy by their supervisor or colleague). <i>Note:</i> <ol style="list-style-type: none"> 1. If you do not have a Driver's License, please provide other government issued photo identification (passport, treaty card). 2. The photo must be clear. 	
1. Birth Certificate (a clear copy of both the front and back of the document on one page, certified to be a true copy by their supervisor or colleague). DOCUMENT MUST BE PROVIDED FOR RRS CLEARANCES – NO ALTERNATE DOCUMENTS IN LIEU OF BIRTH CERTIFICATE.	
2. Two current Passport Style Photographs (do not have to be certified)	
3. Two sets of Fingerprints ("Roll and Ink" style) – must be obtained from a Corp of Commissionaires office.	

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



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 <input type="checkbox"/> Male <input type="checkbox"/> 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**

Surname and full given names	Date of birth Y M D
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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 type="checkbox"/> Date of birth, address, education, professional qualifications, employment history, personal character references				()
2. <input type="checkbox"/> Criminal record check				()
3. <input type="checkbox"/> Credit check (financial assessment, including credit records check)				()
4. <input type="checkbox"/> Loyalty (security assessment only)				
5. <input type="checkbox"/> Other (specify, see instructions) Law Enforcement Records Checks				()

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

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

Signature Date (Y/M/D)

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

Name and title	Telephone number
Address	Facsimile number

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

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

Reliability Status

Approved Reliability Status Not approved

Name and title

Signature Date (Y/M/D)

Security Clearance (if applicable)

Level I Level II Level III Not recommended

Name and title

Signature Date (Y/M/D)

Comments

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





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

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

- d. From – the year and month that you moved to your current / previous residence(s);
**If you cannot recall the month, please state above the M – “unknown”
- e. To – “Present” or the year and month that you moved/vacated your previous residences (not current residence).
- f. City – the name of the city or town that you currently and previously resided in.
- g. Province or State – the name of the province or state that you currently and previously resided in (no abbreviations ie. “AB” or “SK”).
- h. Postal Code – your current and previous postal codes.
- i. Country – the name of the country that you currently and previously resided in (no abbreviations).
- j. Telephone Number – your current and previous home telephone numbers, including area code.
- Note: i. If you do not have enough space on the attached form to list all addresses for the last five years, please use the attached form titled “TBS 330-23E Residence Additional Info”.
- ii. You must include your “Surname” and Date of Birth at the top of the page as requested.
- **NO POST OFFICE BOX NUMBERS;**
- **DATES MUST BE CONSECUTIVE–NO BREAKS IN TIME PERIODS (as stated in 11.)**
12. Have you previously completed a Government of Canada security screening form?:
- a. “No” or
- b. “Yes” – if “Yes”, please provide details. If you cannot recall some or all of the details (ie. year of screening, state “cannot recall”).
13. Criminal Convictions:
- a. “No” OR
- b. “Yes” - if “Yes”, please provide details. If you cannot recall some or all of the details (ie. date of conviction, state “cannot recall”).

Page 2 of Form:

Top of Page 2: To be completed by applicant:

1. Surname (your last name) followed by a comma – ie. Smith,
2. Full given names – your first name and then your middle name
**If you do not have a middle name, state “no middle name” on the form.
**Circle or underline your usual name used (ie. whether you go by your first name or middle name).
3. Date of birth - provide – Year, Month, Day ie. 2012-01-01 (must provide all in this format / no blanks)

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

1. a.) Place a “Checkmark” in Boxes 1. to 5; then:
b.) Initial under “Applicant’s Initials” column – **numbers 1. to 5. (you must initial all boxes-1 to 5).**
2. Read the Privacy Act Statement and sign above “Signature” and “Date (Y/M/D)”

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

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

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

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
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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): DRIVING UNDER THE INFLUENCE OF ALCOHOL
 Name of police force: EDMONTON POLICE SERVICE
 City: EDMONTON

Province/State: ALBERTA
 Country: CANADA
 Date of conviction: 2011012011

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: **SMITH, John (nomiddle name)** Date of birth: **11 19 60 | 01 12 7**

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
<input checked="" type="checkbox"/> Date of birth, address, education, professional qualifications, employment history, personal character references	JS			()
<input checked="" type="checkbox"/> Criminal record check	JS			()
<input checked="" type="checkbox"/> Credit check (financial assessment, including credit records check)	JS			()
<input checked="" type="checkbox"/> Loyalty (security assessment only)	JS			()
<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 034 (*Personnel Security Investigation File*), RCMP PIB CMP PPU 065 (*Security/Reliability Screening Records*), CSIS PIB SIS PPE 015 (*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 Date (Y/M/D) **2011-12-01**

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: _____

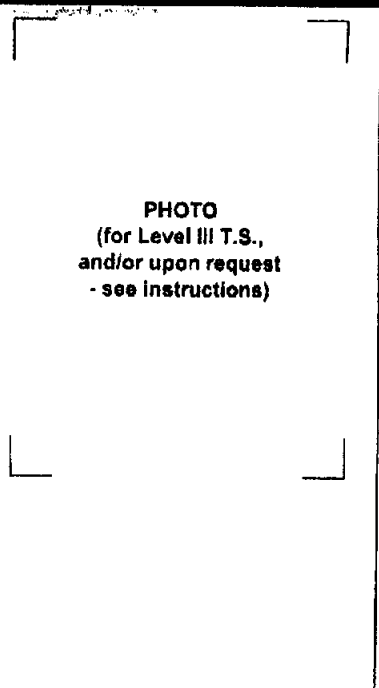
E APPROVAL (To be completed by authorized Departmental/Agency/Organizational Security Official only)

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 (RCMP Employee only)
- Reliability Screening (for all types of screening identified within Section A): complete numbers 1 and 2 and 3 if applicable.
- Security Clearance (for all types of screening identified within Section A): complete numbers 1 to 4 and 5 where applicable.
- Other: number 5 is used only where prior Treasury Board of Canada Secretariat approval has been obtained.

4. Section D (Review)

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

5. Section E (Approval)

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

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

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

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

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.

1.3 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.

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

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- .12 Submit 6 copies of test reports for requirements requested in specification Sections and as requested by Departmental Representative.
 - .1 Report signed by authorized official of testing laboratory that material, product or system identical to material, product or system to be provided has been tested in accord with specified requirements.
 - .2 Testing must have been within 3 years of date of contract award for project.
 - .13 Submit 6 copies of certificates for requirements requested in specification Sections and as requested by Departmental Representative.
 - .1 Statements printed on manufacturer's letterhead and signed by responsible officials of manufacturer of product, system or material attesting that product, system or material meets specification requirements.
 - .2 Certificates must be dated after award of project contract complete with project name.
 - .14 Submit 6 copies of manufacturer's instructions for requirements requested in specification Sections and as requested by Departmental Representative.
 - .1 Pre-printed material describing installation of product, system or material, including special notices and Material Safety Data Sheets concerning impedances, hazards and safety precautions.
 - .15 Submit 6 copies of manufacturer's Field Reports for requirements requested in specification Sections and as requested by Departmental Representative.
 - .1 Documentation of the testing and verification actions taken by manufacturer's representative to confirm compliance with manufacturer's standards or instructions.
 - .16 Submit 6 copies of Operation and Maintenance Data for requirements requested in specification Sections and as requested by Departmental Representative.
 - .17 Delete information not applicable to project.
 - .18 Supplement standard information to provide details applicable to project.
 - .19 If upon review by Departmental Representative, no errors or omissions are discovered or if only minor corrections are made, copies will be returned and fabrication and installation of Work may proceed. If shop drawings are rejected, noted copy will be returned and resubmission of corrected shop drawings, through same procedure indicated above, must be performed before fabrication and installation of Work may proceed.
 - .20 The review of shop drawings by Departmental Representative is for sole purpose of ascertaining conformance with general concept.
 - .1 This review shall not mean that 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 would 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.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 Canada Labour Code, Part 2, Canada Occupational Safety and Health Regulations
- .2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .3 Province of Saskatchewan
 - .1 Occupational Health and Safety Act, 1993, S.S. 2005.

1.2 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.

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. .

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.

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, under separate contract, will be performing lead abatement throughout the renovation area, prior to commencement of this contract. Stop work immediately when material suspected of being lead-contamination is encountered during demolition work. Notify Departmental Representative.
- .3 Notify Departmental Representative if suspicious material is encountered elsewhere within this work.
- .4 Note requirements in Contract Documents for removal of known asbestos containing materials. Notify Departmental Representative if suspicious material is encountered elsewhere within this work.

1.3 BUILDING SMOKING ENVIRONMENT

- .1 Comply with smoking restrictions and municipal by-laws.
- .2 Smoking on site is restricted to within personal vehicles or designated smoking locations.

END OF SECTION

Part 1 General

1.1 INSPECTION

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

1.2 ACCESS TO WORK

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

1.3 PROCEDURES

- .1 Notify appropriate agency and Departmental Representative in advance of requirement for tests, in order that attendance arrangements can be made.
- .2 Submit samples and/or materials required for testing, as specifically requested in specifications. Submit with reasonable promptness and in orderly sequence to not cause delays in Work.
- .3 Provide labour and facilities to obtain and handle samples and materials on site. Provide sufficient space to store and cure test samples.

1.4 REJECTED WORK

- .1 Remove defective Work, whether result of poor workmanship, use of defective products or damage and whether incorporated in Work or not, which has been rejected by Departmental Representative as failing to conform to Contract Documents. Replace or re-execute in accordance with Contract Documents.
- .2 Make good other Contractor's work damaged by such removals or replacements promptly.

- .3 If in opinion of Departmental Representative it is not expedient to correct defective Work or Work not performed in accordance with Contract Documents, 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.

END OF SECTION

Part 1 General

1.1 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

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 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.

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.

1.13 CLEAN-UP

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

END OF SECTION

Part 1 General

1.1 INSTALLATION AND REMOVAL

- .1 Provide temporary controls 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.

1.3 HOARDING

- .1 N/A.

