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**Repair of workshops and  
warehouses**

1156 Mill Street, Montreal, Qc

Project No. SPAC : R.101200.001

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## Repair of workshops and warehouses

1156 Mill Street, Montreal, Qc

### Electromechanical Specifications

Project No. SPAC : R.101200.001

February 12, 2021

## For Tender



2021-02-11

**Mechanical**

**Electrical**

**This document should not be used for construction purposes**



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RAISON / Reason	Pour appel d'offres / for tender

PAGE	NUMÉRO / Number	TITRE DU DESSIN / Drawings title	RÉVISION / Revision	DESCRIPTION
<b>GÉNÉRAL / GENERAL</b>				
M-001	PN-LE	Légende mécanique / Mechanical legend	0	Émis / Issued
M-002	PN-LE	Légende mécanique / Mechanical legend	0	Émis / Issued
M-003	PN-DT	Détails / Details	0	Émis / Issued
M-004	PN-DT	Détails / Details	0	Émis / Issued
<b>PROTECTION INCENDIE / FIRE PROTECTION</b>				
M-101	PN-PI	Protection incendie RDC et 2e étage - Modifié Fire protection ground floor & 2nd level - Modified	0	Émis / Issued
<b>MULTIDISCIPLINAIRES / MULTIDISCIPLINARY</b>				
M-200	PN-MM	Multidisciplinaires RDC et 2e étage - Démolition Multidisciplinary ground floor & 2nd level - Demolition	0	Émis / Issued
<b>PLOMBERIE / PLUMBING</b>				
M-201	PN-PB	Plomberie - eau domestique RDC et 2e étage - Modifié Plumbing - domestic water ground floor & 2nd level - Modified	0	Émis / Issued
M-202	PN-PB	Plomberie - drainage RDC et 2e étage - Modifié Plumbing - drain ground floor & 2nd level - Modified	0	Émis / Issued
M-203	DG-PB	Plomberie - diagrammes - Modifié Plumbing - diagrams - Modified	0	Émis / Issued
<b>VENTILATION / VENTILATION</b>				
M-301	PN-VC	Ventilation RDC et 2e étage - Modifié Ventilation ground floor & 2nd level - Modified	0	Émis / Issued
<b>RÉGULATION / CONTROLS</b>				
M-600	PN-SR	Diagrammes de régulation - Modifié Control diagrams - Modified	0	Émis / Issued



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<b>SÉRIE 000 - GÉNÉRAL / GENERAL</b>				
E-001	PN-LE	Légende électrique / <i>Electrical legend</i>	0	Émis / Issued
E-002	PN-LE	Tableaux / <i>Tables</i>	0	Émis / Issued
E-004	PN-DT	Détails électriques / <i>Electrical details</i>	0	Émis / Issued
E-005	PN-DT	Détails Hydro-Québec / <i>Hydro-Québec details</i>	0	Émis / Issued
E-006	PN-DIA-AI	Diagrammes alarme incendie et tableau de zone / <i>Fire alarm diagram and zone table</i>	0	Émis / Issued
<b>SÉRIE 050 - DISTRIBUTION ÉLECTRIQUE / ELECTRICAL DISTRIBUTION</b>				
E-050	PN-DS	Distribution électrique / <i>Electrical distribution</i>	0	Émis / Issued
E-051	PN-PAN	Panneaux électriques - Existants / <i>Electrical panels - Existing</i>	0	Émis / Issued
E-052	PN-PAN	Panneaux électriques / <i>Electrical panels</i>	0	Émis / Issued
<b>SÉRIE 060 - HYDRO-QUÉBEC</b>				
E-060	PN-ST	Hydro-Québec	0	Émis / Issued
<b>SÉRIE 100 - ÉCLAIRAGE / LIGHTING</b>				
E-100	PN-PFD-X	Éclairage - Rez-de-chaussée - Démolition / <i>Lighting - Ground floor - Demolition</i>	0	Émis / Issued
E-101	PN-PFD-N	Éclairage - Rez-de-chaussée - Modifié / <i>Lighting - Ground floor - Modified</i>	0	Émis / Issued
<b>SÉRIE 200 - SERVICES / SERVICES</b>				
E-200	PN-PRS-X	Services - Rez-de-chaussée - Démolition / <i>Services - Ground floor - Demolition</i>	0	Émis / Issued
E-201	PN-PRS-N	Services - Rez-de-chaussée - Modifié / <i>Services - Ground floor - Modified</i>	0	Émis / Issued
<b>SÉRIE 300 - SERVICES AUXILIAIRES / AUXILIARY SERVICES</b>				
E-300	PN-SA-X	Services - Rez-de-chaussée - Démolition / <i>Services - Ground floor - Demolition</i>	0	Émis / Issued
E-301	PN-SA-N	Services - Rez-de-chaussée - Modifié / <i>Services - Ground floor - Modified</i>	0	Émis / Issued



**Part 1            General**

**1.1                ADMINISTRATIVE REQUIREMENTS**

- .1    Demonstrate operation and maintenance of equipment and systems to Owner's personnel two weeks prior to date of final inspection.
- .2    Owner: provide list of personnel to receive instructions, and co-ordinate their attendance at agreed-upon times.
- .3    Preparation:
  - .1    Verify conditions for demonstration and instructions comply with requirements.
  - .2    Verify designated personnel are present.
  - .3    Ensure equipment has been inspected and put into operation in accordance with Section 01 91 13.
  - .4    Ensure testing, adjusting, and balancing has been performed in accordance with Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS and equipment and systems are fully operational.
- .4    Demonstration and Instructions:
  - .1    Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, and maintenance of each item of equipment.
  - .2    Instruct personnel in phases of operation and maintenance using operation and maintenance manuals as basis of instruction.
  - .3    Review contents of manual in detail to explain aspects of operation and maintenance.
  - .4    Prepare and insert additional data in operations and maintenance manuals when needed during instructions.
- .5    Time Allocated for Instructions: ensure amount of time required for instruction of each item of equipment or system as follows:
  - .1    Section 23 81 40 - Heating Plant.
  - .2    Other items could be added.

**1.2                ACTION AND INFORMATIONAL SUBMITTALS**

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

**1.3 QUALITY ASSURANCE**

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

**Part 2 Products**

**2.1 NOT USED**

- .1 Not Used.

**Part 3 Execution**

**3.1 NOT USED**

- .1 Not Used.

**END OF SECTION**

## **Part 1        General**

### **1.1            TRAINEES**

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

### **1.2            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.

### **1.3            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.

### **1.4            TRAINING MATERIALS**

- .1      Instructors to be responsible for content and quality.
- .2      Training materials to include:
  - .1      "As-Built" Contract Documents.
  - .2      Operating Manual.

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

## **1.5 SCHEDULING**

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

## **1.6 RESPONSIBILITIES**

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

## **1.7 TRAINING CONTENT**

- .1 Training to include demonstrations by Instructors using the installed equipment and systems.
- .2 Content includes:
  - .1 Review of facility and occupancy profile.
  - .2 Functional requirements.
  - .3 System philosophy, limitations of systems and emergency procedures.
  - .4 Review of system layout, equipment, components and controls.
  - .5 Equipment and system start-up, operation, monitoring, servicing, maintenance and shut-down procedures.

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

**1.8 VIDEO-BASED TRAINING**

- .1 Manufacturer's videotapes to be used as training tool with Departmental Representative's review and written approval 1 month prior to commencement of scheduled training.

**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            ACRONYMS**

- .1        BMM - Building Management Manual.
- .2        Cx - Commissioning.
- .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 BMM.
  - .3        Effectively train O&M staff.
- .2        Contractor assists in Cx process, operating equipment and systems, troubleshooting and making adjustments as required.
  - .1        Systems to be operated at full capacity under various modes to determine if they function correctly and consistently at peak efficiency. Systems to be interactively with each other as intended in accordance with Contract Documents and design criteria.
  - .2        During these checks, adjustments to be made to enhance performance to meet environmental or user requirements.
- .3        Design Criteria: as per client's requirements or determined by designer. To meet Project functional and operational requirements.

### **1.3            COMMISSIONING OVERVIEW**

- .1        Section 01 91 13.13 - Commissioning Plan.
- .2        For Cx responsibilities refer to Section 01 91 13.13 - Commissioning Plan.
- .3        Cx to be a line item of Contractor's cost breakdown.
- .4        Cx activities supplement field quality and testing procedures described in relevant technical sections.
- .5        Cx is conducted in concert with activities performed during stage of project delivery. Cx identifies issues in Planning and Design stages which are addressed during Construction and Cx stages to ensure the built facility is constructed and

proven to operate satisfactorily under weather, environmental and occupancy conditions to meet functional and operational requirements. Cx activities includes transfer of critical knowledge to facility operational personnel.

- .6 Consultant will issue Interim Acceptance Certificate when:
  - .1 Completed Cx documentation has been received, reviewed for suitability and approved by Departmental Representative.
  - .2 Equipment, components and systems have been commissioned.
  - .3 O&M training has been completed.

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

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

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

- .1 Before Construction:
  - .1 Review Contract Documents, confirm by writing to Departmental Representative.
    - .1 Adequacy of provisions for Cx.
    - .2 Aspects of design and installation pertinent to success of Cx.
- .2 During Construction:
  - .1 Co-ordinate provision, location and installation of provisions for Cx.
- .3 Before start of Cx:
  - .1 Have completed Cx Plan up-to-date.
  - .2 Ensure installation of related components, equipment, sub-systems, 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 ACTION AND INFORMATIONAL SUBMITTALS**

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

## **1.8 COMMISSIONING DOCUMENTATION**

- .1 Refer to Section 01 91 13.16 - Commissioning Forms: Installation Check Lists and Product Information (PI)/Performance Verification (PV) Forms for requirements and instructions for use.
- .2 Departmental Representative to review and approve Cx documentation.
- .3 Provide completed and approved Cx documentation to Departmental Representative.

## **1.9 COMMISSIONING SCHEDULE**

- .1 Provide detailed Cx schedule as part of construction schedule in accordance with applicable section (GANTT Chart or Critical Path Method (CPM)).
- .2 Provide adequate time for Cx activities prescribed in technical sections and commissioning sections including:
  - .1 Approval of Cx reports.
  - .2 Verification of reported results.
  - .3 Repairs, retesting, re-commissioning, re-verification.
  - .4 Training.

**1.10 COMMISSIONING MEETINGS**

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

**1.11 STARTING AND TESTING**

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

**1.12 WITNESSING OF STARTING AND TESTING**

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

**1.13 MANUFACTURER'S INVOLVEMENT**

- .1 Factory testing: manufacturer to:
  - .1 Coordinate time and location of testing.
  - .2 Provide testing documentation for approval by Departmental Representative.
  - .3 Arrange for Departmental Representative to witness tests.
  - .4 Obtain written approval of test results and documentation from Consultant before delivery to site.
- .2 Obtain manufacturers installation, start-up and operations instructions prior to start-up of components, equipment and systems and review with Departmental Representative.

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

#### **1.14 PROCEDURES**

- .1 Verify that equipment and systems are complete, clean, and operating in normal and safe manner prior to conducting start-up, testing and Cx.
- .2 Conduct start-up and testing in following distinct phases:
  - .1 Included in delivery and installation:
    - .1 Verification of conformity to specification, approved shop drawings and completion of PI report forms. Refer to the model forms attached to section 01 91 13.16 (Cx documents). If the supplier wishes to use another form template, submit the blank document to the Consultant for prior verification and approval.
    - .2 Visual inspection of quality of installation.
  - .2 Start-up: follow accepted start-up procedures.
  - .3 Operational testing: document equipment performance. Refer to the model forms attached to section 01 91 13.16 (Cx documents). If the supplier wishes to use another form template, submit the blank document to the Consultant for prior verification and approval.
  - .4 System PV: include repetition of tests after correcting deficiencies.
  - .5 Post-substantial performance verification: to include fine-tuning.
- .3 Correct deficiencies and obtain approval from Departmental Representative after distinct phases have been completed and before commencing next phase.
- .4 Document require tests on approved PV forms.
- .5 Failure to follow accepted start-up procedures will result in re-evaluation of equipment by an independent testing agency selected by Departmental Representative. If results reveal that equipment start-up was not in accordance with requirements, and resulted in damage to equipment, implement following:
  - .1 Minor equipment/systems: implement corrective measures approved by Departmental Representative.

- .2 Major equipment/systems: if evaluation report concludes that damage is minor, implement corrective measures approved by Departmental Representative.
- .3 If evaluation report concludes that major damage has occurred, Departmental Representative shall reject equipment.
  - .1 Rejected equipment to be remove from site and replace with new.
  - .2 Subject new equipment/systems to specified start-up procedures.

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

- .1 Assemble start-up documentation and submit to Departmental Representative for approval before commencement of commissioning.
- .2 Start-up documentation to include:
  - .1 Factory and on-site test certificates for specified equipment.
  - .2 Pre-start-up inspection reports.
  - .3 Signed installation/start-up check lists.
  - .4 Start-up reports,
  - .5 Step-by-step description of complete start-up procedures, to permit Departmental Representative to repeat start-up at any time.

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

- .1 After start-up, operate and maintain equipment and systems as directed by equipment/system manufacturer.
- .2 With assistance of manufacturer develop written maintenance program and submit Departmental Representative for approval before implementation.
- .3 Operate and maintain systems for length of time required for commissioning to be completed.
- .4 After completion of commissioning, operate and maintain systems until issuance of certificate of interim acceptance.

#### **1.17 TEST RESULTS**

- .1 If start-up, testing and/or PV produce unacceptable results, repair, replace or repeat specified starting and/or PV procedures until acceptable results are achieved.
- .2 Provide manpower and materials, assume costs for re-commissioning.

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

- .1 Notify Departmental Representative at least 21 days prior to start of Cx.
- .2 Start Cx after elements of building affecting start-up and performance verification of systems have been completed.

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

- .1 Submit to Departmental Representative for review and approval:

- .1 Complete list of instruments proposed to be used.
- .2 Listed data including, serial number, current calibration certificate, calibration date, calibration expiry date and calibration accuracy.
- .2 Provide the following equipment as required:
  - .1 2-way radios.
  - .2 Ladders.
  - .3 Equipment as required to complete work.

**1.20 COMMISSIONING PERFORMANCE VERIFICATION**

- .1 Carry out Cx:
  - .1 Under [accepted simulated] [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 Departmental Representative to witness activities and verify results.

**1.22 AUTHORITIES HAVING JURISDICTION**

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

**1.23 COMMISSIONING CONSTRAINTS**

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

**1.24 EXTRAPOLATION OF RESULTS**

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

manufacturer's data, with manufacturer's assistance and using approved formulae.

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

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

#### **1.26 REPEAT VERIFICATIONS**

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

#### **1.27 SUNDRY CHECKS AND ADJUSTMENTS**

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

#### **1.28 DEFICIENCIES, FAULTS, DEFECTS**

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

#### **1.29 COMPLETION OF COMMISSIONING**

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

**1.30 ACTIVITIES UPON COMPLETION OF COMMISSIONING**

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

**1.31 TRAINING**

- .1 In accordance with Section 01 79 00 and 01 79 00.13 - Demonstration and Training, and Demonstration and Training for Building Commissioning.

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

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

**1.33 OCCUPANCY**

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

**1.34 INSTALLED INSTRUMENTATION**

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

**1.35 PERFORMANCE VERIFICATION TOLERANCES**

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

**1.36 OWNER'S PERFORMANCE TESTING**

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

**Part 2          Products**

**2.1              NOT USED**

.1          Not Used.

**Part 3          Execution**

**3.1              NOT USED**

.1          Not Used.

**END OF SECTION**

**Part 1            General**

**1.1                REFERENCE STANDARDS**

- .1    Public Works and Government Services Canada (PWGSC)
  - .1      PWGSC - Commissioning Guidelines CP.4 -3rd edition.

**1.2                GENERAL**

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

- .7 TAB - Testing, Adjusting and Balancing.
- .8 WHMIS - Workplace Hazardous Materials Information System.
- .5 Commissioning terms used in this Section:
  - .1 Bumping: short term start-up to prove ability to start and prove correct rotation.
  - .2 Deferred Cx - Cx activities delayed for reasons beyond Contractor's control due to lack of occupancy, weather conditions, need for heating/cooling loads.

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

- .1 Cx Plan to take into account:
  - .1 Approved shop drawings and product data.
  - .2 Approved changes to contract.
  - .3 Contractor's project schedule.
  - .4 Cx schedule.
  - .5 Contractor's, sub-contractor's, suppliers' requirements.
  - .6 Project construction team's and Cx team's requirements.
- .2 Submit completed Cx Plan to Departmental Representative and obtain written approval.

### **1.4 REFINEMENT OF CX PLAN**

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

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

- .1 Departmental Representative to maintain overall responsibility for project and is sole point of contact between members of commissioning team.
- .2 Project Manager will select Cx Team consisting of following members:
  - .1 PWGSC Design Quality Review Team: during construction, will conduct periodic site reviews to observe general progress.
  - .2 PWGSC Quality Assurance Commissioning Manager: ensures Cx activities are carried out to ensure delivery of a fully operational project including:
    - .1 Review of Cx documentation from operational perspective.

- .2 Review for performance, reliability, durability of operation, accessibility, maintainability, operational efficiency under conditions of operation.
- .3 Protection of health, safety and comfort of occupants and O&M personnel.
- .4 Monitoring of Cx activities, training, development of Cx documentation.
- .5 Work closely with members of Cx Team.
- .3 Departmental Representative is responsible for:
  - .1 Organizing Cx.
  - .2 Writing Cx minutes.
  - .3 Witnessing and certifying TAB and other tests.
  - .4 Performing verification of performance of installed systems and equipment.
  - .5 O&M verification and approval
- .4 Consultant is responsible for:
  - .1 Drafting of Cx specification and Cx requirements in the applicable divisions
  - .2 Cx plan.
  - .3 Monitoring operations Cx activities.
  - .4 Assistance and advice in carrying out the MES and finding solutions to the problems identified;
  - .5 Witnessing and certifying TAB and other tests.
  - .6 Implementation of Training Plan.
  - .7 O&M verification
- .5 Construction Team: contractor, subcontractors, suppliers and support disciplines, is responsible for construction/installation in accordance with Contract Documents, including:
  - .1 Testing.
  - .2 TAB.
  - .3 Performance of Cx activities.
  - .4 Delivery of training and Cx documentation.
  - .5 Assigning one person as point of contact with Consultant and PWGSC Cx Manager for administrative and coordination purposes.
- .6 Contractor's Cx agent implements specified Cx activities including:
  - .1 Demonstrations.
  - .2 Training.
  - .3 Testing.
  - .4 Preparation, submission of test reports.
- .7 Contractor's commissioning agent: he performs the commissioning activities indicated in the specifications and specified in the Cx plan. Among its responsibilities are the following:

- .1 implementation of the final Cx plan;
- .2 implementation of the training plan.
- .3 attendance at tests and certification of declared results;
- .4 presence in balancing operations and related tests, and certification;
- .5 preparation and submission of test reports.
- .6 preparation and submission of the components of the Operation and maintenance manual
- .8 Property Manager: represents lead role in Operation Phase and onwards and is responsible for:
  - .1 Receiving facility.
  - .2 Day-To-Day operation and maintenance of facility.

## 1.6 CX PARTICIPANTS

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

- .7 Provide names of participants to Departmental Representative and details of instruments and procedures to be followed for Cx 1 month prior to starting date of Cx for review and approval.

## **1.7 EXTENT OF CX**

- .1 Cx Structural and Architectural Systems:
  - .1 Architectural and structural:
    - .1 N/A.
  - .2 Commission mechanical systems and associated equipment:
    - .1 Plumbing systems:
    - .2 HVAC and exhaust systems:
      - .1 HVAC and recuperation
      - .2 Heating and cooling
      - .3 Air distribution system
    - .3 Fire and life safety systems:
      - .1 Water based sprinkler system.
    - .4 Seismic restraint and control measures.
      - .1 Conformity report
    - .5 IAQ environmental control systems:
      - .1 Command / regulation / control systems for ambient conditions in modified areas.
    - .6 EMCS:
      - .1 Integration to existing control.
  - .3 Commission electrical systems and equipment:
    - .1 Low voltage below 750 V:
      - .1 Low voltage equipment.
      - .2 Low voltage distribution systems.
    - .2 Lighting systems:
      - .1 Lighting equipment.
      - .2 Distribution systems.
      - .3 Emergency lighting systems, including battery packs.
    - .3 Fire alarm systems, equipment:
      - .1 Annunciators.
      - .2 Control panels.
    - .4 Security systems.

## **1.8 DELIVERABLES RELATING TO O&M PERSPECTIVES**

- .1 General requirements:
  - .1 Compile French documentation.