1.4 WEATHER ENCLOSURES

- .1 Provide weather tight closures to unfinished openings, tops of shafts and other openings in floors and roofs.
- .2 Close off floor areas where walls are not finished; seal off other openings; enclose building interior work for temporary heat.
- .3 Design enclosures to withstand wind pressure and snow loading.

1.5 DUST TIGHT SCREENS

- .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.

1.6 ACCESS TO SITE

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

1.7 PUBLIC TRAFFIC FLOW

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

1.8 FIRE ROUTES

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

1.9 PROTECTION FOR OFF-SITE AND PUBLIC PROPERTY

- .1 Protect surrounding private and public property from damage during performance of Work.
- .2 Be responsible for damage incurred.

1.10 PROTECTION OF BUILDING FINISHES

- .1 Provide protection for finished and partially finished building finishes and equipment during performance of Work.
- .2 Provide necessary screens, covers, and hoardings.
- .3 Confirm with Departmental Representative locations and installation schedule 3 days prior to installation.
- .4 Be responsible for damage incurred due to lack of or improper protection.

1.11 WASTE MANAGEMENT AND DISPOSAL

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

END OF SECTION

Part 1 General

1.1 REFERENCES

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

1.2 QUALITY

- .1 Products, materials, equipment and articles incorporated in Work shall be new, not damaged or defective, and of best quality for purpose intended. If requested, furnish evidence as to type, source and quality of products provided.
- .2 Procurement policy is to acquire, in cost effective manner, items containing highest percentage of recycled and recovered materials practicable consistent with maintaining satisfactory levels of competition. 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 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.

1.4 TRANSPORTATION

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

1.5 MANUFACTURER'S INSTRUCTIONS

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

1.6 QUALITY OF WORK

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

1.7 CO-ORDINATION

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

1.8 CONCEALMENT

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

1.9 REMEDIAL WORK

- .1 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.

1.10 LOCATION OF FIXTURES

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

1.11 FASTENINGS

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

1.12 FASTENINGS - EQUIPMENT

- .1 Use fastenings of standard commercial sizes and patterns with material and finish suitable for service.
- .2 Use heavy hexagon heads, semi-finished unless otherwise specified. Use No. 304 stainless steel for exterior areas.
- .3 Bolts may not project more than one diameter beyond nuts.
- .4 Use plain type washers on equipment, sheet metal and soft gasket lock type washers where vibrations occur. Use resilient washers with stainless steel.

1.13 PROTECTION OF WORK IN PROGRESS

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

1.14 EXISTING UTILITIES

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

Part 1 General

1.1 SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit written request in advance of cutting or alteration which affects:
 - .1 Structural integrity of elements of project.
 - .2 Integrity of weather-exposed or moisture-resistant elements.
 - .3 Efficiency, maintenance, or safety of operational elements.
 - .4 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 may include the following. Forms will be supplied by the Departmental Representative.
 - .1 Hot work.
 - .2 Confined space entry.
 - .3 Site steam protocol.
 - .4 Ground disturbance.

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

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. Do not burn waste materials on site.
- .3 Make arrangements with and obtain permits from authorities having jurisdiction for disposal of waste and debris.
- .4 Provide on-site containers for collection of waste materials and debris.
- .5 Dispose of waste materials and debris off site.
- .6 Clean interior areas prior to start of finishing work, and maintain areas free of dust and other contaminants during finishing operations.
- .7 Store volatile waste in covered metal containers, and remove from premises at end of each working day.
- .8 Provide adequate ventilation during use of volatile or noxious substances. Use of building ventilation systems is not permitted for this purpose.
- .9 Use only cleaning materials recommended by manufacturer of surface to be cleaned, and as recommended by cleaning material manufacturer.
- .10 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 Inspect finishes, fitments and equipment and ensure specified workmanship and operation.
- .4 Vacuum carpet in renovated areas and where construction traffic occurs. If heavily soiled carpeting shall be commercially steam cleaned. This will be at the discretion of the Departmental Representative.
- .5 Clean and wax areas of resilient sheet and tile flooring in renovated areas, where required by specification section.
- .6 Dust all horizontal surfaces, clean all glass and wipe down walls in renovated areas.

END OF SECTION

Part 1 General

1.1 DEFINITIONS

- .1 Materials Source Separation Program (MSSP): consists of series of ongoing activities to separate reusable and recyclable waste material into material categories from other types of waste at point of generation.
- .2 Recyclable: ability of product or material to be recovered at end of its life cycle and re-manufactured into new product for reuse.
- .3 Recycle: process by which waste and recyclable materials are transformed or collected for purpose of being transferred into new products.
- .4 Recycling: process of sorting, cleansing, treating, and reconstituting solid waste and other discarded materials for purpose of using in altered form. Recycling does not include burning, incinerating, or thermally destroying waste.
- .5 Reuse: repeated use of product in same form but not necessarily for same purpose. Reuse includes:
 - .1 Salvaging reusable materials from re-modelling projects, before demolition stage, for resale, reuse on current project or for storage for use on future projects.
 - .2 Returning reusable items including pallets or unused products to vendors.
- .6 Salvage: removal of structural and non-structural materials from deconstruction/disassembly projects for purpose of reuse or recycling.
- .7 Separate Condition: refers to waste sorted into individual types.
- .8 Source Separation: acts of keeping different types of waste materials separate beginning from first time they became waste.
- .9 Waste Audit (WA): detailed inventory of materials in building. Involves quantifying by volume/weight amounts of materials and wastes generated during construction, demolition, deconstruction, or renovation project. Indicates quantities of reuse, recycling and landfill. Refer to Schedule A.
- .10 Waste Management Co-ordinator (WMC): contractor representative responsible for supervising waste management activities as well as coordinating related, required submittal and reporting requirements.
- .11 Waste Reduction Workplan (WRW): written report which addresses opportunities for reduction, reuse, or recycling of materials. Refer to Schedule B. WRW is based on information acquired from WA (Schedule A).

1.2 SUBMITTALS

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

1.3 WASTE REDUCTION WORKPLAN (WRW)

- .1 Prepare WRW prior to project start-up.
- .2 WRW should include but not limited to:
 - .1 Destination of materials listed.
 - .2 Deconstruction/disassembly techniques and sequencing.
 - .3 Schedule for deconstruction/disassembly.
 - .4 Location.
 - .5 Security.
 - .6 Protection.
 - .7 Clear labelling of storage areas.
 - .8 Details on materials handling and removal procedures.
- .3 Structure WRW to prioritize actions and follow 3R's hierarchy, with Reduction as first priority, followed by Reuse, then Recycle.
- .4 Describe management of waste.
- .5 Identify opportunities for reduction, reuse, and recycling of materials.
- .6 Post WRW or summary where workers at site are able to review content.
- .7 Set realistic goals for waste reduction, recognize existing barriers and develop strategies to overcome these barriers.
- .8 Monitor and report on waste reduction.

1.4 MATERIALS SOURCE SEPARATION PROGRAM (MSSP)

- .1 Prepare MSSP and have ready for use prior to project start-up.
- .2 Implement MSSP for waste generated on project in compliance with approved methods and as reviewed by Departmental Representative.
- .3 Provide on-site facilities for collection, handling, and storage of anticipated quantities of reusable and recyclable materials.
- .4 Provide containers to deposit reusable and recyclable materials.
- .5 Locate containers in locations, to facilitate deposit of materials without hindering daily operations.
- .6 Locate separated materials in areas which minimize material damage.
- .7 Collect, handle, store on-site, and transport off-site, salvaged materials in separate condition.
 - .1 Transport to users of material for recycling.
- .8 Collect, handle, store on-site, and transport off-site, salvaged materials in combined condition.

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

1.5 STORAGE, HANDLING AND PROTECTION

- .1 Store, materials to be reused, recycled and salvaged in locations as directed by Departmental Representative.
- .2 Protect surface drainage, mechanical and electrical from damage and blockage.
- .3 Separate and store materials produced during dismantling of structures in designated areas.
- .4 Prevent contamination of materials to be salvaged and recycled and handle materials in accordance with requirements for acceptance by designated facilities.
 - .1 On-site source separation is recommended.
 - .2 Remove co-mingled materials to off-site processing facility for separation.
 - .3 Provide waybills for separated materials.

1.6 DISPOSAL OF WASTES

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

1.7 USE OF SITE AND FACILITIES

- .1 Execute work with least possible interference or disturbance to normal use of premises.
- .2 Maintain security measures established by existing facility and where required provide temporary security measures approved by Departmental Representative.

1.8 SCHEDULING

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

Part 2 Execution

2.1 APPLICATION

- .1 Do Work in compliance with WRW.
- .2 Handle waste materials not reused, salvaged, or recycled in accordance with appropriate regulations and codes.

2.2 CLEANING

- .1 Remove tools and waste materials on completion of Work, and leave work area in clean and orderly condition.
- .2 Clean-up work area as work progresses.

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

END OF SECTION

Part 1 General

1.1 INSPECTION AND DECLARATION

- .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 that corrections have been made.
 - .2 Request Departmental Representative Inspection.
- .2 Departmental Representative Inspection: Departmental Representative and Contractor will perform inspection of Work to identify obvious defects or deficiencies. Contractor to correct Work accordingly.
- .3 Completion: submit written certificate that following have been performed:
 - .1 Work has been completed and inspected for compliance with Contract Documents.
 - .2 Defects have been corrected and deficiencies have been completed.
 - .3 Equipment and systems have been tested, adjusted and balanced and are fully operational.
 - .4 Certificates required by Fire Commissioner and Utility companies have been submitted.
 - .5 Operation of systems have been demonstrated to Owner's personnel.
 - .6 Work is complete and ready for final inspection.
- .4 Final Inspection: when items noted above are completed, request final inspection of Work by Departmental Representative, Consultants and Contractor. If Work is deemed incomplete by Departmental Representative, complete outstanding items and request re-inspection.
- .5 Where re-inspection is required due to uncompleted deficiencies, the time required by the Departmental Representative and Consultants will be recorded and reimbursement of this time may be charges back to the Contractor by deducting from amounts retained.

1.2 CLEANING

- .1 In accordance with Section 01 74 11 - Cleaning.
- .2 Remove waste and surplus materials, rubbish and construction facilities from the site in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

END OF SECTION

Part 1 General

1.1 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 Contractor's own expense.
- .9 Pay costs of transportation.

1.2 FORMAT

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

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

1.3 CONTENTS - EACH VOLUME

- .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 Shop Drawings: illustrating details of a portion of work.
- .4 Product Data: mark each sheet to identify specific products and component parts, and data applicable to installation; delete inapplicable information.
- .5 Drawings: supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams.
- .6 Typewritten Text: as required to supplement product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions specified in Section 01 45 00 - Quality Control.

1.4 AS-BUILTS 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 ACTUAL SITE CONDITIONS

- .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, and 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 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. Submit inventory listing to Departmental Representative. Include approved listings in Maintenance Manual.

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

1.9 MAINTENANCE MATERIALS

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

1.10 SPECIAL TOOLS

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

1.11 STORAGE, HANDLING AND PROTECTION

- .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.

1.12 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 Respond in a timely manner to oral or written notification of required construction warranty repair work.
- .5 Written verification will follow oral instructions. Failure to respond will be cause for the Departmental Representative to proceed with action against Contractor.

1.13 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

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

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

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

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

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures and 01 74 21 - Construction/Demolition Waste Management Disposal.
- .2 Sustainable Design Submittals:
 - .1 Construction Waste Management:
 - .1 Submit project 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 SITE CONDITIONS

- .1 If material resembling spray or trowel-applied asbestos or other designated substance listed as hazardous be encountered, stop work, take preventative measures, and notify Departmental Representative immediately.
 - .1 Proceed only after receipt of written instructions has been received from Departmental Representative.
- .2 Notify Departmental Representative before disrupting building access or services.

Part 2 Products

2.1 NOT USED

- .1 Not used.

Part 3 Execution

3.1 EXAMINATION

- .1 Inspect building and site with Departmental Representative and verify extent and location of items designated for removal, disposal, alternative disposal, recycling, salvage and items to remain.
- .2 Locate and protect utilities. Preserve active utilities traversing site in operating condition.
- .3 Notify and obtain approval of utility companies before starting demolition.

- .4 Disconnect, cap, plug or divert, as required, existing public utilities within the property where they interfere with the execution of the work, in conformity with the requirements of the authorities having jurisdiction. Mark the location of these and previously capped or plugged services on the site and indicate location (horizontal and vertical) on the record drawings. Support, shore up and maintain pipes and conduits encountered.
 - .1 Immediately notify Departmental Representative and utility company concerned in case of damage to any utility or service, designated to remain in place.
 - .2 Immediately notify the Departmental Representative should uncharted utility or service be encountered, and await instruction in writing regarding remedial action.

3.2 PREPARATION

- .1 Protection of In-Place Conditions:
 - .1 Prevent movement, settlement, or damage to adjacent structures, utilities, and parts of building to remain in place. Provide bracing and shoring required.
 - .2 Keep noise, dust, and inconvenience to occupants to minimum.
 - .3 Protect building systems, services and equipment.
 - .4 Provide temporary dust screens, covers, railings, supports and other protection as required.
 - .5 Do Work in accordance with Section 01 35 29.06 - Health and Safety Requirements.
- .2 Demolition/Removal:
 - .1 Remove items as indicated.
 - .2 Remove parts of existing building to permit new construction.
 - .3 Trim edges of partially demolished building elements to tolerances as defined by Departmental Representative to suit future use.

3.3 CLEANING

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

END OF SECTION

Part 1 General

1.1 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 Plywood.

- .2 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 AWWA M4 and revisions specified in CSA O80 Series, Supplementary Requirements to AWWA 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] [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:

3.3 MATERIAL USAGE

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

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

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, welds, washers, nuts, 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 QUALITY ASSURANCE

- .1 Structural steel fabricator to be certified as minimum Division 2 Company under CSA W47.1-09 - "Certification of Companies for Fusion Welding of Steel Structures" or CSA Standard W55.3-08 "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.

1.4 REFERENCE STANDARDS

- .1 CSA Standard CAN/CSA-S16-01 - "Limit States Design of Structural Steel Buildings".
- .2 CSA G40.21-04 (R2009) - "Structural Quality Steel".
- .3 ASTM Standard A325M - "High Strength Bolts for Structural Steel Joints including Suitable Nuts and Plane Hardened Washers".
- .4 CSA Standard W59-03 (R2008) - "Welded Steel Construction".
- .5 CSA Standard W47.1-09 - "Certification of Companies for Fusion Welding of Steel Structures".
- .6 ASTM Standard A53 - "Welded and Seamless Steel Pipe".

1.5 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.

1.6 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 G40.21-04 (R2009), Grade 350W.
- .2 *Beam End Plates, Ledger Angles and Miscellaneous Steel:* new material conforming to CSA G40.21-04 (R2009), Grade 300W.
- .3 *Bolts, Nuts and Washers:* high strength type recommended for structural steel joints, conforming to requirements of ASTM A325M-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.

2.2 FABRICATION

- .1 Fabricate structural steel members in accordance with building design drawings and all requirements of CAN/CSA S16-01. Welding to conform to CSA W59-03 (R2008) "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 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 ± 3 mm.
 - .2 Tolerances of all other structural steel shall be maintained strictly in accordance with CAN/CSA S16-01.
- .5 All exposed steel and all related bridging and bracing shall be fabricated with clean, neat fitting welded connections.

2.3 PAINTING

- .1 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.
- .2 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.

Part 3 Execution

3.1 ERECTION

- .1 Erect structural steel in accordance with building design drawings and all requirements on CAN/CSA S16-01.
- .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 Tolerances
 - .1 Tolerance of all structural steel shall be maintained strictly in accordance with CAN/CSA S16-01.
- .6 After erection, prime all welds, abrasions, bolted connections and all other surfaces not shop primed, except surfaces to be in contact with concrete.
- .7 Obtain written permission of Consultant prior to altering or field welding of structural members.

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 A325-14, Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
 - .3 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.
 - .4 ASTM A653/A653M-15, Standard 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 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).
- .4 Health Canada / Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .5 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, 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.

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 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, 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 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.

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.

2.3 FINISHES

- .1 Galvanizing: hot dipped galvanizing with zinc coating 600 g/m² to CAN/CSA-G164.
- .2 Chromium plating: chrome on steel with plating sequence of 0.009 mm thickness of copper, 0.010 mm thickness of nickel, and 0.0025 mm thickness of chromium.
- .3 Shop coat primer: MPI- INT 5.1B.
- .4 Zinc primer: zinc rich, ready mix to CAN/CGSB-1.181,

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.
- .5 Colour to be selected by Departmental Representative for all exposed steel.

2.5 BAFFLE PLATE

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

2.6 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.

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 Weld field connections.
- .8 Deliver items over for casting into concrete and building into masonry together with setting templates to appropriate location and construction personnel.
- .9 Touch-up rivets, field welds, bolts and burnt or scratched surfaces with primer after completion of:
 - .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 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 metal fabrications installation.

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/m³ 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 and on walls in Range Instruction Area: to ASTM C423 and ASTM E84.
 - .1 Open cell melamine acoustic foam
 - .2 Class: 1.
 - .3 Density: 0.7 lbs/ft³
 - .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 Fire and smoke rating in accordance with CAN/ULC-S102
 - .1 Maximum flame spread rating: 10.
 - .2 Maximum smoke developed rating: 50.
 - .9 Adhesive: as per manufacturer's recommendation.
- .3 Sound batt insulation above ceilings: to CAN/ULC-S702
 - .1 Type: 1.
 - .2 Thickness: 50mm.
 - .3 Non-combustible: to CAN/ULC S114
 - .4 Surface burning characteristics: to CAN /ULC S102
 - .1 Flame spread: 0 to 10
 - .2 Smoke Development: 0 to 10
 - .5 Zero formaldehyde content.

- .6 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.
- .7 Density: to ASTM C612, 45 kg/m³.

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

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 cm² : 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/m³ 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 Interior control and expansion joints in floor surfaces: sealant type: 2.
- .3 Perimeters of interior frames, as detailed and itemized: sealant type: 1.
- .4 Perimeter of millwork: sealant type: 1.
- .5 Perimeter of ductwork through gypsum board assembly: 3.
- .6 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 National Standards Institute (ANSI) / Builders Hardware Manufacturers Association (BHMA)
 - .1 ANSI/BHMA A156.5-2014, Auxiliary Locks and Associated Products.
 - .2 ANSI/BHMA A156.13-2012, Mortise Locks and Latches Series 1000.
- .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.

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.

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 nicks, scratches, and blemishes.
 - .3 Protect prefinished surfaces with wrapping or strippable coating.
 - .4 Replace defective or damaged materials with new.

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 Mortise locks and latches: to ANSI/BHMA A156.13, series 1000 mortise lock, grade 1, designed for function as stated in Hardware Schedule.
 - .2 Lever handle and escutcheon: Sargent 'LE1L' design.
 - .3 Cylinders: Sargent 6 pin, LA keyway, 0 bitted; keying by Owner.
 - .4 Finish: 26D.
 - .5 Acceptable manufacturer: Sargent.
 - .6 List of Locksets:
 - a) ANSI F15; Sargent Model 8251-LE1L-26D (Hotel)
- .2 Electric strike: To ANSI/BHMA A156.5, Grade 1. To accept lockset scheduled. Heavy duty, stainless steel construction, dual voltage, fail secure operation unless noted otherwise, 630 finish. ULC listed for fire rated doors.
 - .1 Acceptable Product: SDC Model 55-DU-630 Uni-flex
- .3 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 Provide construction cores and perform operation verification for all locks.
- .2 Provide permanent cores and keys to Departmental Representative.
- .3 Provide 000000 bitted for keying by Owner
- .4 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 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.

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 152A

1 lockset a)
1 electric strike

Comment: Card Access Controlled Door. See Note 1 below

Door 190A

1 lockset a)
1 electric strike

Comment: Card Access Controlled Door. See Note 1 below

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

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.