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

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

- .1 General:
  - .1 Start-up, testing and Cx requirements, conditions for acceptance and specifications form part of relevant technical sections of these specifications.
- .2 Definitions:
  - .1 Cx as used in this section includes:
    - .1 Cx of components, equipment, systems, subsystems, and integrated systems.
    - .2 Factory inspections and performance verification tests.
- .3 Deliverables: provide:
  - .1 Startup, pre-Cx activities and documentation for systems, and equipment.
  - .2 Completed installation checklists (ICL).
  - .3 Completed product information (PI) report forms.
  - .4 Completed performance verification (PV) report forms.
  - .5 Results of Performance Verification Tests and Inspections.
  - .6 Tests of following witnessed by PWGSC Design Quality Review Team:
  - .7 Training Plans.
  - .8 Cx Reports.
  - .9 Prescribed activities during warranty period.
- .4 Departmental Representative to witness and certify tests and reports of results provided to Departmental Representative.
- .5 Departmental Representative to participate.

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

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

- .1 Pre-Start-Up inspections: by General Contractor prior to permission to start up and rectification of deficiencies to Departmental Representative's satisfaction.
- .2 General Contractor to use approved check lists.
- .3 Consultant will monitor some of these pre-start-up inspections.
- .4 Include completed documentation with Cx report.
- .5 Conduct pre-start-up tests: conduct pressure, static, flushing, cleaning, and "bumping" during construction as specified in technical sections. To be witnessed and certified by General Contractor and does not form part of Cx specifications.
- .6 Consultant will monitor [some] of these inspections and tests.
- .7 Include completed documentation in Cx report.
- .2 Pre-Cx activities - ARCHITECTURAL AND STRUCTURAL:
  - .1 N/A.
- .3 Pre-Cx activities - MECHANICAL:
  - .1 Plumbing systems:
    - .1 N/A.
  - .2 HVAC equipment and systems:
    - .1 "Bump" each item of equipment in its "stand-alone" mode.
    - .2 At this time, complete pre-start-up checks and complete relevant documentation.
    - .3 After equipment has been started, test related systems in conjunction with control systems on a system-by-system basis.
    - .4 Perform TAB on systems. TAB reports to be approved by Consultant.
  - .3 EMCS:
    - .1 EMCS trending to be available as supporting documentation for performance verification.
    - .2 Perform point-by-point testing in parallel with start-up.
    - .3 Carry out point-by-point verification.
    - .4 Demonstrate performance of systems, to be witnessed by Departmental Representative prior to start of 30 day Final Acceptance Test period.
    - .5 Perform final Cx and operational tests during demonstration period and 30 day test period.
    - .6 Only additional testing after foregoing have been successfully completed to be "Off-Season Tests".
- .4 Pre-Cx activities - LIFE SAFETY SYSTEMS
  - .1 N/A.
- .5 Pre-Cx activities - ELECTRICAL:

- .1 Low voltage distribution systems under 750 V:
  - .1 Requires independent testing agency to perform pre- energization and post-energization tests.
  - .2 Perform a phase balance check (loaded) for the distribution elements designated by the client. Provide the load test procedure beforehand for approval. Emergency power generation systems
- .2 Lighting systems:
  - .1 Normal lighting systems:
    - .1 Document the programming for “scenario” systems and validate its operation
  - .2 Emergency lighting systems:
    - .1 Interrupt normal supply then check lighting levels and illuminated area.
- .3 Fire alarm systems: test after other safety and security systems are completed. Testing to include a complete verification in accordance with ULC requirements. Test has witnessed and certified report, demonstrate devices and zones to Consultant.
- .4 Low voltage systems: these include:
  - .1 N/A.

#### **1.11 START-UP**

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

**1.12 CX ACTIVITIES AND RELATED DOCUMENTATION**

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

**1.13 CX OF INTEGRATED SYSTEMS AND RELATED DOCUMENTATION**

- .1 Cx to be performed by specified Cx specialist, using procedures developed by Contractor and Consultant and approved by Departmental Representative.
- .2 Tests to be witnessed by Consultant and/or Departmental Representative and documented on approved report forms.
- .3 Upon satisfactory completion, Cx specialist to prepare Cx Report, to be certified by Consultant and submitted to Departmental Representative for review.
- .4 Departmental Representative reserves right to verify percentage of reported results.
- .5 Integrated systems to include:
  - .1 HVAC and associated systems forming part of integrated HVAC systems.
- .6 Identification:
  - .1 In later stages of Cx, before hand-over and acceptance Departmental Representative, Contractor, Project Manager and Cx Manager to co-operate to complete inventory data sheets and provide assistance to PWGSC in full implementation of MMS identification system of components, equipment, sub-systems, systems.

**1.14 INSTALLATION CHECK LISTS (ICL)**

- .1 Refer to Section 01 91 13.16 - Commissioning Forms: Installation Check Lists and Product Information (PI)/Performance Verification (PV) Forms.

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

- .1 Refer to Section 01 91 13.16 - Commissioning Forms: Installation Check Lists and Product Information (PI)/Performance Verification (PV) Forms.

**1.16 PERFORMANCE VERIFICATION (PV) REPORT**

- .1 Refer to Section 01 91 13.16 - Commissioning Forms: Installation Check Lists and Product Information (PI)/Performance Verification (PV) Forms.

## **1.17 DELIVERABLES RELATING TO ADMINISTRATION OF CX**

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

## **1.18 CX SCHEDULES**

- .1 Prepare detailed Cx Schedule and submit to Departmental Representative for review and approval same time as project Construction Schedule. Include:
  - .1 Milestones, testing, documentation, training and Cx activities of components, equipment, subsystems, systems and integrated systems, including:
    - .1 Pre-TAB review: 28 days after contract award, and before construction starts.
    - .2 Cx agents' credentials: 30 days before start of Cx.
    - .3 Cx procedures: 1 month after award of contract.
    - .4 Cx Report format: 1 month after contract award.
    - .5 Discussion of heating/cooling loads for Cx: 1 month before start-up.
    - .6 Submission of list of instrumentation with relevant certificates: 21 days before start of Cx.
    - .7 Notification of intention to start TAB: 21 days before start of TAB.
    - .8 TAB: after successful start-up, correction of deficiencies and verification of normal and safe operation.
    - .9 Notification of intention to start Cx: 14 days before start of Cx.
    - .10 Notification of intention to start Cx of integrated systems: after Cx of related systems is completed 14 days before start of integrated system Cx.
    - .11 Identification of deferred Cx.
    - .12 Implementation of training plans.
    - .13 Cx reports: immediately upon successful completion of Cx.
  - .2 Detailed training schedule to demonstrate no conflicts with testing, completion of project and hand-over to [Property Manager].
  - .3 6 months in Cx schedule for verification of performance in all seasons and wear conditions.
- .2 After approval, incorporate Cx Schedule into Construction Schedule.
- .3 Consultant, Contractor, Contractor's Cx agent, and Departmental Representative will monitor progress of Cx against this schedule.

## **1.19 CX REPORTS**

- .1 Submit reports of tests, witnessed and certified by Departmental Representative] to [DCC Representative who will verify reported results.

- .2 Include completed and certified PV reports in properly formatted Cx Reports.
- .3 Before reports are accepted, reported results to be subject to verification by Departmental Representative.

**1.20 PRELIMINARY AND FINAL CX**

- .1 N/A.

**1.21 ACTIVITIES DURING WARRANTY PERIOD**

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

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

- .1 None is anticipated on this project.

**1.23 TRAINING PLANS**

- .1 Refer to Section 01 79 00.13 - Demonstration and Training for Building Commissioning.

**1.24 FINAL SETTINGS**

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

**Part 2 Products**

**2.1 NOT USED**

- .1 Not Used.

**Part 3 Execution**

**3.1 NOT USED**

- .1 Not Used.

**END OF SECTION**



**ANNEXE**  
COMMISSIONNING PLAN







# PAGEAU MOREL

UN ENGAGEMENT  
DURABLE

A SUSTAINABLE  
COMMITMENT

SPAC | Réfection des ateliers et  
entrepôts du 1156 rue Mill

Plan de mise en service

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## **SPAC | Réfection des ateliers et entrepôts du 1156 rue Mill**

### **Plan de mise en service**

Révision 0.1 – SR4-99%

Le 16 juillet 2020

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## Abréviations

BEÉFP	Bureau d'examen des édifices fédéraux du patrimoine
C	Consultant
CP	Contrôle de performance
EC	Équipe de construction
ERE	Essai, réglage et équilibrage
GMAO	Gestion de maintenance assistée par ordinateur
LI	Listes d'installation et démarrage
N/A	Non applicable
MES	Mise en service
RBQ	Régie du bâtiment du Québec
RM	Représentant du Ministère
RMS	Responsable de la mise en service de l'entrepreneur
RP	Renseignements sur les produits
SPC	Service Parcs Canada
SPAC	Services publics et approvisionnement Canada (anciennement TPSGC)
TPSGC	Travaux publics et Services gouvernementaux Canada (maintenant SPAC)

## Introduction

Agence Parcs Canada (APC) est le ministère gardien du 1156, rue Mill qui fait partie du Lieu historique national du Canada du Canal-de-Lachine. Le site compte quatre bâtiments construits entre 1909 et 1930.

- Bâtiment no 1 (A) – Atelier principal (2 étages)
- Bâtiment no 2 (B) – Atelier des machinistes
- Bâtiment no 3 (C) – Atelier des forgerons
- Bâtiment no 4 – Garage

Ces installations sont utilisées par l'équipe d'entretien des canaux Lachine, Sainte-Anne-de-Bellevue et Carillon. On retrouve dans ces bâtiments des espaces bureaux, des vestiaires et aires communes, des ateliers de menuiserie, de mécanique, d'électricité et de soudure ainsi que des espaces d'entreposage. Les réaménagements compris dans le présent projet touchent seulement le bâtiment 1.

Dans ce mandat, l'équipe d'experts-conseils est coordonnée par la firme d'architecture DFS inc. Pageau Morel et associés inc. (Pageau Morel) s'implique en tant que concepteur en électromécanique et exerce aussi la surveillance de chantier pour ces disciplines.

Le présent plan de mise en service est publié au moment de la conception (SR4). En réponse aux exigences du devis, il précise notamment les activités associées à la mise en service durant la construction. Le plan décrit le processus, les rôles des différents intervenants ainsi que les documents associés à la mise en service du projet, de manière à l'intégrer efficacement à la construction. Le plan met aussi en la place la mise en service de l'installation en tant que telle, dont les phases clés se déroulent en fin de projet.

## 1 Objectif de la mise en service

La mise en service (MES) a été introduite depuis quelques décennies chez SPAC. En fonction de leur importance, elle est requise dans tous les projets, tel que stipulé dans la Politique de mise en service datée de 2011.

La MES est un effort commun de l'ensemble des intervenants dont l'objectif est de s'assurer que le projet est conçu, construit et étalonné de façon à fonctionner tel que requis. Au terme du processus, le client a en mains tous les outils (documentation, formation) pour maintenir les performances de manière optimale.

La MES va plus loin qu'une surveillance traditionnelle. Elle implique un niveau accru de documentation et de démonstration et comprend notamment l'évaluation de la performance des systèmes sur une base individuelle et dans l'ensemble des interactions.

## 2 Portée de la mise en service

Les systèmes généralement visés peuvent être regroupés en trois (3) catégories. Dans le cadre du réaménagement, les items suivants sont cités au devis de MES :

### 2.1 Systèmes architecturaux et structuraux :

- Non inclus

### 2.2 Systèmes mécaniques :

- Plomberie et drainage;
- Refroidissement;
- Ventilation;
- Contrôle et régulation ;

### 2.3 Systèmes électriques :

- Éclairages;
- Éléments de distribution électrique;
- Système d'alarme incendie;
- Sécurité;
- Autres.

## 3 Rôles et responsabilités

### 3.1 Principaux intervenants

Le présent plan de mise en service s'adresse avant tout aux membres de l'équipe de mise en service. Le rôle des membres de cette équipe est décrit dans cette section.

#### Le Représentant du Ministère (RM)

Le Gestionnaire de projet SPAC détient la responsabilité générale de la gestion du projet. Il est la personne-ressource du client, des consultants et de tous les autres membres de l'équipe du projet. En tant que Représentant du Ministère, il peut déléguer une partie de ses responsabilités. Le RM coordonne les réunions de MES et en rédige le procès-verbal. Il approuve les documents de MES, incluant les manuels et plans de formation et assiste aux essais critiques.

#### Le consultant (C)

Il conçoit l'installation en respectant les exigences fonctionnelles et opérationnelles et prépare les documents de construction, incluant le devis et le plan de MES. Il réalise la surveillance de chantier et dans ce contexte, assiste comme témoin aux démonstrations et essais critiques. Le consultant exerce aussi une surveillance des activités de mise en service. Il vérifie et commente les divers rapports d'essai et le plan de formation. Le consultant participe à la résolution des problèmes relatifs à la MES, révisé les manuels et plans de formation et valide les plans « tel que construit », et transmet la documentation de fin de projet et la documentation de mise en service soumise par l'Entrepreneur afin de constituer le Manuel d'Exploitation et d'entretien.

#### L'équipe de construction (EC)

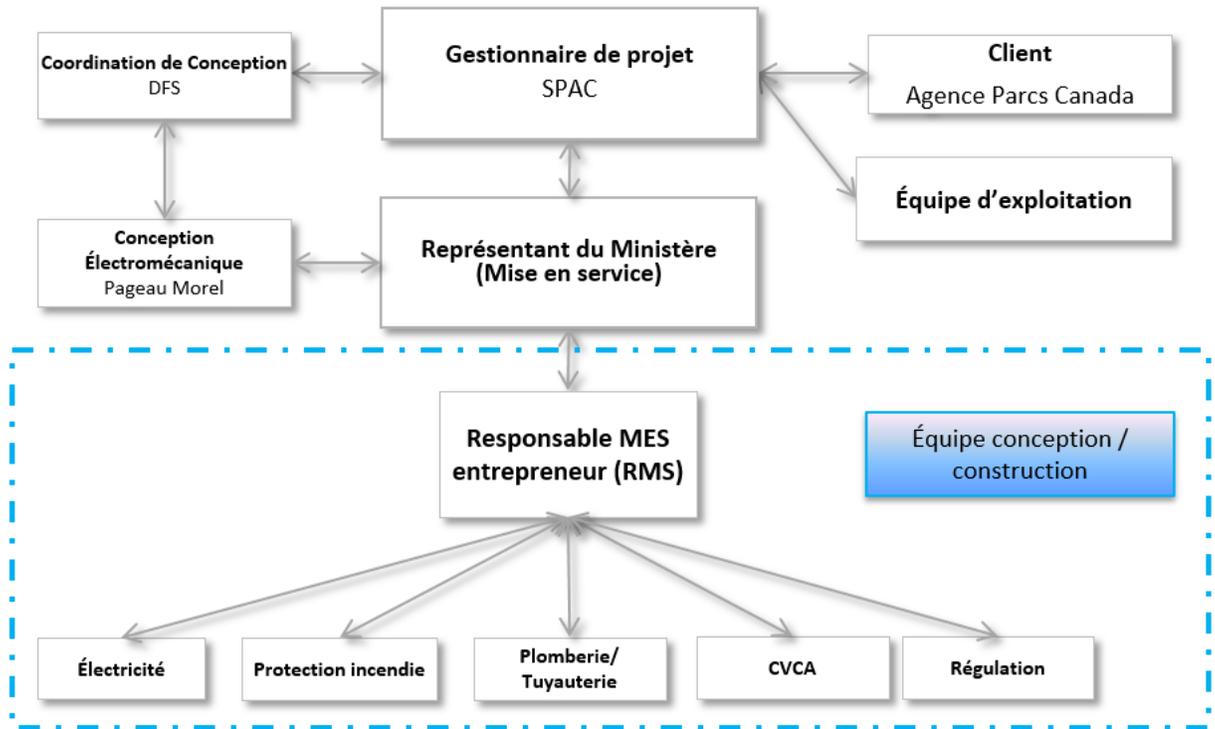
Elle est composée de l'entrepreneur, de ses fournisseurs et des divers corps de métier qui réalisent la construction conformément aux documents contractuels. Sous la coordination du responsable de la mise en service de l'entrepreneur (RMS) l'équipe accomplit aussi toutes les activités de la MES, notamment les essais et la documentation, à la satisfaction du Représentant du Ministère. L'équipe réalise la mise au point, dispense la formation et assemble les manuels et participe à la résolution des problèmes relatifs à la mise en service.

#### Le responsable de la mise en service de l'entrepreneur (RMS)

Il est désigné par l'entrepreneur en fonction de sa compréhension du processus de MES, dont il assure la planification et la coordination. Il révisé le plan de mise en service et les formulaires pour s'assurer de leur compréhension par les sous-traitants et de leur validité. Il fournit le calendrier de MES, et s'assure de l'exécution de toutes les activités de MES exigées. Il complète ou contresigne les fiches de mise en service pour tous les systèmes visés. Il reçoit et analyse les documents d'ERE avant de les transmettre au Consultant et au Représentant du Ministère. Il rassemble et vérifie les manuels et voit à la mise en œuvre du plan de formation. Le RMS se rend aussi disponible pour offrir un service d'urgence et de dépannage pendant la première année d'occupation pour effectuer des réglages et des modifications qui ne font pas partie des responsabilités du personnel d'exploitation et d'entretien.

### 3.2 Organigramme des intervenants

L'organigramme ci-dessous est la représentation graphique des différents membres de l'équipe de mise en service énoncée au point 3.1.



Les flèches représentent les canaux de communications. En cours de projet, les moyens de communication seront principalement les comptes rendus de réunions, les rapports de visites, et le courrier électronique.

## 4 Phases de la mise en service

La mise en service fait idéalement partie de toutes les étapes d'un projet. La subdivision présentée ici résume les principales activités et livrables des diverses phases.

### 4.1 Préconception et conception

Le devis présente la MES aux sections suivantes

- 01 79 00.13 - Démonstration et formation - MES de bâtiment
- 01 91 13 - Mise en service, exigences générales
- 01 91 13.13 - Mise en service, plan de MES
- 01 91 13.16 - Mise en service, documents de MES

De plus, des procédures et critères MES sont inclus aux sections de devis des différentes disciplines par les concepteurs.

### 4.2 Construction

Une rencontre de démarrage de la mise en service est à prévoir le plus tôt possible. Elle permet notamment aux membres de l'équipe de mise en service de valider leur interprétation des tâches, de confirmer la liste des documents attendus et de bâtir le calendrier de MES, dont la fourniture relève du RMS. Les réunions ultérieures pourront être combinées aux réunions de chantier.

La section 01 91 13.16 du devis liste les documents de mise en service normalement applicables aux projets de TPSGC. Ils seront requis à l'achèvement des travaux (voir 01 78 00).

1. Les renseignements sur les produits sont consignés dans des fiches de RP. Il s'agit notamment des informations de la plaque signalétique.
2. Les essais statiques - ou de démarrage préliminaire - sont consignés dans une liste d'installation et de démarrage (LI). Les listes fournies par le manufacturier sont généralement acceptées ; valider auprès du RM. Pour la tuyauterie et les conduites de ventilation, là où des essais d'étanchéité et de pression sont prévus au devis, le rapport de test suffit à documenter l'installation/démarrage.
3. L'atteinte des critères d'acceptabilité des équipements décrits dans les plans et devis est validée lors d'essais de performance. Pour un équipement visé, ceci est documenté dans les formulaires de contrôle de performance (CP).

Finalement, les résultats des essais pour les systèmes intégrés sont documentés dans des formulaires de mise en service des systèmes intégrés. Ceux-ci sont produits par les concepteurs et utilisés par le RM lors des démonstrations de fonctionnalités. La forme générique est présentée en annexe du présent plan de MES.

#### **4.2.1 Fourniture, installation et démarrage des composantes**

L'objectif est de s'assurer que chaque système est complet et conforme (RP), d'utilisation sûre et prêt pour son amorçage lorsque les listes d'installation et démarrage (LI) sont complétées. Les données rassemblées à cette phase permettent aussi d'amorcer les procédures de GMAO. Cette phase statique de la mise en route est suivie par les essais de performances des équipements et sous-systèmes qui en requièrent sont ensuite réalisés et documentés (CP).

Note : Dans le cas d'appareils existants réinstallés ou modifiés, les fiches LI et CP pourraient être exigées afin d'assurer qu'ils sont bien réinstallés et pour définir leur performance actuelle. La portion RP sera à compléter si requis, en fonction des procédures de GMAO en place. Selon les résultats initiaux obtenus (échantillon mentionné au Tableau 1, paragraphe 5), le processus pourra cependant être simplifié en cours de route. Vérifier auprès des responsables de la MES.

Il est à noter que les rapports d'essai, réglage et équilibrage (ERE) font partie des documents de performance puisqu'ils permettent de confirmer les débits et pressions spécifiés au devis.