Door No.	Room Name	Door				Frame			Rating (Min.)	Glass	Comments
		Size (site check)	Type	Mat'l	Fin.	Type	Mat'l	Fin.			
Main Floor											
152A		Existing	-	SCW	-	-	PS	-	45		Remainder of existing hardware to remain
190A		Existing	-	SCW	-	-	PS	-	45		Remainder of existing hardware to remain

Abbreviations	
SCW – Solid Core Wood Door	
PS – Pressed Steel Frame	

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.

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 1.22m x 2.44m 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 assembly.
 - .2 Designed to eliminate all 'line of sight' openings, to the ceiling above, from all shooting positions on the firing line.
 - .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.
- .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

Part 1 General

1.1 REFERENCES

- .1 ASTM International
 - .1 ASTM E84-15b, Standard Test Method for Surface Burning Characteristics of Building Materials
- .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.

Part 2 Products

2.1 ACOUSTIC BALLISTIC PANEL

- .1 Acoustic Ballistic Rubber Panels to:
 - .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 / m³ (70 lbs / ft³) 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.

3.3 BALLISTIC PANEL INSTALLATION

- .1 Apply adhesive to ballistic panel and wall surface in accordance with manufacturer's recommendations.

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.

END OF SECTION

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 Metal access doors: frameless, welded construction, push latching door, removable door, accepts 12.7 mm and 16 mm gypsum board, exposed frames paintable.
- .3 Metal furring runners, hangers, tie wires, inserts, and anchors: to ASTM C841.
- .4 Drywall furring channels: 0.5 mm core thickness galvanized steel channels for screw attachment of gypsum board.
- .5 Resilient drywall furring: 0.5 mm base steel thickness galvanized steel for resilient attachment of gypsum board.
- .6 Metal carrying channel: 1.4mm thick cold rolled steel, coated with rust inhibitive coating.
- .7 Steel drill screws: to ASTM C1002.
- .8 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.
- .9 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.
- .10 Polyethylene: to CAN/CGSB-51.34, Type 2.
- .11 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.
- .12 Joint compound: to ASTM C475, asbestos-free.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for gypsum board assemblies installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 ERECTION

- .1 Do application and finishing of gypsum board to ASTM C840 except where specified otherwise.
- .2 Do application of gypsum sheathing to ASTM C1280.
- .3 Erect hangers and runner channels for suspended gypsum board ceilings to ASTM C840 except where specified otherwise.

- .4 Support light fixtures by providing additional ceiling suspension hangers within 150 mm of each corner and at maximum 600 mm around perimeter of fixture.
- .5 Install work level to tolerance of 1:1200.
- .6 Frame with furring channels, perimeter of openings for access panels, light fixtures, diffusers, and grilles.
- .7 Furr for gypsum board faced vertical bulkheads within and at termination of ceilings.
- .8 Furr above suspended ceilings for gypsum board fire and sound stops and to form plenum areas as indicated.
- .9 Install wall furring for gypsum board wall finishes to ASTM C840, except where specified otherwise.
- .10 Furr openings and around built-in equipment, cabinets, 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.

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

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 m² 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.
- .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 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 1219 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.
- .3 Adhesive: low VOC type recommended by acoustic unit manufacturer.
- .4 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.

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

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

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 Structural steel and metal fabrications: columns, beams, joists:
 - .1 INT 5.1Q – Latex, Gloss Level 5 – Semi-Gloss Finish (over alkyd primer). Premium grade, 1 coat primer, two top coats.
- .3 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.
- .4 Dressed lumber: including 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.
- .5 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.
- .6 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.

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.

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 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:
Due to nature of scope it is assumed there is no requirement for instruction.

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 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/NFPA
Base design for bidding in accordance with existing sprinkler design:
Zoning:
 - .1 System zoning as indicated.
- .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 SPRINKLER VALVE

- .1 Provide approved Automatic Sprinkler Valve with one or two pole (as required) flow detectors with alarm circuits, pressure switch, pressure retard chamber, outside water motor gong, outside electric gong, inside electric gong, and circuit breaker.

2.8 ABOVE GROUND PIPING SYSTEMS

- .1 Provide fittings for changes in direction of piping and for connections.
 - .1 Make changes in piping sizes through tapered reducing pipe fittings, bushings will not be permitted.
 - .2 Perform welding in shop; field welding will not be permitted.
 - .3 Conceal piping in areas with suspended ceiling and as indicated on drawings.

2.9 SPRINKLER HEADS

- .1 General: to ANSI/NFPA 13 and ULC listed for fire services.
- .2 New sprinkler heads to match equivalent types. Confirm on site.
- .3 Temperature rating on fusible links shall suit specific hazard area with minimum of safety 10 deg.C.
- .4 Sprinklers shall be listed with and bear certification marking of nationally recognized testing agency.
- .5 Sprinklers with O-rings are not allowed.
- .6 Provide minimum 12 mm (1/2") nominal diameter discharge orifice, except when approved by authorities having jurisdiction.
- .7 Provide chrome plated finish for sprinklers in all areas: except mechanical rooms where bronze finish is acceptable.
- .8 All pendant type heads to be semi-recessed where possible 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.

2.10 UPRIGHT SPRINKLER HEAD

- .1 Provide glass bulb type in areas indicated on drawings or specified. Bronze in mechanical rooms, chrome elsewhere.

2.11 PENDANT SPRINKLER HEAD

- .1 Provide semi-recessed polished chrome glass bulb type in areas indicated on drawings or specified.

2.12 SIDE WALL SPRINKLER HEAD

- .1 Provide polished chrome glass bulb type in areas indicated on drawings or specified.

2.13 CONCEALED SPRINKLER HEAD

- .1 Bronze glass bulb type sprinkler head with chrome plated steel support cup and brass cover plate.
- .2 Cover plate to have factory applied finish to match ceiling colour.

2.14 WET SPRINKLER SYSTEM

- .1 This project is a modification to a zone 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.

2.15 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.

2.16 SIGNS

- .1 Signs for control drain and test valves: to ANSI/NFPA 13.

2.17 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.

2.18 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.

2.19 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

- .3 Install horizontal valves with stems upright where space allows.
- .4 Do not allow sprinklers that have been dropped, damaged, or show a visible loss of fluid. Never install sprinklers with cracked bulbs.
- .5 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.
- .6 Unless noted otherwise, centre sprinkler heads in two directions in ceiling tile and provide piping offsets as required.
- .7 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 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 Domestic water, drainage and vent piping shall meet the requirements of the National Building Code and the Provincial and Municipal Codes.
- .2 Automatic sprinkler system piping shall conform to the requirements of NFPA No. 13.
- .3 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.
- .4 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 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.
- .2 Use factory fabricated butt welded fittings for welded steel pipes.
- .3 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 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.

3.5 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 Make reductions in water pipes with eccentric reducing fittings installed to provide drainage and venting.
- .4 Grade horizontal drainage and vent piping 20 mm per meter minimum.

3.6 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 branch 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.
 - .1 Grooved joints shall be installed in accordance with the manufacturer's latest published installation instructions.
 - .2 The grooved coupling manufacturer's factory trained representative shall provide on-site training for Contractor's field personnel in the use of grooving tools and installation of grooved joint products. The representative shall periodically visit the job site and review Contractor is following best recommended practices in grooved product installation. (A distributor's representative is not considered qualified to conduct the training or job site visits.)
- .19 Make connections to equipment and branch mains with unions or flanges, as indicated:
 - .1 Unions are not required in installations using grooved mechanical joint couplings (The couplings shall serve as disconnect points.)
- .20 Provide non-conducting type connections wherever jointing dissimilar metals in systems. Brass adaptors and valves are acceptable. Refer to dielectric couplings.
- .21 Pressfit piping and fittings are not permitted.
- .22 Install piping to allow for expansion and contraction without unduly stressing pipe or equipment connected.
 - .1 For mechanical pipe jointing systems, use adequate numbers of Victaulic Style 77 flexible couplings in header piping to accommodate thermal growth and contraction, and for the elimination of expansion loops. (In accordance with Victaulic instructions and as approved by the Departmental Representative.) Where expansion loops are required, use Victualic Style 77 couplings on the loops.
 - .2 Provide plug cocks at all pressure tapping locations.

3.7 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.

3.8 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.

3.9 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.

3.10 FLUSHING OUT OF PIPING SYSTEMS

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

3.11 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 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 structural steel in accordance with the requirements of Structural. Equipment, piping and ductwork shall be supported from the top chords of trusses/beams, supporting off bottom is not permitted, except where specifically noted. Hanging from roof deck is not permitted unless written approval is requested and received from departmental representative.
- .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.
 - .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.
- .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.
- .15 PEX pipe mains and branches running in service spaces (crawl space, ceiling plenum, etc.) shall be installed in a suitable channel to ensure pipes remain plumb. Channel shall be large enough to house pipe and insulation. Pipe shall be secured to channel.

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:

$$\text{Weight per metre of object suspended (kg)} \times \text{Distance between suspension points (m)} = \text{Weight loading per hanger suspension point (kg)}$$

Table 1 Wire Hanger Safe Working Loads

Size	Working Load Limit (kg)	Working Load Limit (lbs)
No. 1	0 - 10 kg	0 - 22 lbs
No. 2	10.5 - 45.5 kg	23 - 100 lbs
No. 3	46 - 91 kg	101 - 200 lbs
No. 4	95.5 - 225 kg	210 - 495 lbs
No. 5	225.5 - 325 kg	496 - 715 lbs

- .5 Where the installed wire rope is not vertical then the working load limit shall be reduced in accordance with the recommendations given in the manufacturer's handbook.
- .6 The Contractor shall select and use the correct length of wire rope required to support the service.
- .7 No in-line joints 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/m³ density insulation plus insulation protection shield to: MSS SP69, galvanized sheet carbon steel. Length designed for maximum 3 m span.
- .2 Insulated hot piping:
 - .1 Curved plate 300 mm long, with edges turned up, welded-in centre plate for pipe sizes NPS 12 and over, carbon steel to comply with MSS SP69.

2.6 CONSTANT SUPPORT SPRING HANGERS

- .1 Springs: alloy steel to ASTM A125, shot peened, magnetic particle inspected, with +/-5% spring rate tolerance, tested for free height, spring rate, loaded height and provided with Certified Mill Test Report (CMTR).
- .2 Load adjustability: 10% minimum adjustability each side of calibrated load. Adjustment without special tools. Adjustments not to affect travel capabilities.
- .3 Provide upper and lower factory set travel stops.
- .4 Provide load adjustment scale for field adjustments.
- .5 Total travel to be actual travel + 20%. Difference between total travel and actual travel 25 mm minimum.
- .6 Individually calibrated scales on each side of support calibrated prior to shipment, complete with calibration record.

2.7 VARIABLE SUPPORT SPRING HANGERS

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

2.8 EQUIPMENT SUPPORTS

- .1 Fabricate equipment supports not provided by equipment manufacturer from structural grade steel meeting requirements of Section 05 50 00 - Metal Fabrications.

2.9 EQUIPMENT ANCHOR BOLTS AND TEMPLATES

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

2.10 HOUSEKEEPING PADS

- .1 Provide 100 mm high concrete housekeeping pads for base-mounted equipment; size pads 50 mm larger than equipment; chamfer pad edges.
- .2 Concrete: to Section 03 30 00 - Cast-in-place Concrete.

2.11 SLEEVES

- .1 Pipes through floors: Form with 18 gauge galvanized steel.
- .2 Pipes through beams, walls, fire proofing, footings, potentially wet floor: Form with steel pipe or 18 gauge galvanized steel.
- .3 Size large enough to allow for movement due to expansion and to provide for continuous insulation.

2.12 OTHER EQUIPMENT SUPPORTS

- .1 Fabricate equipment supports from structural grade steel meeting requirements of Section 05 50 00 - Metal Fabrications.
- .2 Submit structural calculations with shop drawings.

3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

- .1 Install in accordance with:
 - .1 Manufacturer's instructions and recommendations.
- .2 Vibration Control Devices:
 - .1 Install on piping systems at pumps, at all vibration isolated equipment and as indicated.

- .3 Clamps on riser piping:
 - .1 Support independent of connected horizontal pipework using riser clamps and riser clamp lugs welded to riser.
 - .2 Bolt-tightening torques to industry standards.
 - .3 Steel pipes: install below coupling or shear lugs welded to pipe.
 - .4 Cast iron pipes: install below joint.
- .4 Clevis plates:
 - .1 Attach to concrete with 4 minimum concrete inserts, one at each corner.
- .5 Provide supplementary structural steelwork where structural bearings do not exist or where concrete inserts are not in correct locations.
- .6 Use approved constant support type hangers where:
 - .1 Vertical movement of pipework is 13 mm or more,
 - .2 Transfer of load to adjacent hangers or connected equipment is not permitted.
- .7 Use variable support spring hangers where:
 - .1 Transfer of load to adjacent piping or to connected equipment is not critical.
 - .2 Variation in supporting effect does not exceed 25% of total load.
- .8 Installation of Exposed Pipe and Duct Hangers:
 - .1 Exposed pipe and duct shall be any pipe/duct visible to the occupants. This does not include piping and ductwork routing above dropped ceilings.
 - .2 Exposed Pipe and Duct hangers shall be a Wire Rope Suspension System.

3.3 INSERTS

- .1 Use inserts for suspending hangers for reinforced concrete slabs and sides of reinforced concrete beams wherever practicable.
- .2 Set inserts in position in advance of concrete work. Provide reinforcement rod in concrete for inserts carrying pipe over 100 mm.
- .3 Where concrete slabs form finished ceiling, finish inserts flush with slab surface.
- .4 Where inserts are omitted, drill through concrete slab from below and provide rod with recessed square steel plate and nut above slab.

3.4 HANGER SPACING

- .1 Plumbing piping: to Canadian Plumbing Code, Provincial Code, authority having jurisdiction.
- .2 Fire protection: to applicable Fire Code.
- .3 Copper piping: up to NPS 1/2: every 1.5 m.
- .4 Flexible joint roll groove pipe: in accordance with table below, but not less than one hanger at joints.
- .5 Within 300 mm of each elbow.

Maximum Pipe Size : NPS	Maximum Spacing Steel	Maximum Spacing Copper	Rod Diameter
up to 32 mm	1.8 m	1.8 m	9.5 mm
38 mm	1.8 m	1.8 m	9.5 mm
50 mm and 63 mm	3.0 m	3.0 m	9.5 mm
75 mm - 100 mm	3.6 m	3.0 m	15.8 mm
150 mm - 200 mm	4.3 m	4.3 m	22.2 mm

- .6 Install hangers to provide a minimum 12 mm clear space between finished covering and adjacent work.

3.5 HANGER INSTALLATION

- .1 Install hanger so that rod is vertical under operating conditions.
- .2 Adjust hangers to equalize load.
- .3 Support from structural members. Where structural bearing does not exist or inserts are not in suitable locations, provide supplementary structural steel members.
- .4 Use hangers which are vertically adjustable 38 mm minimum after piping is erected.
- .5 Support horizontal soil pipe near each hub, with 1.5 m maximum spacing between hangers.
- .6 Support vertical piping at every other floor. Support vertical soil pipe at each floor at hub.
- .7 Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
- .8 Where practical, support riser piping independently of connected horizontal piping.
- .9 Hangers: Pipe sizes 12 mm to 38 mm: Adjustable wrought steel ring.
- .10 Hangers: Pipe sizes 50 mm to 100 mm and Cold Pipe Sizes: Adjustable wrought steel clevis.

3.6 SLEEVES

- .1 Set sleeves in position in advance of concrete work. Provide suitable reinforcing around sleeves.
- .2 Extend sleeves through potentially wet floors 25 mm above finished floor level. Caulk sleeves full depth and provide floor plate.
- .3 Where piping passes through floor, ceiling or wall close off space between pipe or duct and construction with non-combustible insulation. Provide tight fitting metal caps on both sides and caulk.

- .4 Install chrome plated escutcheons where piping passes through finished surfaces.
- .5 All penetrations through fire rated walls, floors or partition assemblies shall be sealed/fire stopped with fire stop materials that will remain in place and prevent the passage of smoke, toxic gases, flame, etc., when subjected to the standard test method Can 4-S115, "Standard Method of Fire Tests for Firestop Systems" for a period of time equal to fire protection rating required for the grade of fire separation of the penetrated wall or floor.
- .6 Acceptable Product: According to instructions provided, all penetrations in fire rated walls, floors, or partition assemblies shall be sealed/fire stopped with:
 - .1 3M Brand Intumescent, "Fire Barrier" Caulk CP-25, Putty 303, Penetration Sealing Systems 7902 or 7904 Series, Composite Sheet CS-195, or Wrap Strip FS-195.
 - .2 Tremco Firestop Systems: Fyresil, Fyreshield for penetrations and perimeters. Dymeric ULC, THC 900 ULC

3.7 HORIZONTAL MOVEMENT

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

3.8 FINAL ADJUSTMENT

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

END OF SECTION

1 General

1.1 SECTION INCLUDES

- .1 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 23.

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
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 equipment with nameplates.
- .11 Identify valves in main and branch piping with tags.
- .12 Identify air terminal units 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 fire dampers sequentially and record on Fire Damper Tag List. Provide copy of list in O&M Manual.

3.3 VALVE, CONTROLLERS

- .1 Valves and operating controllers, except at plumbing fixtures, 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 Firing Range: Balancer shall adjust system to meet the total supply air and exhaust air requirements and the air velocity requirements in the firing range. Air velocity at all measured points in the firing range shall be between 50fpm and 100 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).
 - .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.

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. Test to include existing ductwork being resealed under this project.
- .5 Medium and High Pressure Ductwork: Check for audible leaks. Test for tightness as specified by the SMACNA Manuals at a duct leakage classification of 3 with a static pressure equal to 2 times the external static pressure of the associated air system.

3.6 FIELD QUALITY CONTROL

- .1 Performance Verification:
 - .1 Departmental Representative to witness tests and to verify reported results.
 - .2 To be certified by same TAB agency approved by Departmental Representative to undertake TAB on this project.

END OF SECTION

1 General

1.1 REFERENCES

- .1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
 - .1 ANSI/ASHRAE/IESNA 90.1-01, SI; Energy Standard for Buildings Except Low-Rise Residential Buildings.

- .2 American Society for Testing and Materials International, (ASTM)
 - .1 ASTM B209M, Specification for Aluminum and Aluminum Alloy Sheet and Plate (Metric).
 - .2 ASTM C335, Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.
 - .3 ASTM C411, Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
 - .4 ASTM C449/C449M, Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.
 - .5 ASTM C547, Specification for Mineral Fiber Pipe Insulation.
 - .6 ASTM C553, Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
 - .7 ASTM C612, Specification for Mineral Fiber Block and Board Thermal Insulation.
 - .8 ASTM C795, Specification for Thermal Insulation for Use with Austenitic Stainless Steel.
 - .9 ASTM C921-(1998)e1, Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.

- .3 Canadian General Standards Board (CGSB)
 - .1 CGSB 51-GP-52Ma, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.

- .4 Thermal Insulation Association of Canada (TIAC): National Insulation Standards (R1999).

- .5 Underwriters Laboratories of Canada (ULC)
 - .1 CAN/ULC-S102, Surface Burning Characteristics of Building Materials and Assemblies.
 - .2 CAN/ULC-S701, Thermal Insulation Polyotrene, Boards and Pipe Covering.

1.2 DEFINITIONS

- .1 For purposes of this section:
 - .1 "CONCEALED" - insulated mechanical services and equipment in suspended ceilings and non-accessible chases and furred-in spaces.
 - .2 "EXPOSED" - will mean "not concealed" as defined herein.
 - .3 Insulation systems - insulation material, fasteners, jackets, and other accessories.

- .2 TIAC Codes:
 - .1 CRD: Code Round Ductwork,
 - .2 CRF: Code Rectangular Finish.

1.3 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit for approval manufacturer's catalogue literature related to installation, fabrication for duct jointing recommendations.

1.4 MANUFACTURERS' INSTRUCTIONS

- .1 Submit manufacturer's installation instructions in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Installation instructions to include procedures used, and installation standards achieved.