#### **4.2.2 Mise en service des systèmes intégrés**

Cette étape vise les systèmes complexes, composés de plusieurs équipements. Avant de débiter cette phase, le RP, LI et CP doivent avoir été documentés, c'est-à-dire que les fiches sont complètes, transmises et approuvées. La complétion de l'équilibrage est aussi requise.

Les essais sur les systèmes intégrés sont réalisés par le responsable MES de l'Entrepreneur, en présence de l'Ingénieur et du RM, et documentés dans des formulaires de mise en service des systèmes intégrés.

### **4.3 Manuels**

Le manuel d'opération et entretien est présenté au concepteur aux fins de révision et d'acceptation. Des renseignements sur ces manuels sont données dans la section 01 92 00 du devis. Valider cette formulation auprès du Représentant du Ministère.

Le manuel d'opération et entretien est présenté au concepteur aux fins de révision et d'acceptation. Se référer à la section 01 78 00 pour les la structure générale du manuel et aux exigences de MES applicables au manuel.

Les sections du manuel devraient être utilisées lors des formations. De cette manière, elles pourront faire l'objet d'une mise au point en fonction des commentaires des personnes suivant ces formations.

### **4.4 Formation**

Des séances de formation à l'intention de l'équipe d'exploitation sont à prévoir pour les items sélectionnés ; se référer à la section 01 79 00.13 pour les exigences en matière de formation. Le calendrier et le contenu de ces séances doivent être transmis au Consultant et au RM.

#### **4.5 Complétion significative et occupation**

Le Représentant du Ministère est le destinataire final de l'ensemble des documents de MES durant la construction. L'approbation du matériel de MES par le RM est un des prérequis à l'achèvement substantiel. Le RM sera aussi responsable du suivi durant l'occupation et de la coordination d'essais saisonniers si requis, auquel cas l'Entrepreneur et le Consultant pourront être appelés à collaborer.

#### **4.6 Fermeture de la mise en service**

La dernière étape de la MES est la revue du projet à la fin de la première année d'opération sous garantie, au moment du suivi des déficiences et de leur correction.

## 5 Mise en service prévue

Les documents de mise en service pour les systèmes visés sont résumés dans le tableau suivant.

Tableau 1 : Résumé des livrables MES

	Fiche de MES	Test au devis	MES intégrée
<b>5.1 Systèmes architecturaux</b>			
Autre	(si applicable)	N/A	N/A
<b>5.2 Systèmes mécaniques</b>			
Composants de protection incendie	non	selon NFPA	non
Composants de plomberie	non	non	non
Unité de ventilation	Non	Équilibrage	oui
Composantes de ventilation	Non	Étanchéité Équilibrage	oui
Autre	(si applicable)	N/A	N/A
<b>5.3 Systèmes électriques</b>			
Distribution basse tension	Oui	Équilibre des phases Fuites à la terre	N/A
Éclairages	Non	Intégration à la régulation Programmation	N/A
Alarme incendie	non	Par firme spécialisée	N/A
Sécurité	Non	N/A	N/A
Autre	(si applicable)	N/A	N/A

N/A : non applicable

## ANNEXE 1 MES DES SYSTÈMES INTÉGRÉS

**Unité de ventilation**

<b>Vérifications préfonctionnelles complétées de manière adéquate</b>	<b>Installation documentée</b>	<b>Performance des composantes</b>	<b>ERE Documenté</b>	<b>Contrôles validés (point à point)</b>
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<b>Notes</b>					

<b>Opération</b>	<b>Programmation complétée</b>	<b>Simulation / Essai réel</b>	<b>Résultat adéquat</b>	<b>Vérifié par</b>	<b>Note #</b>
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<b>Notes</b>					

**Ventilateurs**

<b>Vérifications préfonctionnelles complétées de manière adéquate</b>	<b>Installation documentée</b>	<b>Performance des composantes</b>	<b>ERE Documenté</b>	<b>Contrôles validés (point à point)</b>	
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**Notes**


<b>Opération</b>	<b>Programmation complétée</b>	<b>Simulation / Essai réel</b>	<b>Résultat adéquat</b>	<b>Vérifié par</b>	<b>Note #</b>
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**Notes**

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**Notes**

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**Notes**


**Composantes de ventilation**

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<b>Vérifications préfonctionnelles complétées de manière adéquate</b>	<b>Installation documentée</b>	<b>Performance des composantes</b>	<b>ERE Documenté</b>	<b>Contrôles validés (point à point)</b>
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<b>Notes</b>				

<b>Opération</b>	<b>Programmation complétée</b>	<b>Simulation / Essai réel</b>	<b>Résultat adéquat</b>	<b>Vérifié par</b>	<b>Note #</b>
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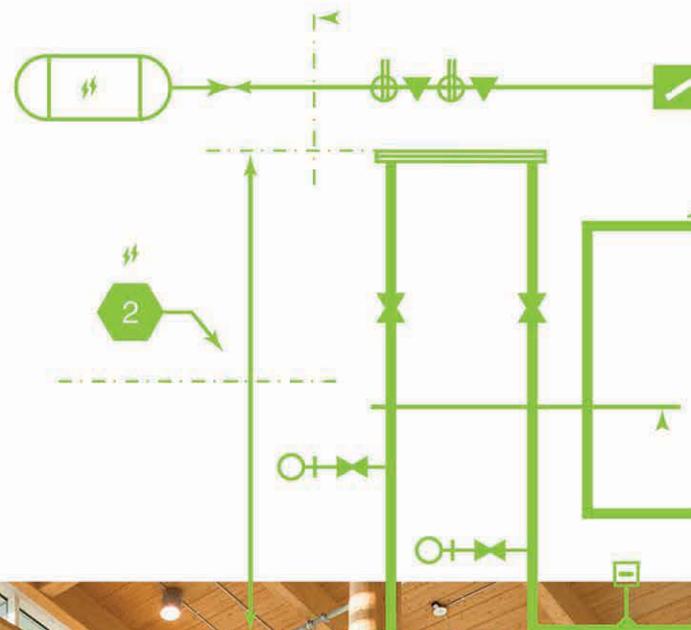
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<b>Notes</b>				

**Points divers**

Des points seront ajoutés au besoin

Préalables complétés et documentés de manière satisfaisante :						Installation documentée	Performance des composantes	ERE Documenté	Contrôles validés (point à point)		
<b>Notes</b>											
Séquence						Programmation complétée	Simulation / Essai réel	Résultat adéquat	Accepté par	Note #	
<b>Communication données BACnet</b>											
<b>Notes</b>											



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**Part 1            General**

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

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

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

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

**1.3                PERFORMANCE VERIFICATION (PV) FORMS**

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

#### **1.4 SAMPLES OF COMMISSIONING FORMS**

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

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

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

#### **1.6 COMMISSIONING FORMS**

- .1 Use Commissioning forms to verify installation and record performance when starting 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 Verify reported results.
  - .8 Form to bear signatures of recording technician and reviewed and signed off by Contractor.
  - .9 Submit immediately after tests are performed.
  - .10 Reported results in true measured SI unit values.
  - .11 Provide Consultant with originals of completed forms.
  - .12 Maintain copy on site during start-up, testing and commissioning period.
  - .13 Forms to be both hard copy and electronic format with typed written results in Building Management Manual in accordance with Section 01 78 00 – Closeout Submittals.

#### **1.7 LANGUAGE**

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

**Part 2          Products**

**2.1              NOT USED**

.1          Not Used.

**Part 3          Execution**

**3.1              NOT USED**

.1          Not Used.

**END OF SECTION**



## **ANNEXE**

## FORMS

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TABLE DES MATIÈRES

FICHES DE MISE EN SERVICE .....	1
1.1 Fiche de renseignement de produit (RP).....	1
1.2 Essais de tuyauterie ou de conduits.....	2
1.3 Thermopompe.....	3
1.4 Transformateur sec basse tension.....	4
1.5 Panneau électrique d'utilisation .....	5
1.6 Panneau électrique de distribution .....	6
1.7 Essai de fuite à la terre.....	8

---

FICHES DE MISE EN SERVICE

1.1 FICHE DE RENSEIGNEMENT DE PRODUIT (RP)

PROJET/ PROJECT	Nom : Name:			
	Bâtiment : Building:			
	Numéro de Projet : Project number:			
IDENTIFICATION	Équipement : Equipment:			
	Description sommaire : Summary:			
	Identification aux plans : No. On Drawings:		Identification système de contrôle du bâtiment : MSS Identifier:	
	Équipement relié au système : Equipment linked to system:			
RENSEIGNEMENT	Fabriquant : Man'fr:			
	Modèle : Model:			
	No série Serial no.:			
	Capacité : Capacity:		Taille : Size:	
	Efficacité : Efficiency:			
	Tension : Voltage:	Volt ./ #Ø / Fréquence		
	Courant : Current:	FLA/LRA		
	Autres : Other:			
ACHAT/ PURCHASE	Fournisseur : Contractor:	Nom/adresse Name/address		
	Distributeur : Distributor:	Nom/adresse Name/address		
	Garantie : Guarantee:			
	Date d'achat : Purchase date:			
	Garantie spécifique : Specific guarantee:			
	Date de démarrage : Date of start-up:			
	Remplacé le : Replaced:			



### 1.3 THERMOPOMPE

<b>IDENTIFICATION</b>	N° au plan :	Service :	Localisation :
	Manufacturier :	Modèle :	No de série :
	<b>Caractéristiques spécifiées</b>		
	Capacité	Type	Réfrigérant
	Efficacité chauffage	Refroidissement	Volume de Réfrigérant :

Préalables (cocher pour confirmer que le préalable est documenté)

<b>DOCUMENTATION</b>	<input type="checkbox"/> Dessin d'ateliers reçus	<input type="checkbox"/> Liste d'installation complétée	<input type="checkbox"/> Rapport de test en usine (si applicable)
	<input type="checkbox"/> Installation conforme documentée	<input type="checkbox"/> ERE hydronique complété	<input type="checkbox"/> ERE hydronique approuvé (Date __)
	<input type="checkbox"/> Séquence de régulation active	<input type="checkbox"/> ERE aéraulique complété	<input type="checkbox"/> ERE aéraulique approuvé (Date __)
	<b>Commentaires:</b>		

<b>PERFORMANCES</b>	Élément de performance	Valeur Prescrite	Valeur mesurée
	Côté source : (fluide : _____ c)		
	- Débit, l/s		
	- Température à l'entrée, °C		
	- Température à la sortie, °C		
	- Perte de pression, kPa		
	Côté charge (fluide: _____) :		
	Débit, l/s		
	- Température à l'entrée, °C		
	- Température à la sortie, °C		
	- Perte de pression, kPa		
	Ampérage moteur compresseur (T <sub>1</sub> / T <sub>2</sub> / T <sub>3</sub> )		
	Voltage moteur compresseur (T <sub>1</sub> - T <sub>2</sub> / T <sub>2</sub> - T <sub>3</sub> / T <sub>3</sub> - T <sub>1</sub> )		
	<b>Commentaires</b>		

Participants à la réalisation (R), la validation (V) et l'approbation (A) des essais :

Autorité/Compagnie	Nom	Activité	Signature	Date
Plomberie				
Ventilation				
Contrôles				
Balancement				
Témoin (entrepreneur général)		V		
Agent de mise en service				

### 1.4 TRANSFORMATEUR SEC BASSE TENSION

<b>IDENTIFICATION</b>	N° au plan :	Service et localisation	Section de devis applicable
	Manufacturier :	Modèle :	No de série :
	Source :	Vers :	<input type="checkbox"/> Urgence / <input type="checkbox"/> Normal
	<b>Caractéristiques spécifiées</b>		
	Tension primaire	Tension secondaire	Facteur K : ___ / NA

<b>INSTALLATION</b>	<b>Vérification</b>	Conforme	Non conforme	Non applicable	Commentaires
	1. Conforme aux dessins d'atelier vérifiés	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
	2. Absence d'humidité et de poussière	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
	3. Ancrages adéquats, incluant protection sismique	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
	4. Façonnage des câbles adéquat	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Commentaires: .....					

<b>VERIFICATIONS DE DEMARRE</b>	<b>Propriétés</b>	Prescrit	Mesuré
	Alimentation primaire :		
	• Sectionneur (A)		
	• Disjoncteur		
	• Fusible (A)		
	• No CCM		
	• Calibre du câble (AWG/kcmil)		
	• Identification		
	Prise haute tension :		
	• 630 V H-1, H-2, H-3		
	• 615 V H-4, H-5, H-6		
	• 600 V H-7, H-8, H-9		
	• 585 V H-10, H-11, H-12		
	• 570 V H-13, H-14, H-15		
	Secondaire :		
• Calibre du câble			
Mégohmmètre :			
• (600 V) h-1 – Terre, H-2 – Terre, H-3 – Terre, Mise à la terre adéquate			

**Participants à la réalisation (R), la validation (V) et l'approbation (A) des essais :**

Autorité/Compagnie	Nom	Activité	Signature	Date
Plomberie				
Ventilation				
Contrôles				
Balancement				
Témoin (entrepreneur général)		V		
Agent de mise en service				

### 1.5 PANNEAU ELECTRIQUE D'UTILISATION

<b>IDENTIFICATION</b>	N° au plan :	Usage : <input type="checkbox"/> Urgence / <input type="checkbox"/> Normal	Localisation :
	Source :	Voltage :	Ampérage :
	Manufacturier :	Modèle :	No de série :
	Filtre <input type="checkbox"/> Oui / <input type="checkbox"/> Non	Type de filtre :	Modèle du filtre :
	<b>Caractéristiques spécifiées</b>		
	<input type="checkbox"/> Nouveau / <input type="checkbox"/> Existant	Matériau des barres : <input type="checkbox"/> Al / <input type="checkbox"/> Cu	Disjoncteurs : <input type="checkbox"/> Boulonnés / <input type="checkbox"/> Enfichables / <input type="checkbox"/> Disjoncteur principal cloisonné
	Si existant, recertifié <input type="checkbox"/> CSA	Boitier : <input type="checkbox"/> Serrure / NEMA : _____	Courant de court-circuit mini aux disj : _____
	<input type="checkbox"/> MALT / <input type="checkbox"/> MALT <sub>i</sub>	Montage : <input type="checkbox"/> Encastré / <input type="checkbox"/> Surface	Mesurage ou compteur <input type="checkbox"/> oui / <input type="checkbox"/> non

Préalables (cocher pour confirmer que le préalable est documenté)

<b>INSTALLATION</b>	<input type="checkbox"/> Dessin d'ateliers reçus	<input type="checkbox"/> Liste des disjoncteurs affichée	<input type="checkbox"/> Identification adéquate des barres
	Installation adéquate :		
	<input type="checkbox"/> Absence d'humidité	<input type="checkbox"/> Absence de poussière	<input type="checkbox"/> Ancrages, dégagement, porte
	<input type="checkbox"/> Façonnage des câbles	<input type="checkbox"/> Manœuvrabilité des disjoncteurs	<input type="checkbox"/> Connecteurs étanches (conduits et câbles)
	Commentaires:		

<b>MESURES</b>	Points de mesure	Essai de résistance de l'isolant (MOhm)	Tension mesurée (Volt)	Ampérage de phase sous charge*
	A – B			N/A
	B – C			N/A
	C – A			N/A
	A – Neutre			
	B – Neutre			
	C – Neutre			
	A – MALT			N/A
	B – MALT			N/A
	C – MALT			N/A

\*Le protocole de mesure doit être approuvé par TPSGC avant de procéder aux essais sous charge

Participants à la réalisation (R), la validation (V) et l'approbation (A) des essais :

Autorité/Compagnie	Nom	Activité	Signature	Date
Plomberie				
Ventilation				
Contrôles				
Balancement				
Témoin (entrepreneur général)		V		
Agent de mise en service				



(Panneau de distribution, page 2/2)

Les disjoncteurs de modèle et de capacité identique peuvent être inscrits une seule fois au tableau.

Disjoncteurs non ajustables	Identification	Capacité	Modèle	Quantité

VERIFICATIONS DE DEMARRAGE (Essais)	Points de mesure	Tension mesurée (Volt)	Essai de résistance de l'isolant (MegOhm)
	A – B		
	B – C		
	C – A		
	A – Neutre		
	B – Neutre		
	C – Neutre		
	A – MALT		
	B – MALT		
	C – MALT		
ESSAI	Mesure de courant sous charge	Courant mesuré ( Ampère)	
	I <sub>A</sub>		
	I <sub>B</sub>		
	I <sub>C</sub>		

**Participants**

	Nom	Activité	Signature	Date
Contrôles Électricien				
Témoin (entrepreneur général) Agent de mise en service		V		

## **1.7        ESSAI DE FUITE A LA TERRE**

L'essai vise les prises installées près d'un appareil de plomberie.

Présenter les résultats sous forme de tableau et faire approuver la formulation par le responsable de la MES



**Part 1            General**

**1.1                ACRONYMS**

- .1        BMM - Building Management Manual.
- .2        Cx - Commissioning.
- .3        HVAC - Heating, Ventilation and Air Conditioning.
- .4        PI - Product Information.
- .5        PV - Performance Verification.
- .6        TAB - Testing, Adjusting and Balancing.
- .7        WHMIS - Workplace Hazardous Materials Information System.

**1.2                GENERAL REQUIREMENTS**

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

**1.3                APPROVALS**

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

**1.4                GENERAL INFORMATION**

- .1        Provide Contractor the following for insertion into appropriate Part and Section of BMM:
  - .1        Exhaustive list of names, addresses and telephone and fax numbers of the contractor and the subcontractors who participated in carrying out the work - Tab A of the manual.
  - .2        Letters of guarantee - Tab B.
  - .3        Approved shop drawings - Tab C.
  - .4        Test reports, in particular from ERE, commissioning checklists, duly completed, including Product Information Report (RP) and Performance Control (CP) forms, reviewed and accepted by the Contractor's MES manager and / or the Consultant. Tab D.
  - .5        Definitive sequences of operations of these systems after commissioning - Tab E.
    - .1        The consultant may, if necessary, attach brief descriptions of the mechanical, electrical and fire protection systems installed and put into service.
  - .6        Information on the operation and maintenance of systems installed and put into service, including preventive and corrective maintenance and maintenance schedules - Tab F.

- .7 Post-execution drawings - Tab G.
- .8 Duly completed EMIS forms by the owner's staff in collaboration with the Contractor's Cx manager - Tab H.
- .9 Inspection reports - Tab I.
- .10 Commissioning reports. - Tab J.

**1.5 SUPPORTING DOCUMENTATION FOR INSERTION INTO SUPPORTING APPENDICES**

- .1 Provide Departmental Representative supporting documentation relating to installed equipment and system, including:
  - .1 General:
    - .1 Finalized commissioning plan.
    - .2 WHMIS information manual.
    - .3 Procedures used during commissioning.
    - .4 Cross-Reference to specification sections.
  - .2 Fire prevention, suppression and protection:
    - .1 Test reports.
  - .3 Mechanical:
    - .1 Piping pressure test certificates.
    - .2 Ducting leakage test reports.
    - .3 TAB and PV reports.
    - .4 Charts of valves and steam traps.
    - .5 Copies of posted instructions.
  - .4 Electrical:
    - .1 TAB and PV reports.
    - .2 Electrical work log book.
    - .3 Charts and schedules.
    - .4 Locations of cables and components.
    - .5 Copies of posted instructions.
- .2 Assist Consultant with preparation of BMM.

**1.6 LANGUAGE**

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

**1.7 IDENTIFICATION OF FACILITY**

- .1 When submitting information to Departmental Representative for incorporation into BMM, use following system for identification of documentation:
  - .1 Refer to Section 23 05 53 - Identification.

**1.8 USE OF CURRENT TECHNOLOGY**

- .1 Use current technology for production of documentation. Emphasis on ease of accessibility at all times, maintain in up-to-date state, compatibility with user's requirements.
- .2 Obtain Departmental Representative's approval before starting Work.

**Part 2 Products**

**2.1 NOT USED**

- .1 Not used.

**Part 3 Execution**

**3.1 NOT USED**

- .1 Not used.

**END OF SECTION**



**Part 1            General**

**1.1                REFERENCE STANDARDS**

- .1 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 Safety Data Sheets (SDS).
- .2 National Fire Protection Association (NFPA)
  - .1 NFPA 10, Standard for Portable Fire Extinguishers.