1.5 QUALITY ASSURANCE

- .1 Installer: specialist in performing work of this section, and have at least 3 years successful experience in this size and type of project, qualified to standards of TIAC.
- .2 Materials: UL listed; flame spread/smoke developed rating of 25/50 in accordance with ASTM E84.
- .3 Do work to TIAC standards.
- .4 Deliver material to job site in original non-broken factory packaging, labelled with manufacturer's density and thickness.
- .5 Perform work at ambient and equipment temperatures as recommended by the adhesive manufacturer. Make good separation of joints or cracking of insulation due to thermal movement or poor workmanship.

2 Products

2.1 FIRE AND SMOKE RATING

- .1 In accordance with CAN/ULC-S102:
 - .1 Maximum flame spread rating: 25.
 - .2 Maximum smoke developed rating: 50.

2.2 INSULATION

- .1 Mineral fibre: as specified includes glass fibre, rock wool, slag wool.
- .2 Thermal conductivity ("k" factor) not to exceed specified values at 24 deg.C mean temperature when tested in accordance with ASTM C335. Maximum "K" factor to be 0.035 W/m. deg.K (0.24 BTU in/hr/sq.ft. Deg.K) to ASTM C5553.
- .3 TIAC Class C-1: Rigid mineral fibre board to ASTM C612, unfaced or faced with vapour retarder jacket; ksi value of 0.035 at 24 degrees C.
- .4 TIAC Code C-2: mineral fibre blanket to ASTM C553 with or without factory applied vapour retarder jacket; ksi value of 0.035 at 24 degrees C

- .5 Flexible Duct Liner: Flexible non-combustible mineral fiber blanket to ASTM C 1071 Type 1; ksi value of 0.035 at 24 degrees C, 24 kg/cu m minimum density; coated air side for maximum 20.3 m/s air velocity. Minimum NRC value of 0.65 at 25mm to ASTM 423.
- .6 Rigid Duct Liner: semi-rigid non-combustible mineral fiber to ASTM C 1071 Type 2; ksi value of 0.035 at 24 degrees C, 48 kg/cu m minimum density; coated air side for maximum 20.3 m/s air velocity. Minimum NRC value of 0.7 at 25mm to ASTM 423.

2.3 JACKETS

- .1 Interior Applications:
 - .1 Vapour Barrier Jackets: to CGSB 51-GP-52Ma.
 - .2 PVC Jackets: One piece, high-gloss pre-moulded type, 0.8 mm (30mls) thick. Jackets exposed to outdoor use or flourescent lighting shall be ultra-violet ray resistant.
 - .3 Canvas Jackets: ULC listed treated cotton fabric, 220 g/sq.m. to ASTM C 921
 - .4 Aluminum Jackets: 0.51 mm thick; stucco embossed.
- .2 Exterior Applications:
 - .1 Aluminum Jackets: 0.51 mm thick; stucco embossed.
 - .2 Stainless Steel Jackets: Type 304 stainless steel; 0.25 mm thick, stucco embossed
 - .3 Outdoor Jacket: Coated glass fibre sheet, 16 kg/sq m.

2.4 ACCESSORIES

- .1 Bands: 20 mm wide; 0.38 mm thick stainless steel.
- .2 Insulating Cement: Hydraulic setting on mineral wool.
- .3 Fibrous Glass Cloth: Untreated; 305 g/sq m weight.
- .4 Adhesives: Compatible with insulation, waterproof, fire-retardant type.
- .5 Impale Anchors: Galvanized steel, 2 mm diameter with 35mm diameter head, length as required for insulation.
- .6 Joint Tape: self adhesive reinforced aluminum, minimum 50mm wide
- .7 Tie Wire: stainless steel, 1.5 mm.
- .8 Outdoor vapour retarder mastic:
 - .1 Vinyl emulsion type acrylic, compatible with insulation
 - .2 Fibrous glass cloth

3 Execution

3.1 PRE-INSTALLATION REQUIREMENTS

- .1 Pressure testing of ductwork systems complete, witnessed and certified.
- .2 Surfaces clean, dry, free from foreign material.

3.2 INSTALLATION

- .1 Install in accordance with TIAC National Standards
- .2 Apply materials in accordance with manufacturer's instructions and as indicated.
- .3 Use 2 layers with staggered joints when required nominal thickness exceeds 75 mm.
- .4 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.
 - .1 Ensure hangers, and supports are outside vapour retarder jacket.
- .5 Fasteners: install at 300 mm on centre in horizontal and vertical directions, minimum 2 rows each side.
- .6 Apply high compressive strength insulation where insulation may be compressed by weight of ductwork.
- .7 Locate insulation or cover seams in least visible location.
- .8 Provide recovering jackets on exposed insulation throughout, including equipment room. Insulation located in crawl spaces, shafts and suspended ceiling spaces is not considered exposed. Use pre-sized paper under recovering at uneven insulated surfaces.
- .9 External Duct Insulation:
 - .1 Secure insulation with vapour barrier with wires and seal jacket joints with vapour barrier adhesive or tape to match jacket.
 - .2 Secure insulation without vapour barrier with staples, tape, or wires.
 - .3 Install without sag on underside of duct work. Use adhesive or mechanical fasteners to prevent sagging. Seal vapour barrier penetrations with vapour barrier adhesive. Stop and point insulation around access doors and damper operators.
- .10 Exposed Rectangular: Secure rigid insulation with 50% coverage of adhesive and 12 gauge galvanized impale anchor tabs on 400 mm (16") centres. Seal joints and breaks with 250 mm (10") wide strips of open mesh glass cloth or tape imbedded between 2 coats of vapour barrier sealant. Point up other joints and breaks with hydraulic setting cement.
- .11 Round Duct and Concealed Rectangular Duct: Adhere flexible insulation to ductwork with adhesive applied in 150 mm (6") wide strips on 400 mm (16") centres. Provide 16 gauge annealed tie wire tied, spiral wound or half hitched at 200 mm (8") centres for securing duct insulation until adhesive sets. Butt insulation and seal joints and breaks with 50 mm (2") lap of foil adhered over joint.

- .12 Acoustic lining: Apply to interior of ducts where shown.
 - .1 Adhere insulation with adhesive for 100 percent coverage. Secure insulation with mechanical fasteners on 375 mm centres maximum on top and side of duct work with dimension exceeding 500 mm. Seal and smooth joints. Seal vapour barrier penetrations with vapour barrier adhesive. Cut off excess fastener length and cover with brush coat of mastic.
 - .2 Use 25 mm (1") thick insulation unless otherwise noted.
 - .3 Provide vapour barrier located on the warm side for outside air intakes.
 - .4 Ducts with acoustic insulation do not require external thermal insulation
 - .5 Ductwork dimensions indicated on drawings include insulation thickness.

3.3 INSTALLATION – JACKETS

- .1 Install in accordance with TIAC standards and manufacturers written requirements.
- .2 Provide recovering jackets on exposed insulation throughout, including equipment room. Insulation located in crawl spaces, shafts and suspended ceiling spaces is not considered exposed. Use pre-sized paper under recovering at uneven insulated surfaces.

3.4 DUCTWORK INSULATION SCHEDULE

.1 Insulation types and thicknesses: conform to following table:

System	TIAC Code	Vapour Retarder	Thickness (mm)
Rectangular cold and dual temperature supply air ducts	C-1	yes	50
Round cold and dual temperature supply air ducts	C-2	yes	50
Supply, return and exhaust ducts exposed in space being served	none, unless indicated otherwise on drawings		
Mixing plenums	C-1	yes	50
Exhaust duct between fan and louvre/discharge	C-1	Yes	50
Ducts outside building	C-1	Yes	special as required to achieve RSI 4.76 (R-20) to match walls in accordance with NECB requirements.
Acoustically lining		none	25
Domestic Kitchen Range Hood Exhaust	C-1	yes	50

.2 Exposed round ducts 600 mm and larger, smaller sizes where subject to abuse:

.1 Use TIAC code C-1 insulation, scored to suit diameter of duct.

.1 Finishes: conform to following TIAC codes noted in table:

	Rectangular	Round
Indoor, concealed	none	none
Indoor, exposed within mechanical room	CRF/1	CRD/2
Indoor, exposed elsewhere	CRF/2	CRD/3
Outdoor, exposed to precipitation	CRF/3	CRD/4
Outdoor, elsewhere	CRF/4	CRD/5

END OF SECTION

1 General

1.1 REFERENCES

- .1 American Society for Testing and Materials International (ASTM)
 - .1 ASTM E202-04, Standard Test Methods for Analysis of Ethylene Glycols and Propylene Glycols.

1.2 CLEANING AND START-UP OF MECHANICAL PIPING SYSTEMS

- .1 In accordance with Section 23 08 02 - Cleaning and Start-up of Mechanical Piping Systems.

2 Products

2.1 NOT USED

- .1 Not Used.

3 Execution

3.1 PREPARATION

- .1 Do not conceal or cover piping, fixtures or equipment until inspected by consultant and tested.
- .2 Provide equipment, materials and labour for tests and pay expenses. Use test instruments by approved laboratory or manufacturer and furnish certificate showing degree of accuracy.
- .3 Test instruments shall have been calibrated within one year
- .4 Install permanent gauges and thermometers just prior to tests to avoid changes in calibration.
- .5 Carry out hydraulic tests for 8 hours and maintain pressure. Where leakage occurs, repair and re-test.
- .6 Before adjusting and balancing, verify that systems are complete and operable. Ensure temperature control systems are complete and operable, thermal overload protection is in place, final filters installed, hydronic systems, flushed, filled, and vented.
- .7 Provide instruments required for testing, adjusting, and balancing operations. Make instruments available to Consultant to facilitate spot checks during testing.
- .8 Recorded data shall represent actually measured, or observed condition.

3.2 PRESSURE TESTS

- .1 Sprinkler System: Test as required by authorities having jurisdiction.

- .2 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.
- .3 During piping system tests, check linear expansion at elbows, U bends, expansion joints, and offsets for proper clearance.
- .4 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.
- .5 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.