**1.2                ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's printed product literature and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
  - .2 Submit two copies WHMIS SDS - Safety Data Sheets in accordance with Section 02 81 00 - Hazardous Materials.
- .3 Provide shop drawings.
- .4 Quality control submittals: submit following in accordance with Section 01 45 00 - Quality Control.
  - .1 Manufacturer's Instructions: submit manufacturer's installation instructions and special handling criteria, installation sequence and cleaning procedures.
  - .2 Manufacturer's Field Reports: submit manufacturer's written reports within 3 days of review, verifying compliance of Work, as described in PART 3, FIELD QUALITY CONTROL.
- .5 Closeout Submittals:
  - .1 Provide operation and maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

**1.3                DELIVERY, STORAGE AND HANDLING**

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

**Part 2 Products**

**2.1 EX-1 VERSATILE POWDER EXTINGUISHERS**

- .1 Multipurpose powder extinguishers, at auxiliary pressure or at permanent pressure, refillable, fitted with a flexible hose and a nozzle with shut-off valve, ULC approved, for class A, B and C fires of 10 lbs.

**2.2 EX-2 POWDER EXTINGUISHERS FOR GENERAL AND MECHANICAL WORKSHOPS**

- .1 Powder fire extinguishers with hose and lance with shut-off valve bearing the label of ULC, placed on a hook and having a capacity of 10 lb.
- .2 Type 10-B: C fire extinguisher

**2.3 EX-3 POWDER EXTINGUISHERS FOR WELDING WORKSHOP**

- .1 Powder fire extinguishers with hose and lance with stopcock bearing the label of ULC, placed on a hook and having a capacity of 20 lb.
- .2 Type 20 -B: C fire extinguisher

**2.4 SUPPORT**

- .1 Built-in or semi-built-in cupboards (see plans)
  - .1 Cabinets for mounting as indicated, 1.6 mm thick steel, with 2.5 mm thick steel door opening 180 and fitted with a locking device.
  - .2 Cabinets with a fire resistance rating equivalent to that of the work on which they will be installed.
  - .3 Cabinet doors: with 5 mm thick glass or metal panel.
  - .4 Finishing coating
    - .1 Box: coated with primary paint.
    - .2 Door and frame: stainless steel, satin finish number 4.
- .2 Support for fire extinguishers: wall hook recommended by the fire extinguisher manufacturer

**2.5 MARKING**

- .1 Fire extinguishers marked in accordance with the recommendations of CAN / ULC-S508 and ANSI / NFPA 10 standards.
- .2 Attach, glue or affix, on the fire extinguisher, a label indicating the year and month of installation. Space must be provided for recording the periodic maintenance dates.

**Part 3 Execution**

**3.1 MANUFACTURER'S INSTRUCTIONS**

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

**3.2 INSTALLATION**

- .1 Install or mount extinguishers in cabinets or on brackets as indicated.
- .2 Install fire safety blankets as indicated.

**3.3 FIELD QUALITY CONTROL**

- .1 Manufacturer's Field Services:
  - .1 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

**END OF SECTION**



**Part 1            General**

**1.1            ACTION AND INFORMATIONAL SUBMITTALS**

- .1    Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2    Product Data:
  - .1    Submit manufacturer's instructions, printed product literature and data sheets 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 Quebec, Canada.
  - .2    Indicate on drawings:
    - .1    Mounting arrangements.
    - .2    Operating and maintenance clearances.
  - .3    Shop drawings and product data accompanied by:
    - .1    Detailed drawings of bases, supports, and anchor bolts.
    - .2    Acoustical sound power data, where applicable.
    - .3    Points of operation on performance curves.
    - .4    Manufacturer to certify current model production.
    - .5    Certification of compliance to applicable codes.

**1.2            CLOSEOUT SUBMITTALS**

- .1    Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2    Operation and Maintenance Data: submit operation and maintenance data for incorporation into manual.
  - .1    Operation and maintenance manual approved by, and final copies deposited with, Departmental Representative before final inspection.
  - .2    Operation data to include:
    - .1    Control schematics for systems including environmental controls.
    - .2    Description of systems and their controls.
    - .3    Description of operation of systems at various loads together with reset schedules and seasonal variances.
    - .4    Operation instruction for systems and component.
    - .5    Description of actions to be taken in event of equipment failure.
    - .6    Valves schedule and flow diagram.
    - .7    Colour coding chart.
  - .3    Maintenance data to include:
    - .1    Servicing, maintenance, operation and trouble-shooting instructions for each item of equipment.

- .2 Data to include schedules of tasks, frequency, tools required and task time.
- .4 Performance data to include:
  - .1 Equipment manufacturer's performance datasheets with point of operation as left after commissioning is complete.
  - .2 Equipment performance verification test results.
  - .3 Special performance data as specified.
  - .4 Testing, adjusting and balancing reports as specified in Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
- .5 Approvals:
  - .1 Submit 2 copies of draft Operation and Maintenance Manual to Departmental Representative for approval. Submission of individual data will not be accepted unless directed by Departmental Representative.
  - .2 Make changes as required and re-submit as directed by Departmental Representative.
- .6 Additional data:
  - .1 Prepare and insert into operation and maintenance manual additional data when need for it becomes apparent during specified demonstrations and instructions.
- .7 Site records:
  - .1 Departmental Representative will provide 1 set of reproducible mechanical drawings. Provide sets of prints as required for each phase of work. Mark changes as work progresses and as changes occur.
  - .2 Transfer information [weekly] to reproducibles, revising reproducibles to show work as actually installed.
  - .3 Use different colour waterproof ink for each service.
  - .4 Make available for reference purposes and inspection.
- .8 As-built drawings:
  - .1 Prior to start of Testing, Adjusting and Balancing for HVAC, finalize production of as-built drawings.
  - .2 Identify each drawing in lower right hand corner in letters at least 12 mm high as follows: - "AS BUILT DRAWINGS: THIS DRAWING HAS BEEN REVISED TO SHOW MECHANICAL SYSTEMS AS INSTALLED" (Signature of Contractor) (Date).
  - .3 Submit to Departmental Representative for approval and make corrections as directed.
  - .4 Perform testing, adjusting and balancing for HVAC using as-built drawings.
  - .5 Submit completed reproducible as-built drawings with Operating and Maintenance Manuals.
- .9 Submit copies of as-built drawings for inclusion in final TAB report.

**1.3 MAINTENANCE MATERIAL SUBMITTALS**

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Furnish spare parts.
- .3 Provide one set of special tools required to service equipment as recommended by manufacturers.
- .4 Furnish one commercial quality grease gun, grease and adapters to suit different types of grease and grease fittings.

**1.4 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with 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, off ground and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.

**Part 2 Products**

**2.1 SLEEVE**

- .1 If the sleeve crosses a wall or a floor, caulk the free spaces between the insulation and the sleeve or between the pipe / conduit and the sleeve using fiberglass and seal the two ends of the sleeve with waterproof, fireproof and non-waterproof putty curable. When the sleeve passes through a partition with a degree of fire resistance, comply with the requirements of the approved fire stop system. Finish with a rosette.

**Part 3 Execution**

**3.1 EXAMINATION**

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

**3.2 SYSTEM CLEANING**

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

**3.3 FIELD QUALITY CONTROL**

- .1 Site Tests: conduct following tests in accordance with Section 01 45 00 - Quality Control and submit report as described in PART 1 -ACTION AND INFORMATIONAL SUBMITTALS.
- .2 Manufacturer's Field Services:
  - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.
  - .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

**3.4 DEMONSTRATION**

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

**3.5 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - 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 00 - Cleaning.

**3.6 PROTECTION**

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

### 3.7 SEISMIC PROTECTION

- .1 General
  - .1 Contractor is responsible to evaluate, furnish and install seismic protection for all new technical components as well as all relocated or modified technical components under his responsibility.
  - .2 Hire an Engineer, member in good standing of the Ordre des ingénieurs du Québec, for the evaluation of the seismic risk and calculation of seismic force resisting systems. The hired Engineering shall demonstrate recognized expertise in seismic protection. Contractor shall provide his contact details no more than two (2) weeks after contract signature.
  - .3 During an earthquake, seismic protection devices shall prevent permanent displacements and damages caused by vertical and horizontal motions and overturns.
- .2 Design criterias
  - .1 Site class and Importance category of the building is to be determined.
- .3 Evaluation and mitigation of seismic effects
  - .1 Evaluation of seismic effects shall be done as per requirements of sub-section 4.1.8 of the Quebec Construction Code, Chapter I – Building, and National Building Code of Canada (amended).
  - .2 Seismic force resisting systems shall be designed as per following standards:
    - .1 NFPA 13 et 20;
    - .2 SMACNA – Seismic Restraint Manual Guidelines for Mechanical System;
    - .3 ASHRAE – Seismic and Wind Design;
    - .4 FEMA;
    - .5 Engineering documents from earthquake-resistant devices manufacturers.
- .4 Evaluation and mitigation of seismic effects report
  - .1 Submit to the Engineer the evaluation and mitigation of seismic effects report before beginning the installation of the technical components.
  - .2 The report shall include, at least, the following information:
    - .1 General data for the project:
      - .1 Location of the building;
      - .2 General description of the building including height of the building ( $h_n$ );
      - .3 Site class at the location of the building;
      - .4 Importance category of the building;
      - .5 Value of  $S_a$  (0.2);
      - .6 Value of  $F_a$ ;
      - .7 Value of  $I_e$ ;

- .2 List of all technical components included in the contract which need to be have an evaluation of the seismic effects.
- .3 List of all technical components which may be exempted with the justifications.
- .4 For each technical component (CT) the evaluation of the seismic effect and the seismic force resisting system applied. Include following elements:
  - .1 Identification of the CT;
  - .2 Location of the CT including height ( $h_x$ );
  - .3 Description of CT including:
    - .1 Type of equipment;
    - .2 Make and model;
    - .3 Dimensions;
    - .4 Weight;
    - .5 Category and values of  $C_p$ ,  $A_r$  et  $R_p$ .
  - .4 Calculation of lateral force  $V_p$ , and forces on building structure;
  - .5 Description of the resisting system applied, including:
    - .1 Make and model of chosen material;
    - .2 Installation drawing specific for this project;
    - .3 Drawing showing the location of the seismic resisting systems.
- .5 For each CT located on the ground, on a slab or on an equipment base, the overturn force calculation and description of the resisting system. Included following elements:
  - .1 Identification of the CT;
  - .2 Location of the CT including height ( $h_x$ );
  - .3 Description of CT including:
    - .1 Type of equipment;
    - .2 Make and model;
    - .3 Dimensions;
    - .4 Weight;
    - .5 Location of gravity center;
  - .4 Calculation of the overturn force;
  - .5 Description of the resisting system applied, including:
    - .1 Mark and model of chosen material;
    - .2 Installation drawing specific for this project;
    - .3 Drawing showing the location of the seismic resisting systems.

- .5 Installation
  - .1 Install seismic force resisting system as per the indications of the evaluation and mitigation of seismic effects report.
  - .2 Any modification to the seismic force resisting system for any reason, shall be subject to a new calculation by the Engineer responsible for the seismic protection, and issued as an amendment to the report.
  - .3 Following requirements apply to the installation of electrical and mechanical material:
    - .1 Power-driven and drop-in anchors are not permitted for traction loads;
    - .2 C-clamps are not allowed to support CT unless they have a retainer mechanism;
    - .3 C-clamps are not allowed for seismic resisting systems;
    - .4 Equipment base shall be anchored to the slab;
    - .5 All vibration isolators shall be designed for seismic protection;
    - .6 Oval bolt adjusting hole are prohibited.
  - .4 Seismic protection systems must be designed in a manner not to compromise the performance of vibration isolation or thermal expansion components designed to allow piping and equipments movements. In these cases, flexible or lose anchors and ties must be used rather than rigid structures.
- .6 Work approval
  - .1 The Engineer who prepared the evaluation and mitigation of seismic effects report shall inspect the work related to the seismic force resisting systems.
  - .2 Obtain from the seismic protection engineer a written and signed certification indicating that the seismic force resisting systems have been installed as per the report and the amendments to the report. Submit this certification before submitting of the work certificate of compliance.
  - .3 Include in the operation and maintenance manual all documents issued by the seismic protection engineer.

**END OF SECTION**



**Part 1            General**

**1.1                REFERENCE STANDARDS**

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

**1.2                DEFINITIONS**

- .1            Demolish: Detach items from existing construction and legally dispose of items off site, unless indicated as removed and salvaged, or removed and reinstalled.
- .2            Remove: Planned deconstruction and disassembly of electrical items from existing construction including removal of conduit, junction boxes, cabling and wiring from electrical component to panel taking care not to damage adjacent assemblies designated to remain; legally dispose of items off site, unless indicated as removed and salvaged, or removed and reinstalled.
- .3            Remove and Salvage: Detach items from existing construction and deliver them to Departmental Representative ready for reuse.
- .4            Remove and Reinstall: Detach items from existing construction, prepare them for reuse, and reinstall them where indicated.
- .5            Existing to Remain: Existing items of construction that are not removed and that are not otherwise indicated as being removed and salvaged, or removed and reinstalled.
- .6            Hazardous Substances: Dangerous substances, dangerous goods, hazardous commodities and hazardous products may include asbestos, mercury and lead, PCB's, poisons, corrosive agents, flammable substances, radioactive substances, or other material that can endanger human health or wellbeing or environment if handled improperly as defined by the Federal Hazardous Products Act (RSC 1985) including latest amendments.

**1.3                ADMINISTRATIVE REQUIREMENTS**

- .1            Coordination: Coordinate work of this Section to avoid interference with work by other Sections.

**1.4                SITE CONDITIONS**

- .1            Existing Conditions: Condition of materials identified as being salvaged or demolished are based on their observed condition on date that tender is accepted.
- .2            Discovery of Hazardous Substances: It is not expected that Hazardous Substances will be encountered in the Work; immediately notify Departmental Representative if materials suspected of containing hazardous substances are encountered and perform the following activities:
  - .1            Refer to Section 01 41 00- Regulatory Requirements for directives associated with specific material types.
  - .2            Hazardous substances will be as defined in the Hazardous Products Act.

- .3 Stop work in the area of the suspected hazardous substances.
- .4 Take preventative measures to limit users' and workers' exposure, provide barriers and other safety devices and do not disturb.
- .5 Hazardous substances will be removed by Departmental Representative under a separate contract or as a change to the Work.

## **1.5 SALVAGE AND DEBRIS MATERIALS**

- .1 Demolished items become Contractor 's property and will be removed from Project site; except for items indicated as being reused, salvaged, or otherwise indicated to remain Owner property.
- .2 Carefully remove materials and items designated for salvage and store in a manner to prevent damage or devaluation of materials in accordance with Section 02 42 00- Removal and Salvage of Construction Materials.

## **Part 2 Products**

### **2.1 MATERIALS**

- .1 General Patching and Repair Materials: Patching and repair materials incidental to removal or demolition of components associated with work of this Section.
- .2 Plumbing Repair Materials: Use only new materials required for completion or repair matching materials damaged during performance of work of this Section; new materials are required to meet assembly or system characteristics as existing systems indicated to remain and carry CSA approval labels required by the Authority Having Jurisdiction.
- .3 Fire stopping Repair Materials: Use fire stopping materials compatible with existing fire stopping systems where removal or demolition work affects rated assemblies, restore to match existing fire rated performance.

## **Part 3 Execution**

### **3.1 EXAMINATION**

- .1 Verification of Existing Conditions: Visit site, thoroughly examine and become familiar with conditions that may affect the work of this Section before tendering the Bid; Departmental Representative will not consider claims for extras for work or materials necessary for proper execution and completion of the contract that could have been determined by a site visit.

### **3.2 PREPARATION**

- .1 Protection of Existing Systems to Remain: Protect systems and components indicated to remain in place during selective demolition operations and as follows:
  - .1 Prevent movement and install bracing to prevent settlement or damage of adjacent services and parts of existing buildings scheduled to remain.

- .2 Notify Departmental Representative and cease operations where safety of buildings being demolished, adjacent structures or services appears to be endangered and await additional instructions before resuming demolition work specified in this Section.
- .3 Prevent debris from blocking drainage inlets.
- .4 Protect mechanical systems that must remain in operation.

### **3.3 EXECUTION**

- .1 Coordinate requirements of this Section with information contained in this section and as follows:
  - .1 Disconnect and cap mechanical services in accordance with requirements of local Authority Having Jurisdiction.
  - .2 Do not disrupt active or energized utilities without approval of the Departmental Representative.
  - .3 Erect and maintain dust proof and weather tight partitions to prevent the spread of dust and fumes to occupied building areas; remove partitions when complete.
  - .4 Demolish parts of existing building to accommodate new construction and remedial work as indicated.
  - .5 At end of each day's work, leave worksite in safe condition.
  - .6 Perform demolition work in a neat and workmanlike manner:
    - .1 Remove any tools or equipment after completion of work, and leave site clean and ready for subsequent renovation work.
    - .2 Repair and restore damages caused as a result of work of this Section to match existing materials and finishes.

### **3.4 CLOSEOUT ACTIVITIES**

- .1 Demolition Waste Disposal: Arrange for legal disposal and remove demolished materials to accredited provincial landfill site or alternative disposal site (recycle centre) except where explicitly noted otherwise for materials being salvaged for re use in new construction in accordance with Section 02 42 00 - Removal and Salvage of Construction Materials.
- .2 Hazardous Substances Disposal: Arrange for disposal of hazardous substances in accordance with requirements of Section 02 81 00 - Hazardous Materials.

**END OF SECTION**



**Part 1            General**

**1.1                REFERENCE STANDARDS**

- .1    ASTM International (ASTM)
  - .1    ASTM A126, Standard Specification for Gray Iron Castings for Valves, Flanges and Pipe Fittings.
  - .2    ASTM B62, Standard Specification for Composition Bronze or Ounce Metal Castings.
- .2    CSA Group (CSA)
  - .1    CSA-B64 Series, Backflow Preventers and Vacuum Breakers.
  - .2    CSA B79, Commercial and Residential Drains and Cleanouts.
- .3    National Research Council Canada (NRC)
  - .1    National Plumbing Code of Canada 2015 (NPC).
- .4    Plumbing and Drainage Institute (PDI)
  - .1    PDI-WH201, Water Hammer Arresters Standard.

**Part 2            Products**

**2.1                FLOOR DRAINS**

- .1    Floor Drains and Trench Drains: to CSA B79.
- .2    Type 1: general duty; cast iron body round, adjustable head, sediment basket nickel bronze strainer, integral seepage pan, and clamping collar.
- .3    Type 2: heavy duty; cast iron body, heavy duty non-tilting or hinged lacquered cast iron grate, integral seepage pan and clamping collar.
- .4    Type 3: combination funnel floor drain; cast iron body with integral seepage pan, clamping collar, nickel-bronze adjustable head strainer with integral funnel.

**2.2                RETENTION PIT - BA**

- .1    Prefabricated polypropylene retaining tank with 100 mm with adjustable height connection.
- .2    Complete cast iron frame with anchor screw and grid in class F stainless steel.
- .3    Dimensions: see plan.

**2.3                CLEANOUTS**

- .1    Cleanout Plugs: heavy cast iron male ferrule with brass screws and threaded brass or bronze plug. Sealing-caulked lead seat or neoprene gasket.

- .2 Access Covers:
  - .1 Wall Access: face or wall type, polished nickel bronze, square cover with flush head securing screws, bevelled edge frame complete with anchoring lugs.
  - .2 Floor Access: cast iron body and frame with adjustable secured nickel bronze top and:
    - .1 Plugs: bolted bronze with neoprene gasket.
    - .2 Cover for Unfinished Concrete Floors: square, cast iron gasket, vandal-proof screws.
    - .3 Cover for Terrazzo Finish: polished nickel bronze with recessed cover for filling with terrazzo, vandal-proof locking screws.

## **2.4 NON-FREEZE WALL HYDRANTS**

- .1 Recessed type with integral vacuum breaker, NPS 3/4 hose outlet, removable operating key. Polished bronze finish.

## **2.5 WALL HYDRANT - PE**

- .1 Recessed wall type: bronze valves, galvanized plug and key and vacuum breaker, DN 20 mm ( $\frac{3}{4}$  ").

## **2.6 BACKFLOW PREVENTER**

- .1 Complies with NSF 61 / ANSI 372 "lead free" standard.
- .2 DARPR: Reduced pressure backflow preventer. According to CSA B.64.4. DN 12 mm ( $\frac{1}{2}$  ") up to DN 50 mm (2"): Bronze frame and stainless steel flange bolts and rubber seats. Maximum pressure 1,200 kPa (175 psi).
- .3 DAR2CR: Backdraft device with double check valve, in accordance with CSA B.64.5. DN 19 mm ( $\frac{3}{4}$  ") up to 50 mm (2"): bronze frame, stainless steel fittings, discs with sealed rubber seats with ball test valves. Maximum pressure 1,200 kPa (175 psi).

## **2.7 VACUUM BREAKERS**

- .1 Breakers: to CSA-B64 Series, vacuum breaker atmospheric.