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 Provide services of mechanics and manufacturer's representatives, ladders, tools and associated equipment required to assist the Owner in final tests.

3.4 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.

3.5 REPORTS

- .1 Include record of all tests in Operation and Maintenance Manuals.

3.6 TRAINING

- .1 In accordance with Section 21 05 01 - Common Work Results Mechanical.

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

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 joints 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.

2.3 DUCT ACCESS DOORS

- .1 Fabricate to SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated.
- .2 Access doors to be ULC labelled.
- .3 Fabrication for un-insulated ducts: Rigid and close-fitting of galvanized steel with sealing gaskets and quick fastening locking devices.
- .4 Fabrication for insulated ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.6 mm thick complete with sheet metal angle frame and 25 mm thick rigid glass fibre insulation with sealing gaskets and quick fastening locking devices.
- .5 Gaskets: neoprene.
- .6 Hardware:
 - .1 Less Than 300 mm Square: Secure with sash locks complete with safety chain.
 - .2 Up to 450 mm Square: Provide two hinges and two sash locks.
 - .3 451 to 1000 mm: piano hinge and minimum two sash locks.
 - .4 Doors over 1000 mm: piano hinge and two handles operable from both sides.
 - .5 300 x 300 mm glass viewing panels where indicated.
 - .6 Hold open devices.
- .7 Access doors with sheet metal screw fasteners are not acceptable.

2.4 DUCT TEST HOLES

- .1 Temporary Test Holes: Cut or drill in ducts as required. Cap with neat patches, neoprene plugs, threaded plugs, or threaded or twist-on metal caps.
- .2 Permanent Test Holes: Factory fabricated, air tight flanged fittings with screw cap. Provide extended neck fittings to clear insulation.

2.5 FLEXIBLE DUCT CONNECTIONS

- .1 Fabricate to SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated.
- .2 Connector:
 - .1 Fabric: cUL listed fire-retardant self extinguishing neoprene coated woven glass fibre fabric to NFPA 90A, minimum density 1.0 kg/sq m. Approximately 50mm of fabric clenched by means of double locked seams.
 - .2 Frame: 75 mm wide, 0.6 mm thick galvanized sheet metal.
 - .3 Attach edging strip to ducting and equipment by screws or bolts at 150 mm (6") intervals
- .3 Leaded Vinyl Sheet: Minimum 14 mm0.55 inch thick, 4.2 kg/sq m0.87 lbs per sq ft, 10 dB attenuation in 10 to 10,000 Hz range.

3 Execution

3.1 INSTALLATION

- .1 Install accessories to manufacturer's written instructions, NFPA 90A, and follow SMACNA HVAC Duct Construction Standards - Metal and Flexible. Refer to Section 23 31 00 for duct construction and pressure class.
- .2 Provide backdraft dampers on exhaust fans or exhaust ducts nearest to outside and where indicated.

3.2 ACCESS DOORS

- .1 Provide adequately sized duct access doors for inspection and cleaning.
- .2 Sizes:
 - .1 600 x 600 mm for person size entry.
 - .2 900 x 900 mm for servicing entry.
 - .3 300 x 300 mm for viewing.
 - .4 As indicated.
- .3 Locations (before and after):
 - .1 Fire and smoke dampers (install at fire dampers).
 - .2 Control dampers.
 - .3 Devices requiring maintenance.
 - .4 Required by code.
 - .5 Reheat coils.
 - .6 Filters.
 - .7 To facilitate cleaning of ductwork (minimum
 - .8 Elsewhere as indicated.

- .4 Provide 100 mm x 100 mm (4" x 4") quick opening access doors for inspection at balancing dampers, before and after filters, coils, fans, automatic dampers, at fire dampers, combination fire and smoke dampers, and elsewhere as indicated. Provide for cleaning kitchen exhaust duct work to NFPA 96. Provide minimum 200 x 200 mm size for hand access, 450 x 450 mm size for shoulder access, and as indicated. Provide 100 x 100 mm for balancing dampers only. Review locations prior to fabrication.

3.3 TEST PORTS

- .1 Install in accordance with recommendations of SMACNA and in accordance with manufacturer's instructions.
- .2 Provide duct test ports where indicated and required for testing and balancing purposes.
- .3 Install insulation port extensions as required.
- .4 Locations:
 - .1 For traverse readings:
 - .1 Ducted inlets to roof and wall exhausters.
 - .2 Inlets and outlets of other fan systems.
 - .3 Main and sub-main ducts.
 - .4 And as indicated.
 - .2 For temperature readings:
 - .1 At outside air intakes.
 - .2 In mixed air applications in locations as approved by Departmental Representative.
 - .3 At inlet and outlet of coils.
 - .4 Downstream of junctions of two converging air streams of different temperatures.
 - .5 And as indicated.

3.4 FLEXIBLE CONNECTORS

- .1 Provide flexible connections immediately adjacent to equipment in ducts associated with fans and motorized equipment, and supported by vibration isolators, including but not limited to the following:
 - .1 Inlets and outlets to supply air units and fans.
 - .2 Inlets and outlets of exhaust and return air fans.
 - .3 As indicated.
- .2 Length of connection: 100 mm.
- .3 Minimum distance between metal parts when system in operation: 75 mm.
- .4 Install in accordance with recommendations of SMACNA.
- .5 When fan is running:
 - .1 Ducting on sides of flexible connection to be in alignment.
 - .2 ensure slack material in flexible connection.
- .6 For fans developing static pressures of 1250 Pa and over, cover connections with leaded vinyl sheet, held in place with metal straps.

END OF SECTION

1 General

1.1 SUMMARY

- .1 Section Includes:
 - .1 Balancing dampers for mechanical forced air ventilation and air conditioning systems.
 - .2 Sustainable requirements for construction and verification.

1.2 REFERENCES

- .1 Sheet Metal and Air Conditioning National Association (SMACNA).
 - .1 SMACNA HVAC Duct Construction Standards, Metal and Flexible-1985.
- .2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).

1.3 SUBMITTALS

- .1 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.
 - .1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .2 Instructions: submit manufacturer's installation instructions.

1.4 QUALITY ASSURANCE

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

2 Products

2.1 GENERAL

- .1 Manufacture to SMACNA standards.

2.2 MANUAL VOLUME CONTROL DAMPERS.

- .1 Fabricate to SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated.
- .2 Splitter Dampers:
 - .1 Fabricate from same material as duct but one sheet metal thickness heavier (minimum 16 gauge), with appropriate stiffening to avoid vibration.
 - .2 Blade: Fabricate of double thickness sheet metal to streamline shape, secured with continuous piano hinge.
 - .3 Operator: Minimum 6 mm diameter rod in self aligning, universal joint action, flanged bushing with set screw and position indicator.
 - .4 Rod configuration to prevent end from entering duct.
 - .5 Folded leading edge.
 - .6 Size on basis of straight air volume proportioning.
- .3 Single Blade Dampers:
 - .1 Fabricate for duct sizes up to 150 (in depth) x 760 mm.
 - .2 Fabricate from same material as duct, but one sheet metal thickness heavier (minimum 16 gauge). V-groove stiffened.
 - .3 Size and configuration to recommendations of SMACNA
 - .4 Locking quadrant with shaft extension to accommodate insulation thickness.
 - .5 Inside and outside nylon end bearings.
 - .6 Channel frame of same material as adjacent duct, complete with angle stop.
- .4 Multi-Blade Damper:
 - .1 Factory manufactured of material compatible with duct.
 - .2 Opposed blade: configuration, metal thickness and construction to recommendations of SMACNA.
 - .3 Maximum blade height: 100 mm
 - .4 Bearings: self-lubricating oil impregnated nylon.
 - .5 Linkage: shaft extension with locking quadrant.
 - .6 Channel frame of same material as adjacent duct, complete with angle stop.
- .5 End Bearings: Except in round duct work 300 mm and smaller, provide end bearings.
- .6 Quadrants:
 - .1 Provide locking, indicating quadrant regulators on single and multi-blade dampers.
 - .2 On insulated ducts mount quadrant regulators on stand-off mounting brackets, bases, or adapters.
 - .3 Where rod lengths exceed 750 mm provide regulator at both ends.

3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

- .1 Install where specified, where required for balancing and where indicated on drawings.
- .2 Install in accordance with recommendations of SMACNA and in accordance with manufacturer's instructions.
- .3 Use splitter dampers only where indicated.
- .4 Provide commercial balancing dampers on all low velocity duct take-offs to diffusers, grilles, and registers, regardless of whether dampers are specified as part of the diffuser, grille, or register assembly unless specifically noted otherwise.
- .5 Runouts to registers and diffusers: install single blade damper located as close as possible to main ducts. Where indicated on the drawings, a balancing damper is not required for runouts in non-accessible ceiling spaces provided a damper is specified on the register and diffuser.
- .6 Dampers: shall be installed vibration free.
- .7 Ensure damper operators are observable and accessible. Provide access doors in ceilings/ walls where required.

END OF SECTION

1 General

1.1 SUMMARY

- .1 Section Includes:
 - .1 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

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 C22.1-2012, 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 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 09 25 – HMI and Lighting Control Narrative
 - .3 26 50 00 – Lighting
- .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 05 36 – Cable Trays
 - .2 26 09 24 - Lighting Control Devices - Low Voltage
 - .3 26 09 25 – HMI and Lighting Control Narrative
 - .4 26 24 17 - Panelboards Breaker Type
 - .5 26 50 00 – Lighting
- .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 HMI Programming
 - .8 Communications systems
 - .9 Security Systems
 - .10 Specials
 - .11 Miscellaneous - 8% maximum
 - .12 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 09 25	HMI and Lighting Control Narrative	12
26 50 00	Lighting	4

- .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.

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 6 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 CAT6 cable are to be solid 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.

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.

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.

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

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 C22.1-2012, 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.

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

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 C22.1-2012, 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 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

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 C22.1-2012, 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 armoured 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

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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 - .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

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:
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 - .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.

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.
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 - .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

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- .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.