## **2.8 HOSE BIBBS AND SEDIMENT FAUCETS**

- .1 Bronze construction complete with integral back flow preventer, hose thread spout, replaceable composition disc, and chrome plated in finished areas.

## **2.9 WATER METERS**

- .1 Meter with tap of the size required to meet the requirements of local water distribution authorities.

## **2.10 P-TRAP WATER HOLDING DEVICE**

- .1 Insertion type gutter guard. Made of a single piece of soft and flexible elastomeric PVC without restriction at the entrance.

## **2.11 STRAINERS**

- .1 860 kPa, Y type with 20 mesh, monel, bronze or stainless steel removable screen.
- .2 NPS 2 and under, bronze body, screwed ends, with brass cap.

## **2.12 WASHING MACHINE OUTLET**

- .1 Built-in taps with handles and chrome wall plates with fittings for hoses and vacuum breaker.

## **2.13 CONNECTION FOR EQUIPMENT**

- .1 Coffee machine, dishwasher and water cooler when applicable
  - .1 All these connections must be provided with an atmospheric pressure vacuum breaker.

## **2.14 COMBINED EMERGENCY SHOWER**

- .1 Type DU
  - .1 Combination of shower and eye wash.
  - .2 Shower head in ABS plastic, with valve, chrome finish, remaining in open position, actuated by a stainless steel handle.
  - .3 Stainless steel eyewash bowl, with valve, chrome finish, remaining in open position, actuated by hand lever or pedal.
- .2 Thermostatic mixing valve: pre-assembled system with thermostatic valves for low flow and high flow, piping, unions, check valves, wall support, adjustable temperature, thermometers etc. Shower supply temperature: 35 ° C (95 ° F). Frame and cover for wall mounting.

## **2.15 OIL SEPARATOR**

- .1 20 mm opaque white polypropylene interceptor with reinforced cover for heavy traffic, retained by hexagonal stainless steel screws and gasket. 100 mm inlet and outlet connections and 50 mm vents (2).
- .2 Integrated and fixed flow regulator. 95L / min flow rate and 56L reserve. Oil tank adjoining the separator.
- .3 Aluminum non-slip plate for installation at floor level.
- .4 Sound and light level sensor and alarm. Normal, high level indicator and audible alarm.

## **Part 3 Execution**

### **3.1 EXAMINATION**

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for plumbing specialties and accessories installation in accordance with manufacturer's written instructions.

**3.2 MANUFACTURER'S INSTRUCTIONS**

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

**3.3 INSTALLATION**

- .1 Install in accordance with National Plumbing Code of Canada (NPC).
- .2 Install in accordance with manufacturer's instructions and as specified.

**3.4 CLEANOUTS**

- .1 Install cleanouts at base of soil and waste stacks, and rainwater leaders, at locations required code, and as indicated.
- .2 Bring cleanouts to wall or finished floor unless serviceable from below floor.
- .3 Building drain cleanout and stack base cleanouts: line size to maximum NPS 4.

**3.5 NON-FREEZE WALL HYDRANTS**

- .1 Install 600 mm above finished grade and as indicated.

**3.6 WATER HAMMER ARRESTORS**

- .1 Install on branch supplies to fixtures or group of fixtures where indicated.

**3.7 BACK FLOW PREVENTERS**

- .1 Install in accordance with CSA-B64 Series, where indicated and elsewhere as required by code.
  - .1 Drains.
  - .2 Backwater Valves.
  - .3 Water Make-up Assembly.
  - .4 Grease Interceptors.
- .2 Pipe discharge to terminate over nearest drain service sink.

**3.8 BACKWATER VALVES**

- .1 Install cleanout where indicated.

**3.9 HOSE BIBBS AND SEDIMENT FAUCETS**

- .1 Install at bottom of risers, at low points to drain systems, and as indicated.

**3.10 FILTER**

- .1 Install filters, providing space required to remove screens to allow maintenance.

**3.11 WATER METERS**

- .1 Install water metre provided by local water authority.
- .2 Install water metre as indicated.

### **3.12 START-UP**

- .1 General:
  - .1 In accordance with Section 01 91 13 - General Commissioning Requirements: General Requirements, supplemented as specified herein.
- .2 Timing: start-up only after:
  - .1 Pressure tests have been completed.
  - .2 Disinfection procedures have been completed.
  - .3 Certificate of static completion has been issued.
  - .4 Water treatment systems operational.
- .3 Provide continuous supervision during start-up.

### **3.13 TESTING AND ADJUSTING**

- .1 General:
  - .1 Test and adjust plumbing specialties and accessories in accordance with Section 01 91 13 - General Commissioning Requirements: General Requirements, supplemented as specified.
- .2 Timing:
  - .1 After start-up deficiencies rectified.
  - .2 After certificate of completion has been issued by authority having jurisdiction.
- .3 Application tolerances:
  - .1 Pressure at fixtures: +/- 70 kPa.
  - .2 Flow rate at fixtures: +/- 20 %.
- .4 Adjustments:
  - .1 Verify that flow rate and pressure meet design criteria.
  - .2 Make adjustments while flow rate or withdrawal is (1) maximum and (2) 25 % of maximum and while pressure is (1) maximum and (2) minimum.
- .5 Floor drains:
  - .1 Verify operation of trap seal primer.
  - .2 Prime, using trap primer. Adjust flow rate to suit site conditions.
  - .3 Check operations of flushing features.
  - .4 Check security, accessibility, removability of strainer.
  - .5 Clean out baskets.
- .6 Vacuum breakers, backflow preventers, backwater valves:
  - .1 Test tightness, accessibility for O&M of cover and of valve.
  - .2 Simulate reverse flow and back-pressure conditions to test operation of vacuum breakers, backflow preventers.
  - .3 Verify visibility of discharge from open ports.
- .7 Access doors:
  - .1 Verify size and location relative to items to be accessed.

- .8 Cleanouts:
  - .1 Verify covers are gas-tight, secure, yet readily removable.
- .9 Water hammer arrestors:
  - .1 Verify proper installation of correct type of water hammer arrester.
- .10 Wall, ground hydrants:
  - .1 Verify complete drainage, freeze protection.
  - .2 Verify operation of vacuum breakers.
  - .3 Adjust settings to suit locations, flow rates, pressure conditions.
- .11 Strainers:
  - .1 Clean out repeatedly until clear.
  - .2 Verify accessibility of cleanout plug and basket.
  - .3 Verify that cleanout plug does not leak.
- .12 Hose bibbs, sediment faucets:
  - .1 Verify that flow and pressure meet design criteria.
  - .2 Check for leaks, replace compression washer if required.
- .13 Water meters:
  - .1 Verify location and accessibility.
  - .2 Test metre reading accuracy.

### **3.14 COMBINED EMERGENCY SHOWER**

- .1 Test procedure specific to eyewash stations and emergency showers
- .2 Emergency showers and emergency eyewash stations must be tested in accordance with applicable ANSI / ISEA Z358.1 standard. The standard covers, but is not limited to, the pressure of the rinse aid, the flow of rinse aid and the area covered by the rinse aid.
- .3 When more than one device listed in 3.4.2 is combined in the same unit, the test procedures for each sub-device must be followed in accordance with the current ANSI / ISEA Z358.1 standard. All sub-devices of the combined device must be able to operate simultaneously.
- .4 Provide report of all tests carried out.

### **3.15 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - 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 00 - Cleaning.

**END OF SECTION**

## **Part 1        General**

### **1.1        REFERENCE STANDARDS**

- .1 American Society of Mechanical Engineers International (ASME)
  - .1 ANSI/ASME B16.15, Cast Copper Alloy Threaded Fittings, Classes 125 and 250.
  - .2 ANSI/ASME B16.18, Cast Copper Alloy Solder Joint Pressure Fittings.
  - .3 ANSI/ASME B16.22, Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
  - .4 ANSI/ASME B16.24, Cast Copper Alloy Pipe Flanges and Flanged Fittings: Class 150, 300, 400, 600, 900, 1500 and 2500.
  - .5 ASME B16.26, Cast Copper Alloy Fittings for Flared Copper Tubes.
  - .6 ASME B31.9, Building Services Piping.
  - .7 ASME B36.19M, Stainless Steel Pipe.
- .2 ASTM International (ASTM)
  - .1 ASTM A182/A 182M, Standard Specification for Forged or Rolled Alloy and Stainless Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service.
  - .2 ASTM A269, Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
  - .3 ASTM A307, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
  - .4 ASTM A312/A312M, Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes.
  - .5 ASTM A351/A351M, Castings, Austenitic, for Pressure Containing Parts.
  - .6 ASTM A403/A403M, Wrought Austenitic Stainless Steel Piping Fittings.
  - .7 ASTM A536, Standard Specification for Ductile Iron Castings.
  - .8 ASTM B32, Standard Specification for Solder Metal.
  - .9 ASTM B42, Seamless Copper Tube, Standard Sizes.
  - .10 ASTM B88M, Standard Specification for Seamless Copper Water Tube (Metric).
- .3 American National Standards Institute/American Water Works Association (ANSI)/(AWWA)
  - .1 ANSI/AWWA C111/A21.11, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
  - .2 ANSI/AWWA C151/A21.51, Ductile Iron Pipe, Centrifugally Cast, for Water.

- .4 Underwriters Laboratories of Canada (ULC)
  - .1 CAN/ULC S101, Fire Endurance Tests of Buildings Construction and Materials.
  - .2 CAN/ULC S102.2, Method of Test for Surface Burning Characteristics of Flooring, Floor Coverings and Miscellaneous Materials and Assemblies.
  - .3 CAN/ULC S115, Standard Method of Fire Tests of Firestop.
- .5 Department of Justice Canada (Jus)
  - .1 Canadian Environmental Protection Act, 1999, c. 33 (CEPA).
- .6 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 Safety Data Sheets (SDS).
- .7 Manufacturer's Standardization Society of the Valve and Fittings Industry (MSS).
  - .1 MSS-SP-67, Butterfly Valves.
- .8 National Research Council (NRC)
  - .1 National Plumbing Code of Canada (NPC) 2015.
- .9 Transport Canada (TC)
  - .1 Transportation of Dangerous Goods Act, 1992, c. 34 (TDGA).

## **Part 2 Products**

### **2.1 PIPING**

- .1 Domestic hot, cold and recirculation systems, within building.
  - .1 Above ground:
    - .1 Copper tube, hard drawn, type L: to ASTM B88M.
  - .2 Buried or embedded:
    - .1 Copper tube, soft annealed, type K: to ASTM B88M, in long lengths and with no buried joints.

### **2.2 FITTINGS**

- .1 Bronze pipe flanges and flanged fittings, Class 150: to ANSI/ASME B16.24.
- .2 Cast bronze threaded fittings, Class 125: to ANSI/ASME B16.15.
- .3 Cast copper, solder type: to ANSI/ASME B16.18.
- .4 Wrought copper and copper alloy, solder type: to ANSI/ASME B16.22.
- .5 NPS 2 and larger:
  - .1 ANSI/ASME B16.18 or ANSI/ASME B16.22 roll grooved to CSA B242.
  - .2 PEX fittings to CSA B137.5 and F1960.
- .6 NPS 1 ½ and smaller:
  - .1 cast copper to ANSI/ASME B16.18 or Wrought copper to ANSI/ASME B16.22; with 301 stainless steel internal components and EPDM seals. Suitable for operating pressure to 1380 kPa.

### **2.3 JOINTS**

- .1 Rubber gaskets, 1.6 mm thick: to AWWA C111.
- .2 Bolts, nuts, hex head and washers: to ASTM A307, heavy series.
- .3 Solder: tin / antimony 95/5, conforms to ASTM B32, lead content less than 0.2.
- .4 Teflon tape: for threaded joints.
- .5 Grooved couplings: designed with angle bolt pads to provide rigid joint, complete with EPDM gasket.

### **2.4 BALL VALVES**

- .1 NPS 2 and under, screwed:
  - .1 Class 150.
  - .2 Bronze body, stainless steel ball, PTFE adjustable packing, brass gland and PTFE seat, steel lever handle.
- .2 NPS 2 and under, soldered:
  - .1 To ANSI/ASME B16.18, Class 150.
  - .2 Bronze body, stainless steel ball, PTFE adjustable packing, brass gland and PTFE seat, steel lever handle, with NPT to copper adaptors.

### **2.5 SLEEVE**

- .1 If the sleeve crosses a wall or a floor, caulk the free spaces between the insulation and the sleeve or between the pipe / conduit and the sleeve using fiberglass and seal the two ends of the sleeve with waterproof, fireproof and non-waterproof putty curable. When the sleeve passes through a partition with a degree of fire resistance, comply with the requirements of the approved fire stop system. Finish with a rosette.

## **Part 3 Execution**

### **3.1 APPLICATION**

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

### **3.2 INSTALLATION**

- .1 Install in accordance with NPC.
- .2 Assemble piping using fittings manufactured to ANSI and Standard Council of Canada (SCC) standards.
- .3 Install CWS piping below and away from HWS and HWC and other hot piping so as to maintain temperature of cold water as low as possible.
- .4 Connect to fixtures and equipment in accordance with manufacturer's written instructions unless otherwise indicated.

- .5 Buried tubing:
  - .1 Lay in well compacted washed sand in accordance with AWWA Class B bedding.
  - .2 Bend tubing without crimping or constriction. Minimize use of fittings.
- .6 Valves
  - .1 Isolate equipment, fixtures and branches with ball valves.
  - .2 Balance recirculation system using lockshield globe valves. Mark settings and record on as-built drawings on completion.
- 3.3 PRESSURE TESTS**
  - .1 Test pressure: greater of 1 times maximum system operating pressure or 860 kPa.
- 3.4 FLUSHING AND CLEANING**
  - .1 Flush entire system for 8 h. Ensure outlets flushed for 2 hours. Let stand for 24 hours, then draw one sample off longest run. Submit to testing laboratory to verify that system is clean copper to Federal potable water guidelines. Let system flush for additional 2 hours, then draw off another sample for testing.
- 3.5 PRE-START-UP INSPECTIONS**
  - .1 Systems to be complete, prior to flushing, testing and start-up.
  - .2 Verify that system can be completely drained.
  - .3 Ensure that pressure booster systems are operating properly.
  - .4 Ensure that air chambers, expansion compensators are installed properly.
- 3.6 DISINFECTION**
  - .1 Flush out, disinfect and rinse system to requirements of authority having jurisdiction.
  - .2 Upon completion, provide laboratory test reports on water quality for Departmental Representative approval.
- 3.7 START-UP**
  - .1 Timing: start up after:
    - .1 Pressure tests have been completed.
    - .2 Disinfection procedures have been completed.
    - .3 Certificate of static completion has been issued.
    - .4 Water treatment systems operational.
  - .2 Provide continuous supervision during start-up.

- .3 Start-up procedures:
  - .1 Establish circulation and ensure that air is eliminated.
  - .2 Check pressurization to ensure proper operation and to prevent water hammer, flashing and/or cavitation.
  - .3 Bring HWS storage tank up to design temperature slowly.
  - .4 Monitor piping HWS and HWC piping systems for freedom of movement, pipe expansion as designed.
  - .5 Check control, limit, safety devices for normal and safe operation.
- .4 Rectify start-up deficiencies.

### **3.8 PERFORMANCE VERIFICATION**

- .1 Scheduling:
  - .1 Verify system performance after pressure and leakage tests and disinfection are completed, and Certificate of Completion has been issued by authority having jurisdiction.
- .2 Procedures:
  - .1 Verify that flow rate and pressure meet Design Criteria.
  - .2 TAB HWC in accordance with Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
  - .3 Sterilize HWS and HWC systems for Legionella control.
  - .4 Verify performance of temperature controls.
  - .5 Verify compliance with safety and health requirements.
  - .6 Confirm water quality consistent with supply standards, and ensure no residuals remain as result of flushing or cleaning.
  - .7 Check for proper operation of water hammer arrestors. Run one outlet for 10 seconds, then shut of water immediately. If water hammer occurs, replace water hammer arrestor or re-charge air chambers. Repeat for outlets and flush valves.
- .3 Reports:
  - .1 In accordance with Section 01 91 13 - General Commissioning (Cx) Requirements: Reports, using report forms as specified in Section 01 91 13 - General Commissioning (Cx) Requirements: Report Forms and Schematics.
  - .2 Include certificate of water flow and pressure tests conducted on incoming water service, demonstrating adequacy of flow and pressure.

### **3.9 OPERATION REQUIREMENTS**

- .1 Co-ordinate operation and maintenance requirements including, cleaning and maintenance of specified materials and products with Section 23 05 15 - Common Installation Requirements for HVAC Pipework.

**3.10 CLEANING**

- .1 Clean in accordance with Section 01 74 00 - Cleaning.

**END OF SECTION**

## **Part 1 General**

### **1.1 REFERENCE STANDARDS**

- .1 ASTM International (ASTM)
  - .1 ASTM B32, Standard Specification for Solder Metal.
  - .2 ASTM B306, Standard Specification for Copper Drainage Tube (DWV).
  - .3 ASTM C564, Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings.
- .2 CSA Group (CSA)
  - .1 CSA B67, Lead Service Pipe, Waste Pipe, Traps, Bends and Accessories.
  - .2 CAN/CSA-B70, Cast Iron Soil Pipe, Fittings and Means of Joining.
  - .3 CAN/CSA-B125.3, Plumbing Fittings.
- .3 National Research Council Canada (NRC)
  - .1 National Plumbing Code of Canada 2015 (NPC).

## **Part 2 Products**

### **2.1 COPPER TUBE AND FITTINGS**

- .1 Above ground sanitary and vent Type DWV to: ASTM B306.
  - .1 Fittings.
    - .1 Cast brass: to CAN/CSA-B125.3.
    - .2 Wrought copper: tin / antimony 95/5, conforms to ASTM B32, lead content less than 0.2.

### **2.2 CAST IRON PIPING AND FITTINGS**

- .1 Buried sanitary and vent cast iron, nominal diameter equal to or greater than DN 75, intended to be buried in the ground, and related fittings: conform to CAN / CSA-B70 standard, and covered with a layer of protective coating.
- .2 Joints:
  - .1 Mechanical joints:
    - .1 Neoprene or butyl rubber compression gaskets: to CAN/CSA-B70.ASTM C564 or
    - .2 Stainless steel clamps.
  - .2 Hub and spigot:
    - .1 Caulking lead: to CSA B67.
    - .2 Cold caulking compounds.

- .3 Above ground sanitary and vent: to CAN/CSA-B70.
  - .1 Joints:
    - .1 Hub and spigot:
      - .1 Caulking lead: to CSA B67.
    - .2 Mechanical joints:
      - .1 Neoprene or butyl rubber compression gaskets with stainless steel clamps.

## **2.3 SLEEVE**

- .1 If the sleeve crosses a wall or a floor, caulk the free spaces between the insulation and the sleeve or between the pipe / conduit and the sleeve using fiberglass and seal the two ends of the sleeve with waterproof, fireproof and non-waterproof putty curable. When the sleeve passes through a partition with a degree of fire resistance, comply with the requirements of the approved fire stop system. Finish with a rosette.

## **Part 3 Execution**

### **3.1 APPLICATION**

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

### **3.2 INSTALLATION**

- .1 In accordance with Section 23 05 15 - Common installation requirements for HVAC pipework.

### **3.3 TESTING**

- .1 Pressure test buried systems before backfilling.
- .2 Hydraulically test to verify grades and freedom from obstructions.

### **3.4 PERFORMANCE VERIFICATION**

- .1 Cleanouts:
  - .1 Ensure accessible and that access doors are correctly located.
  - .2 Open, cover with linseed oil and re-seal.
  - .3 Verify that cleanout rods can probe as far as the next cleanout, at least.
- .2 Test to ensure traps are fully and permanently primed.
- .3 Storm water drainage:
  - .1 Verify domes are secure.
  - .2 Ensure weirs are correctly sized and installed correctly.
  - .3 Verify provisions for movement of roof system.

- .4 Ensure that fixtures are properly anchored, connected to system and effectively vented.
- .5 Affix applicable label (storm, sanitary, vent, pump discharge etc.) c/w directional arrows every floor or 4.5 m (whichever is less).

### **3.5 CLEANING**

- .1 Clean in accordance with Section 01 74 00 - Cleaning.

**END OF SECTION**



## **Part 1        General**

### **1.1            REFERENCE STANDARDS**

- .1 American Society of Mechanical Engineers (ASME)
  - .1 ASME B16.5, Pipe Flanges and Flanged Fittings.
  - .2 ASME B16.11, Forged Fittings, Socket-Welding and Threaded.
- .2 ASTM International (ASTM)
  - .1 ASTM A53/A53M, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
  - .2 ASTM A181/A181M, Standard Specification for Carbon Steel Forgings for General Purpose Piping.
- .3 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 Safety Data Sheets (SDS).

## **Part 2        Products**

### **2.1            AIR COMPRESSOR**

- .1 Existing compressor provide by the Owner's property.