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
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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:
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END OF SECTION

Part 1 General

1.1 GENERAL REQUIREMENTS

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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

PART 1 General

1.1 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 74 19 - Construction/Demolition Waste Management And Disposal.

1.2 REFERENCES

- .1 2012 Canadian Electrical Code
- .2 Canadian Standards Association (CSA International)
 - .1 CAN/CSA C22.2No.126-M91 (R1997), Cable Tray Systems.
- .3 National Electrical Manufacturers Association (NEMA) standards
 - .1 NEMA FG 1-1993, Fibreglass and Cable Tray Systems.
 - .2 NEMA VE 1-1998, Metal Cable Tray Systems.

1.3 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with section 01 33 00 - Submittal Procedures.
- .2 Identify types of cabletroughs used.
- .3 Show actual cabletrough installation details and suspension system.

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.

PART 2 Products

2.1 CABLETROUGH

- .1 Cable trays shall be complete with necessary factory elbows, fittings, joiner plates, radius turns, supports, etc., as necessary for the total installation.
- .2 Cable tray shall be provided for communications conductors where shown on the drawings. The cable tray shall be used for the running of data/voice communications cables, power over Ethernet cables, cable TV coax cable, and security cables.
- .3 The cable tray may also be used for the running of low-voltage Class 2 control wiring.

- .4 Conduit shall be used where cable trays and J-hooks not shown or described on drawings.
- .5 Cable tray indicated on the drawings for the purpose of running communications conductors shall be a basket tray cable support system, electroplated welded wire-mesh, 50 x 100mm mesh size, 105 mm deep, in standard 3048 mm lengths. Tray width shall be 300mm unless otherwise noted on the drawings. Increase tray size if necessary to accommodate cables and spacing specified on the drawings.
- .6 Provide conduit connectors where conduits are run to the basket tray.
- .7 Provide cable drop out or “waterfall” kits at all equipment racks or locations where groups of cable leave a tray.
- .8 Provide cable clamps or ties at 1000 mm intervals to maintain alignment of cable in tray.
- .9 All hanger rods and supports shall be galvanized.
- .10 Cable tray shall be manufactured by Cooper B-Line Systems, Cablofil, Canstrut, Code Manufacturing Ltd., or Thomas and Betts ‘Express’ Tray.

2.2 SUPPORTS

- .1 Provide supports as required.

PART 3 Execution

3.1 INSTALLATION

- .1 Install a complete cable tray system.
- .2 Where cable trays pass through floor, arrange for concrete curb around opening.
- .3 Do not run tray within 300 mm of steam or hot water lines. Cable tray shall not be in contact of any sprinkler piping water lines.
- .4 Cuts shall be filed smooth and treated with a galvanizing compound where cutting of certain sections is required.
- .5 Cable tray shall be supported on 1500 mm centres, and shall be adequately braced to withstand loads due to pulling in of cables.
- .6 Check routing and field dimensions to ensure there is absolutely no interference with work and equipment of other divisions. Provide all tray offsets to avoid duct work, piping and structural members.
- .7 Tray shall be provided to support cable above all equipment in data/IT rooms or other rooms containing cable termination points.
- .8 Cable tray shall be grounded every 15 meters with AWG #1 bare copper unless otherwise noted.

- .9 Remove sharp burrs or projections to prevent damage to cables or injury to personnel.
- .10 Communication tray shall be installed a minimum of 300mm from all power wiring.

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 C22.1-2012, 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.

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

- .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 C22.1-2012, 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 existing gun range control post touchscreen. All required changes to touchscreen programming are to be included in this contract.

.2 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 control narrative as described by the drawings and specifications.

.2 Lighting control system shall be provided such that it is capable of responding from commands from range control post 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 Provide all required components for low voltage lighting system to properly communicate with existing range control post. Currently commands are output from range control post through RS232 serial connection sending ASCII commands.

.5 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.

- .6 Light 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.
- .7 System shall be capable of resuming normal operation on return of power after outage 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 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. 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’ or ‘C’ 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 2012 CEC requirements for voltage drop. All output cabling from zone controllers to light fixtures shall be run in conduit.

2.5 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 future 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 manufacture 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

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 C22.1-2012, 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 09 24 – Low Voltage Lighting System
 - .4 Section 26 50 00 - Lighting
- .2 Shop drawings shall include but not be limited to devices, 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 the shop drawing package.
- .2 Shop Drawings:

- .1 Proposed graphic screen layouts. Include computer generated proposed layouts for owner/consultant approval minimum 4 weeks prior to programming on site.

1.5 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.

1.6 SYSTEM DESCRIPTION & PERFORMANCE PARAMETERS

- .1 The range control system incorporates an existing industrial PLC (programmable logic controller) based control system coupled with graphic operation touchscreen HMI (human-machine-interface) used to control lighting and all other functions in the gun range.
- .2 All lighting controls changes herein described shall be operated from the existing range control HMI. All work involved with reprogramming of HMI shall be included in this contract. Any range control hardware and HMI programming work required as part of this contract shall be completed by the manufacturer of these existing components: Mancom – partner of Action Target.
- .3 All components and programming required for range control to communicate with low voltage lighting 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 Mancom. 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.
- .4 All changes described herein shall only affect the existing lighting control functions of the existing range control. Existing control capabilities of range targets and all other target functions shall not be diminished by changes made in this contract in any fashion.
- .5 Range control system shall be provided such that it is capable of responding from commands from user input and outputting subsequent actions to complete these commands to low voltage lighting control system without stutter or lag (<0.5s). Screen refresh rate shall also respond to user input without evidence of stutter or lag.

1.7 HMI CHARACTERISTICS & CONTROLS NARRATIVE

- .1 Provide additional HMI touchscreen pages in order to meet the requirements outlined below and on the drawings.
- .2 Range control shall have override ability of low voltage switches in range and in hallway overlooking range.

- .3 All fixtures except types 'AA', 'RB', and 'R' shall be dimmable from range control touchscreen. For dimming zones, provide either High-Med-Low-(Night for 'BB' fixtures)-Off settings or 0-100% slider with a zoom on the last 5% of the slider.
- .4 In addition to zone control shown on drawings, contractor shall allow for the programming of 5 additional custom scenes as directed by the owner a minimum of 4 weeks prior to commissioning of system.
- .5 System shall be capable of operating in two modes: manual and auto. Toggle between these two modes shall be accessible from all lighting control HMI pages. Provide button in HMI complete with description of current mode on all lighting control pages
- .6 Manual Mode:
 - .1 User at range control post has control of zones as per the zoning shown in drawings. Provide HMI control of all lighting zones.
 - .2 Immediately following when manual mode is engaged, all range lights (all light fixtures type 'BB' and 'C') currently energized shall be turned off.
 - .3 Owner custom scenes are accessible in this mode.
- .7 Auto Mode:
 - .1 User at range control post no longer has control of range lighting zones (all zones associated with fixture types 'BB' and 'C'). User still has full control of all other lighting zones.
 - .2 All range lights are now slaved to the movement of range targets. This applies to both single target movement and multiple target movements. When a target moves position, the light associated with that new position shall energize
 - .3 Dimming control of range lighting zones shall still be accessible in this mode.
 - .4 In order to engage auto mode, all range targets must be at the 0 meter line, in the 'Home' position.
 - .5 Immediately following when auto mode is engaged, all range lights (all light fixtures type 'BB' and 'C') currently energized shall be turned off.
- .8 Provide external dry contact for future connection to access control system card reader output. Provide programming to shut-down and start-up range control system upon activation of this dry contact. When system is disabled through this contact, system shall also energize red warning lights to signal that the range is not to be used.

1.8 WARRANTY

- .1 Provide a one year limited manufacturer's warranty and support on all PLC programming changes against bugs and omissions.

Part 2 Products

2.1 MANUFACTURERS

- .1 Acceptable Manufacturers/PLC Programmers:
 - .1 Mancom

Part 3 Execution

3.1 COMMISSIONING AND TESTING

- .1 The following items are to be completed in conjunction with the low voltage lighting system commissioning and training.
- .2 The Owner's operating and maintenance personnel shall be instructed in the operating and maintenance of the control system. The contractor, lighting supplier, and a Mancom manufacture representative shall be present during commissioning.
- .3 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.
- .4 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.
- .5 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.
- .6 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

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 C22.1-2012, 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.

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:
 - .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 C22.1-2012, 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.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

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 C22.1-2012, 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 $\geq 4.5''$ (345 lumens for apertures $\leq 4.5''$), 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.
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 0.1%, 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 LED colour, 1219mm length, 5W/305mm, 1219mm length, 30° x 60° beam width, extruded aluminum body, tempered glass lens, integral driver/power supply shall be capable of being field replaced with requiring the replacement of the accompanying luminaire.

Lumenpulse Lumenfacade series

GVA Lighting STR9 series

- .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 'A'** – Track mounted LED dimmable downlight fixture, 1,000 lumen output, 4000k colour temperature, minimum 45° beam width, adjustable beam direction, complete with frosted lens. Provide new track as required by light fixture in mounting location shown on drawings. Fixture shall be supplied to provide maximum light diffusion.

Lumenpulse Lumenalpha series

Senso Leto 16 series

- .9 **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

- .10 **Fixture type 'C'** - Surface mounted floodlight style LED dimmable light fixture, 1,890 lumen minimum output, 4000k colour temperature, 120 volt, 40° beam angle, yoke mount. With yoke mount, fixture shall be able to adjust both vertical and horizontal aim.

Lumenpulse Lumenbeam Medium series

Senso Lighting Helios series

- .11 **Fixture type 'D'** – Recessed 4" round LED dimmable downlight fixture suitable for mounting in t-bar ceilings. 120 volt, 4000k colour temperature, 2,000 lumen minimum output, maximum 20° beam angle reflector.

Liton Lighting 4 LED series

Senso Leto 3 series

ADDITIONAL MATERIALS

- .12 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': 3 x additional fixtures

Fixture type 'CC': 2 x additional fixtures

Fixture type 'A': 2 x additional fixtures

Part 3 Execution

3.1 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.

3.2 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.

3.3 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.

3.4 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.

3.5 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.

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.

3.7 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.

3.8 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