### **2.2            PIPING**

- .1 Piping: to ASTM A53/A53M, schedule 80 seamless black steel.
- .2 Fittings:
  - .1 NPS2 and smaller: to ASME B16.11, schedule 80 steel, socket welded.
  - .2 NPS2 1/2 and larger: to ASME B16.11, schedule 80 steel, butt or socket welded.
- .3 Couplings: to ASME B16.11, socket welded or threaded half coupling type.
- .4 Unions: 1000 kPa malleable iron with brass-to-iron ground seat.
- .5 Dissimilar metal junctions: use dielectric unions.
- .6 Flanges:
  - .1 NPS2 and smaller: to ASME B16.5, forged steel, raised face and socket welded.
  - .2 NPS2 1/2 and larger: to ASME B16.5, forged steel, raised face and slip-on or weld neck.
- .7 Joints:
  - .1 NPS2 and smaller: socket welded.
  - .2 NPS2 1/2 and larger: butt welded.

### **2.3 BALL VALVES**

- .1 Three piece design or top entry for ease of in-line maintenance.
  - .1 To ASTM A181/A181M, Class 70, carbon steel body socket welded ends, carbon steel ball and associated trim suitable for compressed air application.
  - .2 To withstand 1034 kPa maximum pressure.

### **2.4 COUPLERS/CONNECTORS**

- .1 Industrial interchange series, full-bore.
- .2 Maximum inlet pressure: 1700 kPa.
- .3 Valve seat: moulded nylon.
- .4 Body: zinc plated steel.
- .5 Threads: NPT.

### **2.5 SLEEVE**

- .1 If the sleeve crosses a wall or a floor, caulk the free spaces between the insulation and the sleeve or between the pipe / conduit and the sleeve using fiberglass and seal the two ends of the sleeve with waterproof, fireproof and non-waterproof putty curable. When the sleeve passes through a partition with a degree of fire resistance, comply with the requirements of the approved fire stop system. Finish with a rosette.

## **Part 3 Execution**

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

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

### **3.2 COMPRESSOR STATION**

- .1 Install on vibration isolators on housekeeping pad as indicated.

### **3.3 COMPRESSED AIR PIPING CONNECTIONS AND INSTALLATION**

- .1 Install shut-off valves at outlets, major branch lines and in locations as indicated.
- .2 Install quick-coupler chucks and pressure gauges on drop pipes.
- .3 Install unions to permit removal or replacement of equipment.
- .4 Install tees in lieu of elbows at changes in direction of piping. Install plug in open ends of tees.
- .5 Grade piping at 1 % slope minimum.
- .6 Install compressed air trap and pressure equalizing pipe at moisture collecting points. Drain pipe to nearest floor drain.

- .7 Make branch connections from top of main.
- .8 Install compressed air trap at bottom of risers and at low points in mains, piped to nearest drain. Distance between drain points to be 30 m maximum.
- .9 Provide drain from refrigerated air dryer.
- .10 Weld steel piping in accordance with:
  - .1 To ASME code and requirements of authority having jurisdiction.
  - .2 Weld concealed and inaccessible piping regardless of size.

### **3.4 FIELD QUALITY CONTROL**

- .1 Site Tests/Inspection:
  - .1 Testing: pressure test for 4 hours minimum, to 1100 kPa, with outlets closed and with compressor isolated from system. Pressure drop not to exceed 10 kPa.

### **3.5 CLEANING**

- .1 Cleaning: blow out piping to clean interior thoroughly of oil and foreign matter.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

**END OF SECTION**



**Part 1 General**

**1.1 REFERENCE STANDARDS**

- .1 CSA Group (CSA)
  - .1 CSA B51, Boiler, Pressure Vessel, and Pressure Piping Code.
  - .2 CAN/CSA C22.2 No.110, Construction and Test of Electric Storage Tank Water Heaters.
- .2 National Research Council Canada (NRC)
  - .1 National Plumbing Code of Canada 2015 (NPC).

**1.2 WARRANTY**

- .1 For the Work of this Section 22 33 00 - Electric Domestic Water Heaters, 12 months warranty period prescribed in subsection GC 32.1 of General Conditions &quot;C&quot; is extended to number of years specified for each product.
- .2 Contractor hereby warrants domestic water heaters in accordance with CCDC2, but for number of years specified for each product.

**Part 2 Products**

**2.1 ELECTRIC WATER HEATER**

- .1 To CAN/CSA C22.2 No.110, CAN/CSA-C191, with immersion type elements, 3000 W each, and surface mounted or immersion type adjustable thermostats and a thermowell.
- .2 Tank: 455 L, glass lined steel, 720 mm diameter x1710 mm high, 50 mm mineral wool or fibreglass insulation, enamelled steel jacket, 3 year warranty certificate.

**2.2 EXPANSION TANK**

- .1 Cylinder made of steel, of the fixed butyl bladder type and designed for a drinking water supply network and ASME certification.
- .2 Factory preload at 40 psig and adjustable on site.
- .3 Stainless steel fittings with NPT thread.
- .4 Maximum operating temperature 80 °C. (180 °F).
- .5 Strap for suspended installation.
- .6 Acceptance volume of 20 L.

**2.3 TRIM AND INSTRUMENTATION**

- .1 Drain valve: NPS 1 with hose end.
- .2 Thermometer: 100 mm dial type with red pointer and thermowell filled with conductive paste.

- .3 Pressure gauge: 75 mm dial type with red pointer, syphon, and shut-off cock.
- .4 ASME rated temperature and pressure relief valve sized, having discharge terminating over floor drain and visible to operators.

### **Part 3 Execution**

#### **3.1 APPLICATION**

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

#### **3.2 INSTALLATION**

- .1 Install in accordance with manufacturer's recommendations authority having jurisdiction.
- .2 Provide insulation between tank and supports.

#### **3.3 CLEANING**

- .1 Clean in accordance with Section 01 74 00 - Cleaning.
  - .1 Remove surplus materials, excess materials, rubbish, tools and equipment.

**END OF SECTION**

## **Part 1        General**

### **1.1        REFERENCE STANDARDS**

- .1    CSA Group (CSA)
  - .1    CAN/CSA-B45 Series, Plumbing Fixtures, (Consists of B45.0, B45.1, B45.2, B45.3, B45.4, B45.5, B45.6, B45.7, B45.8 and B45.9).
  - .2    CSA B125.3, Plumbing Fittings.
  - .3    CSA B651, Accessible Design for the Built Environment.
- .2    National Research Council Canada (NRC)
  - .1    National Building Code of Canada 2015 (NBC).

## **Part 2        Products**

### **2.1        MANUFACTURED UNITS**

- .1    Fixtures: manufacture in accordance with CAN/CSA-B45 series.
- .2    Trim, fittings: manufacture in accordance with CSA B125.3.
- .3    Exposed plumbing brass to be chrome plated.
- .4    Fixtures in any one location to be product of one manufacturer and of same type.
- .5    Trim in any one location to be product of one manufacturer and of same type.
- .6    WC-1: floor-mounted, flush tank.
  - .1    Bowl: vitreous china, floor mounted, syphon jet, elongated rim, top spud for flush valve, bolt caps.
  - .2    Closet tank: vitreous china with, flapper type flush valve assembly for ultra low flush cycle: 5.7 litres/flush.
  - .3    Top of seat to be between 400 mm and 460 mm from finished floor.
  - .4    Seat: solid molded plastic, black, elongated, open at the front, fitted with stainless steel friction hinges and a stainless steel fixing rod.
- .7    L-1: Wall-hung, integral back:
  - .1    Vitreous china, with splash lip, soap depressions, supply openings on 299 mm centres, overflow. Size: 675 x 500 mm. Offset outlet.
  - .2    Universal access supply valves, including swan neck spout with aerator, handles with 150 mm blade, with marked cap, and elbow drain connection.
    - .1    Devices used to limit the supply flow to 8.35 L / min at a pressure of 413 kPa.
    - .2    Emptying device: with valve.

- .8 Piping serving each appliance
  - .1 Hot and cold water supply
    - .1 Chrome pipes, flexible, including a shut-off valve operated by a screwdriver, reducers and a rosette.
  - .2 Water drainage
    - .1 Siphon P in bronze with drain plug on all devices without integrated siphon.
    - .2 Chromed elements wherever they are visible.
- .9 Supports consoles
  - .1 Factory-made floor-mount brackets for all wall fixtures.

### **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 washroom fixtures 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 Mounting heights:
  - .1 Barrier-free: to most stringent CSA B651.

#### **3.3 ADJUSTING**

- .1 Conform to water conservation requirements specified this section.
- .2 Adjustments:
  - .1 Adjust water flow rate to design flow rates.
  - .2 Adjust pressure to fixtures to ensure no splashing at maximum pressures.
  - .3 Adjust flush valves to suit actual site conditions.
  - .4 Set controls of automatic flush valves for WCs and urinals to prevent unnecessary flush cycles.
- .3 Checks:
  - .1 Water closets, urinals: flushing action.
  - .2 Aerators: operation, cleanliness.
  - .3 Vacuum breakers, backflow preventers: operation under all conditions.

- .4 Thermostatic controls:
  - .1 Verify temperature settings, operation of control, limit and safety controls.

### **3.4 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - 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 00 - Cleaning.

**END OF SECTION**



## **Part 1        General**

### **1.1        REFERENCE STANDARDS**

- .1    CSA Group (CSA)
  - .1    CAN/CSA-B45 Series, Plumbing Fixtures.
  - .2    CAN/CSA-B125.3, Plumbing Fittings.
  - .3    CAN/CSA-B651, Accessible Design for the Built Environment.
- .2    National Research Council Canada (NRC)
  - .1    National Building Code of Canada 2015 (NBC).

## **Part 2        Products**

### **2.1        MANUFACTURED UNITS**

- .1    Fixtures: manufacture in accordance with CAN/CSA-B45 series.
- .2    Trim, fittings: manufacture in accordance with CAN/CSA-B125.
- .3    Exposed plumbing brass to be chrome plated.
- .4    Fixtures to be product of one manufacturer.
- .5    Trim to be product of one manufacturer.
- .6    Kitchen sink E-1
  - .1    Stainless steel sink, type 302 20 gauge, satin finish, single bowl, 522 x 511 x 127 mm for installation on a worktop. Rear edge with spacing joint. Built-in frame, with factory installed gasket. 89 mm (3½ ") crumb screen, with offset 38 mm (1½") discharge connection and brass nuts. Universal access.
  - .2    Taps and accessories: vacuum breaker, in chrome-plated brass, including a swivel spout, an aerator, a single lever handle, regulation cartridges without sealing washer and devices allowing the flow rate to be limited to 5.3 L / min at a pressure of 413 kPa.
  - .3    Emptying block: drain in chromed molded brass, standard siphon in enamelled cast iron with drain plug in brass and adjustable floor flange.
  - .4    Edge guard: stainless steel.
  - .5    Connection for dishwasher.
- .7    CU-1 service sinks
  - .1    Mop sink: high density molded stone composite, 610 mm x 610 mm x 254 mm, 44 mm x 16 mm flanges, drain connection with stainless steel body, grid and basket / lint filter stainless steel, compressible rubber gasket for 75 mm hose.

- .2 Wall-mounted sink mixer: polished chrome finish, cruciform handles, fixed spout with vacuum breaker and upper wall support, threaded outlet for upper hose, threaded outlet for hose, bucket hook, shut-off valves with screwdriver incorporated.
- .3 Edge guard: 610 mm long vinyl.
- .4 Hose: reinforced for intensive use, 16 mm x 762 mm long with coupling connection and stainless steel wall support. with mordache hook.
- .5 Mop stand: wall mounted in stainless steel. 610 mm x 76 mm, with three (3) jaw hooks.
- .6 Set of splash-proof wall panels: for corner installation, stainless steel cal. 20, satin finish, height of 305 mm, corner molding (2 of 310 mm).
- .8 Piping serving each appliance
  - .1 Hot and cold water supply
    - .1 Chrome pipes, rigid or flexible, including a shut-off valve operated by a screwdriver, reducers and a rosette.
  - .2 Water drainage
    - .1 P-trap in brass with drain plug on all devices without integrated siphon.
    - .2 Chromed elements wherever they are visible.

### **Part 3 Execution**

#### **3.1 APPLICATION**

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

#### **3.2 INSTALLATION**

- .1 Mounting heights:
  - .1 Standard: to comply with manufacturer's recommendations unless otherwise indicated or specified.
  - .2 Physically handicapped: to comply with most stringent of either NBC or CAN/CSA-B651.

#### **3.3 ADJUSTING**

- .1 Conform to water conservation requirements specified this section.
- .2 Adjustments:
  - .1 Adjust water flow rate to design flow rates.
  - .2 Adjust pressure to fixtures to ensure no splashing at maximum pressures.
- .3 Checks:
  - .1 Aerators: operation, cleanliness.
  - .2 Vacuum breakers, backflow preventers: operation under all conditions.

- .3 Wash fountains: operation of flow-actuating devices.
- .4 Thermostatic controls:
  - .1 Verify temperature settings, operation of control, limit and safety controls.
- 3.4 CLEANING**
  - .1 Clean in accordance with Section 01 74 00 - Cleaning.
    - .1 Remove surplus materials, excess materials, rubbish, tools and equipment.

**END OF SECTION**



## **Part 1        General**

### **1.1        REFERENCE STANDARDS**

- .1    CSA Group (CSA)
  - .1    CAN/CSA-B45 Series, Plumbing Fixtures.
  - .2    CAN/CSA-B125.3, Plumbing Fittings.
  - .3    CAN/CSA-B651, Accessible Design for the Built Environment.
- .2    National Research Council Canada (NRC)
  - .1    National Building Code of Canada 2015 (NBC).

## **Part 2        Products**

### **2.1        SUSTAINABLE MATERIAL**

- .1    Sustainable Requirements:
  - .1    Materials and products in accordance with Section [01 47 15 - Sustainable Requirements: Construction].

### **2.2        MANUFACTURED UNITS**

- .1    Fixtures: manufacture in accordance with CAN/CSA-B45 series.
- .2    Trim, fittings: manufacture in accordance with CAN/CSA-B125.3.
- .3    Exposed plumbing brass to be chrome plated.
- .4    Number, locations: architectural drawings to govern.
- .5    Fixtures in any one location to be product of one manufacturer and of same type.
- .6    Trim in any one location to be product of one manufacturer and of same type.
- .7    Shower DO-1
  - .1    Shower head in chrome-plated brass, anti-limescale, with adjustable jet, ball joint, bent arm and fitted with a rosette, with devices allowing the flow rate to be limited to 9.5 L / min at a pressure of 550 kPa.
  - .2    ADA compliant assembly including a mixer, 1.5m hose, vacuum breaker, 30 "rod and shower head.
- .8    Piping serving each appliance
  - .1    Hot and cold water supply: Pipes including a shut-off valve, reducers and a rosette.

**Part 3 Execution**

**3.1 APPLICATION**

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

**3.2 INSTALLATION**

- .1 Mounting heights:
  - .1 Standard: to comply with manufacturer's recommendations unless otherwise indicated or specified.
  - .2 Physically handicapped: to comply with most stringent of either NBC or CAN/CSA B651.

**3.3 ADJUSTING**

- .1 Conform to water conservation requirements specified this section.
- .2 Adjustments:
  - .1 Adjust water flow rate to design flow rates.
  - .2 Adjust pressure to fixtures to ensure no splashing at maximum pressures.
- .3 Checks:
  - .1 Aerators: operation, cleanliness.
  - .2 Vacuum breakers, backflow preventers: operation under all conditions.
- .4 Thermostatic controls:
  - .1 Verify temperature settings, operation of control, limit and safety controls.

**3.4 CLEANING**

- .1 Clean in accordance with Section 01 74 00 - Cleaning.
  - .1 Remove surplus materials, excess materials, rubbish, tools and equipment.

**END OF SECTION**

**Part 1        General**

**1.1            USE OF SYSTEMS**

- .1        Use of existing permanent heating systems for supplying temporary heat is permitted only under following conditions:
  - .1        Building has been closed in, areas to be heated/ventilated are clean and will not thereafter be subjected to dust-producing processes.
  - .2        There is no possibility of damage.
  - .3        Systems will be:
    - .1        Operated as per manufacturer's recommendations and instructions.
    - .2        Operated by Contractor.
    - .3        Monitored continuously by Contractor.

**Part 2        Products**

**2.1            NOT USED**

**Part 3        Execution**

**3.1            NOT USED**

**END OF SECTION**



## **Part 1            General**

### **1.1            ACTION AND INFORMATIONAL SUBMITTALS**

- .1    Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2    Product Data:
  - .1    Submit manufacturer's instructions, printed product literature and data sheets and include product characteristics, performance criteria, physical size, finish and limitations.
- .3    Shop Drawings:
  - .1    Submit drawings stamped and signed by professional engineer registered or licensed in Quebec, Canada.
  - .2    Indicate on drawings:
    - .1    Mounting arrangements.
    - .2    Operating and maintenance clearances.
  - .3    Shop drawings and product data accompanied by:
    - .1    Detailed drawings of bases, supports, and anchor bolts.
    - .2    Acoustical sound power data, where applicable.
    - .3    Points of operation on performance curves.
    - .4    Manufacturer to certify current model production.
    - .5    Certification of compliance to applicable codes.
  - .4    In addition to transmittal letter referred to in Section 01 33 00 - Submittal Procedures: use MCAC "Shop Drawing Submittal Title Sheet"; Identify section and paragraph number.

### **1.2            CLOSEOUT SUBMITTALS**

- .1    Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2    Operation and Maintenance Data: submit operation and maintenance data for incorporation into manual.
  - .1    Operation and maintenance manual approved by, and final copies deposited with, Consultant before final inspection.
  - .2    Operation data to include:
    - .1    Control schematics for systems including environmental controls.
    - .2    Description of systems and their controls.
    - .3    Description of operation of systems at various loads together with reset schedules and seasonal variances.
    - .4    Operation instruction for systems and component.
    - .5    Description of actions to be taken in event of equipment failure.
    - .6    Valves schedule and flow diagram.
    - .7    Colour coding chart.

- .3 Maintenance data to include:
  - .1 Servicing, maintenance, operation and trouble-shooting instructions for each item of equipment.
  - .2 Data to include schedules of tasks, frequency, tools required and task time.
- .4 Performance data to include:
  - .1 Equipment manufacturer's performance datasheets with point of operation as left after commissioning is complete.
  - .2 Equipment performance verification test results.
  - .3 Special performance data as specified.
  - .4 Testing, adjusting and balancing reports as specified in Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
- .5 Approvals:
  - .1 Submit 2 copies of draft Operation and Maintenance Manual to Consultant for approval. Submission of individual data will not be accepted unless directed by Consultant.
  - .2 Make changes as required and re-submit as directed by Consultant.
- .6 Additional data:
  - .1 Prepare and insert into operation and maintenance manual additional data when need for it becomes apparent during specified demonstrations and instructions.
- .7 Site records:
  - .1 Consultant will provide 1 set of reproducible mechanical drawings. Provide sets of prints as required for each phase of work. Mark changes as work progresses and as changes occur. Include changes to existing mechanical systems, control systems and low voltage control wiring.
  - .2 Transfer information weekly to reproducibles, revising reproducibles to show work as actually installed.
  - .3 Use different colour waterproof ink for each service.
  - .4 Make available for reference purposes and inspection.
- .8 As-built drawings:
  - .1 Prior to start of Testing, Adjusting and Balancing for HVAC, finalize production of as-built drawings.
  - .2 Identify each drawing in lower right hand corner in letters at least 12 mm high as follows: - "AS BUILT DRAWINGS: THIS DRAWING HAS BEEN REVISED TO SHOW MECHANICAL SYSTEMS AS INSTALLED" (Signature of Contractor) (Date).
  - .3 Submit to Consultant for approval and make corrections as directed.
  - .4 Perform testing, adjusting and balancing for HVAC using as-built drawings.

.5 Submit completed reproducible as-built drawings with Operating and Maintenance Manuals.

.9 Submit copies of as-built drawings for inclusion in final TAB report.

### **1.3 MAINTENANCE MATERIAL SUBMITTALS**

.1 Submit in accordance.

.2 Furnish spare parts as follows:

.1 One set of packing for each pump.

.2 One casing joint gasket for each size pump.

.3 One head gasket set for each heat exchanger.

.4 One glass for each gauge glass.

.5 One filter cartridge or set of filter media for each filter or filter bank in addition to final operating set.

.3 Provide one set of special tools required to service equipment as recommended by manufacturers.

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

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

.1 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:

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

.2 Store and protect from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

## **Part 2 Products**

**2.1 NOT USED**

## **Part 3 Execution**

### **3.1 EXAMINATION**

.1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate in presence of Consultant.

- .2 Inform Consultant 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 PAINTING REPAIRS AND RESTORATION**

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

**3.3 SYSTEM CLEANING**

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

**3.4 FIELD QUALITY CONTROL**

- .1 Site Tests: conduct following tests in accordance with Section 01 45 00 - Quality Control and submit report as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.
- .2 Manufacturer's Field Services:
  - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.
  - .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

**3.5 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - 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 00 - Cleaning.
- .3 Waste Management: separate waste materials for recycling in accordance with Section 01 74 19 - Waste Management and Disposal.
  - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

**3.6 PROTECTION**

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

### 3.7 SEISMIC PROTECTION

- .1 General
  - .1 Contractor is responsible to evaluate, furnish and install seismic protection for all new technical components as well as all relocated or modified technical components under his responsibility.
  - .2 Hire an Engineer, member in good standing of the Ordre des ingénieurs du Québec, for the evaluation of the seismic risk and calculation of seismic force resisting systems. The hired Engineering shall demonstrate recognized expertise in seismic protection. Contractor shall provide his contact details no more than two (2) weeks after contract signature.
  - .3 During an earthquake, seismic protection devices shall prevent permanent displacements and damages caused by vertical and horizontal motions and overturns.
- .2 Design criterias
  - .1 Site class and Importance category of the building is to be determined.
- .3 Evaluation and mitigation of seismic effects
  - .1 Evaluation of seismic effects shall be done as per requirements of sub-section 4.1.8 of the Quebec Construction Code, Chapter I – Building, and National Building Code of Canada (amended).
  - .2 Seismic force resisting systems shall be designed as per following standards:
    - .1 NFPA 13 et 20;
    - .2 SMACNA – Seismic Restraint Manual Guidelines for Mechanical System;
    - .3 ASHRAE – Seismic and Wind Design;
    - .4 FEMA;
    - .5 Engineering documents from earthquake-resistant devices manufacturers.
- .4 Evaluation and mitigation of seismic effects report
  - .1 Submit to the Engineer the evaluation and mitigation of seismic effects report before beginning the installation of the technical components.
  - .2 The report shall include, at least, the following information:
    - .1 General data for the project:
      - .1 Location of the building;
      - .2 General description of the building including height of the building ( $h_n$ );
      - .3 Site class at the location of the building;
      - .4 Importance category of the building;
      - .5 Value of  $S_a$  (0.2);
      - .6 Value of  $F_a$ ;
      - .7 Value of  $I_e$ ;

- .2 List of all technical components included in the contract which need to be have an evaluation of the seismic effects.
- .3 List of all technical components which may be exempted with the justifications.
- .4 For each technical component (CT) the evaluation of the seismic effect and the seismic force resisting system applied. Include following elements:
  - .1 Identification of the CT;
  - .2 Location of the CT including height ( $h_x$ );
  - .3 Description of CT including:
    - .1 Type of equipment;
    - .2 Make and model;
    - .3 Dimensions;
    - .4 Weight;
    - .5 Category and values of  $C_p$ ,  $A_r$  et  $R_p$ .
  - .4 Calculation of lateral force  $V_p$ , and forces on building structure;
  - .5 Description of the resisting system applied, including:
    - .1 Make and model of chosen material;
    - .2 Installation drawing specific for this project;
    - .3 Drawing showing the location of the seismic resisting systems.
- .5 For each CT located on the ground, on a slab or on an equipment base, the overturn force calculation and description of the resisting system. Included following elements:
  - .1 Identification of the CT;
  - .2 Location of the CT including height ( $h_x$ );
  - .3 Description of CT including:
    - .1 Type of equipment;
    - .2 Make and model;
    - .3 Dimensions;
    - .4 Weight;
    - .5 Location of gravity center;
  - .4 Calculation of the overturn force;
  - .5 Description of the resisting system applied, including:
    - .1 Mark and model of chosen material;
    - .2 Installation drawing specific for this project;
    - .3 Drawing showing the location of the seismic resisting systems.
- .5 Installation
  - .1 Install seismic force resisting system as per the indications of the evaluation and mitigation of seismic effects report.

- .2 Any modification to the seismic force resisting system for any reason, shall be subject to a new calculation by the Engineer responsible for the seismic protection, and issued as an amendment to the report.
- .3 Following requirements apply to the installation of electrical and mechanical material:
  - .1 Power-driven and drop-in anchors are not permitted for traction loads;
  - .2 C-clamps are not allowed to support CT unless they have a retainer mechanism;
  - .3 C-clamps are not allowed for seismic resisting systems;
  - .4 Equipment base shall be anchored to the slab;
  - .5 All vibration isolators shall be designed for seismic protection;
  - .6 Oval bolt adjusting hole are prohibited.
- .4 Seismic protection systems must be designed in a manner not to compromise the performance of vibration isolation or thermal expansion components designed to allow piping and equipments movements. In these cases, flexible or lose anchors and ties must be used rather than rigid structures.
- .6 Work approval
  - .1 The Engineer who prepared the evaluation and mitigation of seismic effects report shall inspect the work related to the seismic force resisting systems.
  - .2 Obtain from the seismic protection engineer a written and signed certification indicating that the seismic force resisting systems have been installed as per the report and the amendments to the report. Submit this certification before submitting of the work certificate of compliance.
  - .3 Include in the operation and maintenance manual all documents issued by the seismic protection engineer.

**END OF SECTION**



**Part 1            General**

**1.1                REFERENCE STANDARDS**

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

**1.2                DEFINITIONS**

- .1    Demolish: Detach items from existing construction and legally dispose of items off site, unless indicated as removed and salvaged, or removed and reinstalled.
- .2    Remove: Planned deconstruction and disassembly of electrical items from existing construction including removal of conduit, junction boxes, cabling and wiring from electrical component to panel taking care not to damage adjacent assemblies designated to remain; legally dispose of items off site, unless indicated as removed and salvaged, or removed and reinstalled.
- .3    Remove and Salvage: Detach items from existing construction and deliver them to Owner ready for reuse.
- .4    Remove and Reinstall: Detach items from existing construction, prepare them for reuse, and reinstall them where indicated.
- .5    Existing to Remain: Existing items of construction that are not removed and that are not otherwise indicated as being removed and salvaged, or removed and reinstalled.
- .6    Hazardous Substances: Dangerous substances, dangerous goods, hazardous commodities and hazardous products may include asbestos, mercury and lead, PCB's, poisons, corrosive agents, flammable substances, radioactive substances, or other material that can endanger human health or wellbeing or environment if handled improperly as defined by the Federal Hazardous Products Act (RSC 1985) including latest amendments.

**1.3                ADMINISTRATIVE REQUIREMENTS**

- .1    Coordination: Coordinate work of this Section to avoid interference with work by other Sections.
- .2    Scheduling: Account for Departmental Representative 's continued occupancy requirements during selective demolition with Section 02 41 19.16 - Selective Interior Demolition and schedule staged occupancy and worksite activities as a defined Activity in Section 01 32 16.19 - Construction Progress Schedule - Bar (GANTT) Chart.

**1.4                QUALITY ASSURANCE**

- .1    Regulatory Requirements: Perform work of this Section in accordance with the following

- .1 Provincial/Territorial Workers' Compensation Boards/Commissions.
- .2 Provincial/Territorial Occupational Health and Safety Standards and Programs.

## **1.5 SITE CONDITIONS**

- .1 Existing Conditions: Condition of materials identified as being salvaged or demolished are based on their observed condition on date that tender is accepted.
- .2 Discovery of Hazardous Substances: It is not expected that Hazardous Substances will be encountered in the Work; immediately notify Departmental Representative if materials suspected of containing hazardous substances are encountered and perform the following activities:
  - .1 Refer to Section 01 41 00- Regulatory Requirements for directives associated with specific material types.
  - .2 Hazardous substances will be as defined in the Hazardous Products Act.
  - .3 Stop work in the area of the suspected hazardous substances.
  - .4 Take preventative measures to limit users' and workers' exposure, provide barriers and other safety devices and do not disturb.
  - .5 Hazardous substances will be removed by Contractor under a separate contract or as a change to the Work.
  - .6 Proceed only after written instructions have been received from Departmental Representative.

## **1.6 SALVAGE AND DEBRIS MATERIALS**

- .1 Demolished items become Contractor 's property and will be removed from Project site; [except for items indicated as being reused, salvaged, or otherwise indicated to remain Departmental Representative 's property].
- .2 Carefully remove materials and items designated for salvage and store in a manner to prevent damage or devaluation of materials in accordance with Section 02 42 00- Removal and Salvage of Construction Materials.

## **Part 2 Products**

### **2.1 MATERIAL**

- .1 General Patching and Repair Materials: Refer to Section 02 41 19.16 - Selective Interior Demolition for listing of patching and repair materials incidental to removal or demolition of components associated with work of this Section.
- .2 HVAC Repair Materials: Use only new materials required for completion or repair matching materials damaged during performance of work of this Section; new materials are required to meet assembly or system characteristics as existing systems indicated to remain and carry CSA approval labels required by the Authority Having Jurisdiction.

- .3 Fire stopping Repair Materials: Use fire stopping materials compatible with existing fire stopping systems where removal or demolition work affects rated assemblies, restore to match existing fire rated performance.

### **Part 3 Execution**

#### **3.1 PREPARATION**

- .1 Protection of Existing Systems to Remain: Protect systems and components indicated to remain in place during selective demolition operations and as follows:
  - .1 Prevent movement and install bracing to prevent settlement or damage of adjacent services and parts of existing buildings scheduled to remain.
  - .2 Notify Departmental Representative and cease operations where safety of buildings being demolished, adjacent structures or services appears to be endangered and await additional instructions before resuming demolition work specified in this Section.
  - .3 Prevent debris from blocking drainage inlets.
  - .4 Protect mechanical systems that must remain in operation.

#### **3.2 CLOSEOUT ACTIVITIES**

- .1 Demolition Waste Disposal: Arrange for legal disposal and remove demolished materials to accredited provincial landfill site or alternative disposal site (recycle centre) [except where explicitly noted otherwise for materials being salvaged for re use in new construction in accordance with Section 02 42 00 - Removal and Salvage of Construction Materials].
- .2 Hazardous Substances Disposal: Arrange for disposal of hazardous substances in accordance with requirements of Section 02 81 00 - Hazardous Materials.

**END OF SECTION**



## **Part 1        General**

### **1.1            REFERENCE STANDARDS**

- .1    American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE)
  - .1    ASHRAE 90.1-01, Energy Standard for Buildings Except Low-Rise Residential Buildings (IESNA cosponsored; ANSI approved; Continuous Maintenance Standard).
- .2    Electrical Equipment Manufacturers' Association Council (EEMAC)
- .3    Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1    Safety Data Sheets (SDS).

### **1.2            QUALITY ASSURANCE**

- .1    Regulatory Requirements: work to be performed in compliance with applicable Provincial/Territorial regulations.
- .2    Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

## **Part 2        Products**

### **2.1            GENERAL**

- .1    Motors: high efficiency, in accordance with local Hydro company standards and to ASHRAE 90.1.

### **2.2            MOTORS**

- .1    Provide motors for mechanical equipment as specified.
- .2    Motors under 373 W 1/2 HP: speed as indicated, continuous duty, built-in overload protection, resilient mount, single phase, 120 V, unless otherwise specified or indicated.
- .3    Motors 373 W 1/2 HP and larger: EEMAC Class B, squirrel cage induction, speed as indicated, continuous duty, drip proof, ball bearing, maximum temperature rise 40 degrees C, 3 phase, 600 V, unless otherwise indicated.

### **2.3            TEMPORARY MOTORS**

- .1    If delivery of specified motor will delay completion or commissioning work, install motor approved by Consultant for temporary use. Work will only be accepted when specified motor is installed.

### **2.4            BELT DRIVES**

- .1    Fit reinforced belts in sheave matched to drive. Multiple belts to be matched sets.

- .2 Use cast iron or steel sheaves secured to shafts with removable keys unless otherwise indicated.
- .3 For motors under 7.5 kW: standard adjustable pitch drive sheaves, having plus or minus 10% range. Use mid-position of range for specified r/min.
- .4 For motors 7.5 kW and over: sheave with split tapered bushing and keyway having fixed pitch unless specifically required for item concerned. Provide sheave of correct size to suit balancing.
- .5 Correct size of sheave determined during commissioning.
- .6 Minimum drive rating: 1.5 times nameplate rating on motor. Keep overhung loads within manufacturer's design requirements on prime mover shafts.
- .7 Motor slide rail adjustment plates to allow for centre line adjustment.
- .8 Supply one set of spare belts for each set installed in accordance with Section 01 78 00 - Closeout Submittals.

## 2.5

### **DRIVE GUARDS**

- .1 Provide guards for unprotected drives.
- .2 Guards for belt drives;
  - .1 Expanded metal screen welded to steel frame.
  - .2 Minimum 1.2 mm thick sheet metal tops and bottoms.
  - .3 38 mm dia holes on both shaft centres for insertion of tachometer.
  - .4 Removable for servicing.
- .3 Provide means to permit lubrication and use of test instruments with guards in place.
- .4 Install belt guards to allow movement of motors for adjusting belt tension.
- .5 Guard for flexible coupling:
  - .1 "U" shaped, minimum 1.6 mm thick galvanized mild steel.
  - .2 Securely fasten in place.
  - .3 Removable for servicing.
- .6 Unprotected fan inlets or outlets:
  - .1 Wire or expanded metal screen, galvanized, 19 mm mesh.
  - .2 Net free area of guard: not less than 80 % of fan openings.
  - .3 Securely fasten in place.
  - .4 Removable for servicing.

**Part 3 Execution**

**3.1 MANUFACTURER'S INSTRUCTIONS**

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

**3.2 INSTALLATION**

- .1 Fasten securely in place.
- .2 Make removable for servicing, easily returned into, and positively in position.

**3.3 FIELD QUALITY CONTROL**

- .1 Site Tests: conduct following tests in accordance with Section 01 45 00 - Quality Control and submit report as described in PART 1 - SUBMITTALS.
- .2 Manufacturer's Field Services:
  - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - SUBMITTALS.
  - .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
  - .3 Schedule site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.
- .3 Verification requirements in accordance with Section 01 33 29 - Sustainable Design Reporting, include:
  - .1 Materials and resources.
  - .2 Storage and collection of recyclables.
  - .3 Construction waste management.
  - .4 Resource reuse.
  - .5 Recycled content.
  - .6 Local/regional materials.
  - .7 Certified wood.
  - .8 Low-emitting materials.

**3.4 CLEANING**

- .1 Proceed in accordance with Section 01 74 00 - Cleaning.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

**END OF SECTION**



**Part 1        General**

**1.1            REFERENCE STANDARDS**

- .1 Canadian General Standards Board (CGSB)
  - .1 CAN/CGSB-1.181, Ready-Mixed Organic Zinc-Rich Coating.
- .2 CSA Group (CSA)
  - .1 CAN/CSA B139, Installation Code for Oil Burning Equipment.
- .3 Green Seal Environmental Standards (GSES)
  - .1 Standard GS-11, Environmental Standard for Paints and Coatings.
- .4 National Research Council Canada (NRC)
  - .1 National Fire Code of Canada (NFC).
- .5 South Coast Air Quality Management District (SCAQMD), California State, Regulation XI. Source Specific Standards
  - .1 SCAQMD Rule 1113, Architectural Coatings.
  - .2 SCAQMD Rule 1168, Adhesive and Sealant Applications.

**Part 2        Products**

**2.1            MATERIAL**

- .1 Paint: zinc-rich to CAN/CGSB-1.181.
  - .1 In accordance with manufacturer's recommendations for surface conditions.
  - .2 Primer: maximum VOC limit 250 g/L to SCAQMD Rule 1113.
  - .3 Paints: maximum VOC limit 150 g/L to SCAQMD Rule 1113.
- .2 Sealants: maximum VOC limit to SCAQMD Rule 1168.
- .3 Adhesives: maximum VOC limit to SCAQMD Rule 1168.
- .4 Fire Stopping: in accordance with Section 07 84 00 - Fire Stopping.

**Part 3        Execution**

**3.1            APPLICATION**

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

### **3.2 CONNECTIONS TO EQUIPMENT**

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

### **3.3 CLEARANCES**

- .1 Provide clearance around systems, equipment and components for observation of operation, inspection, servicing, maintenance and as recommended by manufacturer.

### **3.4 DRAINS**

- .1 Install piping with grade in direction of flow except as indicated.
- .2 Install drain valve at low points in piping systems, at equipment and at section isolating valves.
- .3 Pipe each drain valve discharge separately to above floor drain.
  - .1 Discharge to be visible.
- .4 Drain valves: NPS 3/4 gate or globe valves unless indicated otherwise, with hose end male thread, cap and chain.

### **3.5 DIELECTRIC COUPLINGS**

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

### **3.6 PIPEWORK INSTALLATION**

- .1 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 size of main.
  - .1 Hole saw (or drill) and ream main to maintain full inside diameter of branch line prior to welding saddle.
- .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 Group piping wherever possible.
- .11 Ream pipes, remove scale and other foreign material before assembly.
- .12 Use eccentric reducers at pipe size changes to ensure positive drainage and venting.
- .13 Provide for thermal expansion as indicated.
- .14 Valves:
  - .1 Install in accessible locations.
  - .2 Remove interior parts before soldering.
  - .3 Install with stems above horizontal position unless indicated.
  - .4 Valves accessible for maintenance without removing adjacent piping.
  - .5 Install globe valves in bypass around control valves.
  - .6 Install butterfly valves between weld neck flanges to ensure full compression of liner.
  - .7 Use chain operators on valves NPS 2 1/2 and larger where installed more than 2400 mm above floor in Mechanical Rooms.

### **3.7 SLEEVES**

- .1 General: install where pipes pass through masonry, concrete structures, fire rated assemblies, and as indicated.
- .2 Material: schedule 40 black steel pipe.
- .3 Construction: use annular fins continuously welded at mid-point at foundation walls and where sleeves extend above finished floors.
- .4 Sizes: 6 mm minimum clearance between sleeve and uninsulated pipe or between sleeve and insulation.
- .5 Installation:
  - .1 Concrete, masonry walls, concrete floors on grade: terminate flush with finished surface.
  - .2 Other floors: terminate 25 mm above finished floor.
  - .3 Before installation, paint exposed exterior surfaces with heavy application of zinc-rich paint to CAN/CGSB-1.181.
- .6 Sealing:
  - .1 Foundation walls and below grade floors: fire retardant, waterproof non-hardening mastic.

- .2 Elsewhere:
  - .1 Provide space for fire stopping.
  - .2 Maintain the fire-resistance rating integrity of the fire separation.
- .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.
  - .1 Chrome or nickel plated brass or type 302 stainless steel.
- .3 Sizes: outside diameter to cover opening or sleeve.
  - .1 Inside diameter to fit around pipe or outside of insulation if so provided.

### **3.9 PREPARATION FOR FIRE STOPPING**

- .1 Coordinate the installation of fire stopping around pipes, insulation and adjacent fire separation in accordance with Section 07 84 00 - Fire Stopping.
- .2 Pipes subject to movement: conform to fire stop system design listing to ensure pipe movement without damaging fire stopping material or installation.
- .3 Insulated pipes: ensure integrity of insulation and vapour barriers.

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

- .1 Pipework: test as specified in relevant sections of heating, ventilating and air conditioning work.
- .2 Maintain specified test pressure without loss for 4 hours minimum unless specified for longer period of time in relevant mechanical sections.
- .3 Prior to tests, isolate equipment and other parts which are not designed to withstand test pressure or media.
- .4 Insulate or conceal work only after approval and certification of tests.

**END OF SECTION**

## **Part 1        General**

### **1.1            REFERENCE STANDARDS**

- .1 American Society of Mechanical Engineers (ASME)
  - .1 ASME B31.1-07, Power Piping.
- .2 ASTM International (ASTM)
  - .1 ASTM A125-1996 (2007), Standard Specification for Steel Springs, Helical, Heat-Treated.
  - .2 ASTM A307-07b, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
  - .3 ASTM A563-07a, Standard Specification for Carbon and Alloy Steel Nuts.
- .3 Factory Mutual (FM)
- .4 Manufacturer's Standardization Society of the Valves and Fittings Industry (MSS)
  - .1 MSS SP58-2002, Pipe Hangers and Supports - Materials, Design and Manufacture.
  - .2 MSS SP69-2003, Pipe Hangers and Supports - Selection and Application.
  - .3 MSS SP89-2003, Pipe Hangers and Supports - Fabrication and Installation Practices.
- .5 National Research Council Canada (NRC)
  - .1 National Plumbing Code of Canada 2015 (NPC).
- .6 Underwriter's Laboratories of Canada (ULC)

## **Part 2        Products**

### **2.1            SYSTEM DESCRIPTION**

- .1 Design Requirements:
  - .1 Construct pipe hanger and support to manufacturer's recommendations utilizing manufacturer's regular production components, parts and assemblies.
  - .2 Base maximum load ratings on allowable stresses prescribed by ASME B31.1 or MSS SP58.
  - .3 Ensure that supports, guides, anchors do not transmit excessive quantities of heat to building structure.
  - .4 Design hangers and supports to support systems under conditions of operation, allow free expansion and contraction, prevent excessive stresses from being introduced into pipework or connected equipment.
  - .5 Provide for vertical adjustments after erection and during commissioning. Amount of adjustment in accordance with MSS SP58.

- .2 Performance Requirements:
  - .1 Design supports, platforms, catwalks, hangers to withstand seismic events.

## 2.2 GENERAL

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

## 2.3 PIPE HANGERS

- .1 Finishes:
  - .1 Pipe hangers and supports: galvanized after manufacture.
  - .2 Use electro-plating galvanizing process.
  - .3 Ensure steel hangers in contact with copper piping are epoxy coated.
- .2 Upper attachment structural: suspension from lower flange of I-Beam:
  - .1 Cold piping NPS 2 maximum: malleable iron C-clamp with hardened steel cup point setscrew, locknut carbon steel retaining clip.
    - .1 Rod: 9 mm UL listed.
  - .2 Cold piping NPS 2 1/2 or greater, hot piping: malleable iron beam clamp, eye rod, jaws and extension with carbon steel retaining clip, tie rod, nuts and washers, UL listed 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, FM approved and 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, FM approved.
- .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, FM approved to MSS SP69.
- .5 Hanger rods: threaded rod material to MSS SP58:
  - .1 Ensure that hanger rods are subject to tensile loading only.
  - .2 Provide linkages where lateral or axial movement of pipework is anticipated.
  - .3 Do not use 22 mm or 28 mm rod.

- .6 Pipe attachments: material to MSS SP58:
  - .1 Attachments for steel piping: carbon steel galvanized.
  - .2 Attachments for copper piping: copper plated black steel.
  - .3 Use insulation shields for hot pipework.
  - .4 Oversize pipe hangers and supports.
- .7 Adjustable clevis: material to MSS SP69 UL listed, FM approved, clevis bolt with nipple spacer and vertical adjustment nuts above and below clevis.
  - .1 Ensure "U" has hole in bottom for rivetting to insulation shields.
- .8 Yoke style pipe roll: carbon steel yoke, rod and nuts with cast iron roll, to MSS SP69.
- .9 U-bolts: carbon steel to MSS SP69 with 2 nuts at each end to ASTM A563.
  - .1 Finishes for steel pipework: galvanized.
  - .2 Finishes for copper, glass, brass or aluminum pipework: galvanized, with formed portion plastic coated.
- .10 Pipe rollers: cast iron roll and roll stand with carbon steel rod to MSS SP69.

#### **2.4 INSULATION PROTECTION SHIELDS**

- .1 Insulated cold piping:
  - .1 64 kg/m<sup>3</sup> density insulation plus insulation protection shield to: MSS SP69, galvanized sheet carbon steel. Length designed for maximum 3 m span.

#### **2.5 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.

#### **2.6 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.

## **2.7 EQUIPMENT SUPPORTS**

- .1 Fabricate equipment supports not provided by equipment manufacturer from structural grade steel. Submit calculations with shop drawings.

## **2.8 EQUIPMENT ANCHOR BOLTS AND TEMPLATES**

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

## **2.9 HOUSE-KEEPING PADS**

- .1 Provide 100 mm high concrete housekeeping pads for base-mounted equipment; size pads 50 mm larger than equipment; chamfer pad edges.

## **Part 3 Execution**

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

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

### **3.2 INSTALLATION**

- .1 Install in accordance with:
  - .1 Manufacturer's instructions and recommendations.
- .2 Vibration Control Devices:
  - .1 Install on piping systems at pumps, boilers, chillers, cooling towers, and as indicated.
- .3 Clamps on riser piping:
  - .1 Support independent of connected horizontal pipework using riser clamps and riser clamp lugs welded to riser.
  - .2 Bolt-tightening torques to industry standards.
  - .3 Steel pipes: install below coupling or shear lugs welded to pipe.
  - .4 Cast iron pipes: install below joint.
- .4 Clevis plates:
  - .1 Attach to concrete with 4 minimum concrete inserts, one at each corner.
- .5 Provide supplementary structural steelwork where structural bearings do not exist or where concrete inserts are not in correct locations.

- .6 Use approved constant support type hangers where:
  - .1 Vertical movement of pipework is 13 mm or more,
  - .2 Transfer of load to adjacent hangers or connected equipment is not permitted.
- .7 Use variable support spring hangers where:
  - .1 Transfer of load to adjacent piping or to connected equipment is not critical.
  - .2 Variation in supporting effect does not exceed 25 % of total load.

### 3.3 HANGER SPACING

- .1 Plumbing piping: to National Plumbing Code of Canada (NPC).
- .2 Copper piping: up to NPS 1/2: every 1.5 m.
- .3 Flexible joint roll groove pipe: in accordance with table below for steel, but not less than one hanger at joints. Table listings for straight runs without concentrated loads and where full linear movement is not required.
- .4 Within 300 mm of each elbow.

Maximum Pipe Size: NPS	Maximum Spacing Steel	Maximum Spacing Copper
up to 1-1/4	2.4 m	1.8 m
1-1/2	3.0 m	2.4 m
2	3.0 m	2.4 m
2-1/2	3.7 m	3.0 m
3	3.7 m	3.0 m
3-1/2	3.7 m	3.3 m
4	3.7 m	3.6 m
5	4.3 m	
6	4.3 m	
8	4.3 m	
10	4.9 m	
12	4.9 m	

- .5 Pipework greater than NPS 12: to MSS SP69.

### 3.4 HANGER INSTALLATION

- .1 Install hanger so that rod is vertical under operating conditions.
- .2 Adjust hangers to equalize load.
- .3 Support from structural members. Where structural bearing does not exist or inserts are not in suitable locations, provide supplementary structural steel members.

### 3.5 HORIZONTAL MOVEMENT

- .1 Angularity of rod hanger resulting from horizontal movement of pipework from cold to hot position not to exceed 4 degrees from vertical.

- .2 Where horizontal pipe movement is less than 13 mm, offset pipe hanger and support so that rod hanger is vertical in the hot position.

### **3.6 FINAL ADJUSTMENT**

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

**END OF SECTION**

## **Part 1        General**

### **1.1            SUMMARY**

- .1    Section Includes:
  - .1    Vibration isolation materials and components, seismic control measures and their installation.

### **1.2            REFERENCE STANDARDS**

- .1    Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1    Safety Data Sheets (SDS)
- .2    National Fire Protection Association (NFPA)
  - .1    NFPA 13-2002, Standard for the Installation of Sprinkler Systems.
- .3    National Research Council Canada (NRC)
  - .1    National Building Code of Canada 2015 (NBC).

## **Part 2        Products**

### **2.1            GENERAL**

- .1    Size and shape of bases type and performance of vibration isolation as indicated.

### **2.2            ELASTOMERIC PADS**

- .1    Type EP1 - neoprene waffle or ribbed; 9 mm minimum thick; 50 durometer; maximum loading 350 kPa.
- .2    Type EP2 - rubber waffle or ribbed; 9 mm minimum thick; 30 durometer natural rubber; maximum loading 415 kPa.
- .3    Type EP3 - neoprene-steel-neoprene; 9 mm minimum thick neoprene bonded to 1.71 mm steel plate; 50 durometer neoprene, waffle or ribbed; holes sleeved with isolation washers; maximum loading 350 kPa.
- .4    Type EP4 - rubber-steel-rubber; 9 mm minimum thick rubber bonded to 1.71 mm steel plate; 30 durometer natural rubber, waffle or ribbed; holes sleeved with isolation washers; maximum loading 415 kPa.

### **2.3            ELASTOMERIC MOUNTS**

- .1    Type M1 - colour coded; neoprene in shear; maximum durometer of 60; threaded insert and two bolt-down holes; ribbed top and bottom surfaces.

### **2.4            SPRINGS**

- .1    Design stable springs: ratio of lateral to axial stiffness is equal to or greater than 1.2 times ratio of static deflection to working height. Select for 50% travel beyond rated load. Units complete with levelling devices.
- .2    Ratio of height when loaded to diameter of spring between 0.8 to 1.0.

- .3 Cadmium plate for 100% relative humidity outdoor installations.
- .4 Colour code springs.

## **2.5 SPRING MOUNT**

- .1 Zinc or cadmium plated hardware; housings coated with rust resistant paint.
- .2 Type M2 - stable open spring: support on bonded 6 mm minimum thick ribbed neoprene or rubber friction and acoustic pad.
- .3 Type M3 - stable open spring: 6 mm minimum thick ribbed neoprene or rubber friction and acoustic pad, bonded under isolator and on isolator top plate; levelling bolt for rigidly mounting to equipment.
- .4 Type M4 - restrained stable open spring: supported on bonded 6 mm minimum thick ribbed neoprene or rubber friction and acoustic pad; built-in resilient limit stops, removable spacer plates.

## **2.6 HANGERS**

- .1 Colour coded springs, rust resistant, painted box type hangers. Arrange to permit hanger box or rod to move through a 30 degrees arc without metal to metal contact.
- .2 Type H1 - neoprene - in-shear, moulded with rod isolation bushing which passes through hanger box.
- .3 Type H2 - stable spring, elastomeric washer, cup with moulded isolation bushing which passes through hanger box.
- .4 Type H3 - stable spring, elastomeric element, cup with moulded isolation bushing which passes through hanger box.
- .5 Type H4 - stable spring, elastomeric element with precompression washer.

## **2.7 HORIZONTAL THRUST RESTRAINT**

- .1 Spring and elastomeric element housed in box frame; assembly complete with rods and angle brackets for equipment and ductwork attachment; provision for adjustment to limit maximum start and stop movement to 9 mm.
- .2 Arrange restraints symmetrically on either side of unit and attach at centerline of thrust.

## **2.8 STRUCTURAL BASES**

- .1 Type B1 - Prefabricated steel base: integrally welded on sizes up to 2400 mm on smallest dimension, split for field welding on sizes over 2400 mm on smallest dimension and reinforced for alignment of drive and driven equipment; without supplementary hold down devices; complete with isolation element attached to base brackets arranged to minimize height; pre-drilled holes to receive equipment anchor bolts; and complete with adjustable built-in motor slide rail where indicated.
- .2 Type B2 - Steel rail base: structural steel, positioned for alignment of drive and driven equipment; without supplementary hold down devices; complete with

isolation element attached to base brackets arranged to minimize height; and pre-drilled holes to receive equipment anchor bolts.

- .3 Bases to clear housekeeping pads by 25 mm minimum.

## **2.9 INERTIA BASE**

- .1 Type B3 - Full depth perimeter structural or formed channels, frames: welded in place reinforcing rods running in both directions; spring mounted, carried by gusseted height-saving brackets welded to frame; and clear housekeeping pads by 50 mm minimum.
- .2 Pump bases: "T" shaped, where applicable, to provide support for elbows.
- .3 Concrete: to Division 03.

## **Part 3 Execution**

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

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

### **3.2 INSTALLATION**

- .1 Seismic control measures to meet requirements of NBC.
- .2 Install vibration isolation equipment in accordance with manufacturers instructions and adjust mountings to level equipment.
- .3 Ensure piping, ducting and electrical connections to isolated equipment do not reduce system flexibility and that piping, conduit and ducting passage through walls and floors do not transmit vibrations.
- .4 Unless indicated otherwise, support piping connected to isolated equipment with spring mounts or spring hangers with 25 mm minimum static deflection as follows:
  - .1 Up to NPS4: first 3 points of support. NPS5 to NPS8: first 4 points of support. NPS10 and Over: first 6 points of support.
  - .2 First point of support: static deflection of twice deflection of isolated equipment, but not more than 50 mm.
- .5 Where isolation is bolted to floor use vibration isolation rubber washers.
- .6 Block and shim level bases so that ductwork and piping connections can be made to rigid system at operating level, before isolator adjustment is made. Ensure that there is no physical contact between isolated equipment and building structure.

**END OF SECTION**



## Part 1 General

### 1.1 REFERENCE STANDARDS

- .1 Canadian General Standards Board (CGSB)
  - .1 CAN/CGSB-1.60, Interior Alkyd Gloss Enamel.
  - .2 CAN/CGSB-24.3, Identification of Piping Systems.

## Part 2 Products

### 2.1 MANUFACTURER'S EQUIPMENT NAMEPLATES

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

### 2.2 SYSTEM NAMEPLATES

- .1 Colours:
  - .1 Hazardous: red letters, white background.
  - .2 Elsewhere: black letters, white background (except where required otherwise by applicable codes).
- .2 Construction:
  - .1 3 mm thick laminated plastic, matte finish, with square corners, letters accurately aligned and machine engraved into core.
- .3 Sizes:
  - .1 Conform to following table:

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

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

- .4 Locations:
  - .1 Terminal cabinets, control panels: use size #5.
  - .2 Equipment in Mechanical Rooms: use size #9.
- .5 Identification for PSPC Preventive Maintenance Support System (PMSS):
  - .1 Use arrangement of Main identifier, Source identifier, Destination identifier.
  - .2 Equipment in Mechanical Room:
    - .1 Main identifier: size #9.
    - .2 Source and Destination identifiers: size #6.
    - .3 Terminal cabinets, control panels: size #5.
  - .3 Equipment elsewhere: sizes as appropriate.

### **2.3 IDENTIFICATION OF PIPING SYSTEMS**

- .1 Identify contents by background colour marking, pictogram (as necessary), legend; direction of flow by arrows. To CAN/CGSB 24.3 except where specified otherwise.
- .2 Pictograms:
  - .1 Where required: Workplace Hazardous Materials Information System (WHMIS) regulations.
- .3 Legend:
  - .1 Block capitals to sizes and colours listed in CAN/CGSB 24.3.
- .4 Arrows showing direction of flow:
  - .1 Outside diameter of pipe or insulation less than 75 mm: 100 mm long x 50 mm high.
  - .2 Outside diameter of pipe or insulation 75 mm and greater: 150 mm long x 50 mm high.
  - .3 Use double-headed arrows where flow is reversible.
- .5 Extent of background colour marking:
  - .1 To full circumference of pipe or insulation.
  - .2 Length to accommodate pictogram, full length of legend and arrows.
- .6 Materials for background colour marking, legend, arrows:
  - .1 Pipes and tubing 20 mm and smaller: waterproof and heat-resistant pressure sensitive plastic marker tags.
  - .2 Other pipes: pressure sensitive vinyl with protective overcoating, waterproof contact adhesive undercoating, suitable for ambient of 100% RH and continuous operating temperature of 150 degrees C and intermittent temperature of 200 degrees C.
- .7 Colours and Legends:
  - .1 Where not listed, obtain direction from 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
Steam _____ kPa	Yellow	_____ kPa STEAM
Steam condensate (gravity)	Yellow	ST.COND.RET (GRAVITY)
Domestic hot water supply	Green	DOM. HW SUPPLY
Domestic cold water supply	Green	DOM. CWS
Sanitary	Green	SAN
Plumbing vent	Green	SAN. VENT
Refrigeration suction	Yellow	REF. SUCTION
Refrigeration liquid	Yellow	REF. LIQUID
Compressed air _____ kPa	Green	COMP. AIR _____ kPa

**2.4 IDENTIFICATION DUCTWORK SYSTEMS**

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

**2.5 VALVES, CONTROLLERS**

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

**2.6 CONTROLS COMPONENTS IDENTIFICATION**

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

**Part 3 Execution**

**3.1 MANUFACTURER'S INSTRUCTIONS**

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

### **3.2 INSTALLATION**

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

### **3.3 NAMEPLATES**

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

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

- .1 On long straight runs in open areas in boiler rooms, equipment rooms, galleries, tunnels: at not more than 17 m intervals and more frequently if required to ensure that at least one is visible from any one viewpoint in operating areas and walking aisles.
- .2 Adjacent to each change in direction.
- .3 At least once in each small room through which piping or ductwork passes.
- .4 On both sides of visual obstruction or where run is difficult to follow.
- .5 On both sides of separations such as walls, floors, partitions.
- .6 Where system is installed in pipe chases, ceiling spaces, galleries, confined spaces, at entry and exit points, and at access openings.
- .7 At beginning and end points of each run and at each piece of equipment in run.
- .8 At point immediately upstream of major manually operated or automatically controlled valves, and dampers. Where this is not possible, place identification as close as possible, preferably on upstream side.
- .9 Identification easily and accurately readable from usual operating areas and from access points.
  - .1 Position of identification approximately at right angles to most convenient line of sight, considering operating positions, lighting conditions, risk of physical damage or injury and reduced visibility over time due to dust and dirt.

### **3.5 VALVES, CONTROLLERS**

- .1 Valves and operating controllers, except at plumbing fixtures, radiation, or where in plain sight of equipment they serve: Secure tags with non-ferrous chains or closed; hooks.

- .2 Install one copy of flow diagrams, valve schedules mounted in frame behind non-glare glass where directed by Departmental Representative. Provide one copy (reduced in size if required) in each operating and maintenance manual.
- .3 Number valves in each system consecutively.

**END OF SECTION**



**Part 1            General**

**1.1                QUALIFICATION OF PERSONNEL IN CHARGE OF TAB OPERATIONS**

- .1        Submit documentation which demonstrates the competence and experience of the personnel.
- .2        The testing, adjusting and balancing operations must be executed according to the standard which controls the qualifications of the company and of the personnel in charge of it.
  - .1        Associated Air Balance Council, (AABC), National Standards for Total System Balance, MN-1.
  - .2        National Environmental Balancing Bureau (NEBB) TABES, Procedural Standards for Testing, Adjusting, Balancing of Environmental Systems.
  - .3        Sheet Metal and Air Conditioning Contractors' National Association (SMACNA), HVAC TAB HVAC Systems - Testing, Adjusting and Balancing.
- .3        TAB operations must be carried out according to the suggested recommendations and practices of the retained standard.
- .4        In order to satisfy the contractual requirements, conform to the provisions of the retained standard which are aimed at TAB operations and use the verification lists and forms offered.
- .5        Conform to the provisions of the retained standard in regards to TAB operations including company and personnel (those in charge of the work) qualifications, and calibration of measurement equipment.
- .6        Conform to manufacturer recommendations for the calibration of measurement equipment when they are more rigorous than those stated in the relative TAB operations standard.
- .7        The provisions of the retained standard concerning quality assurance, notably the warranties related to performance, are an integral part of the contract.
  - .1        In the case of systems or components which are not covered by the retained standard concerning TAB operations, use the methods established by the specialist in charge of the work.
  - .2        When new methods and requirements which are applicable to the contractual requirements and which have been published or enforced by the policy-maker (AABC, NEDD, or TABB), the requirements and recommendations defined are mandatory.

**1.2                GOAL OF TAB OPERATIONS**

- .1        Carry out systems testing to verify whether they function reliably and appropriately, to determine the true operating point and to evaluate the qualitative and quantitative performances of equipments, systems and related command/regulation apparatus, at nominal load, at medium or light load, this load being real or simulated.

- .2 Adjust the equipment and systems such that they respond to the performance requirements prescribed and that they can interact with related systems in the prescribed way, within normal and emergency loading and operating conditions.
- .3 Balance equipment and systems such that the flow corresponds to the load over the entire operating window.

### **1.3 EXCEPTIONS**

- .1 The testing, adjusting and balancing of equipment and systems subject to standards or specific codes must be executed to the satisfaction of the proper authority.

### **1.4 WORKS PERFORMED IN EXISTING BUILDINGS**

- .1 Before the beginning of the works, performed TAB operations on existing systems that may be impacted by the scope of works. TAB operations must determine existing operating conditions to be preserved.
- .2 Once all works are completed, performed TAB operations on these same existing systems in order to determine if the works have impacted unintentionally the existing operating conditions
- .3 If needed, rebalance the existing systems in order to recover the initial operating conditions.

### **1.5 COORDINATION**

- .1 Schedule time, within the construction work calendar, for trial operations and for the adjustment and balancement of systems (including fixes and reworks) which need to be done before the work is handed over.
- .2 Test-drive, adjust and balance each distinct system then repeat for each system with respect to related systems, in the case of systems with control mechanisms.

### **1.1 REVIEW OF TERMS IN CONTRACTUAL DOCUMENTS RELATED TO TAB OPERATION**

- .1 Review contractual documents before the start of construction work and confirm in writing to the Engineer that the provisions regarding testing, adjusting and balancing of equipment and systems, as well as all other aspects relating to their conception and installation are appropriate and will ensure the success of these operations.
- .2 Review standards and other prescribed reference documents and inform the Engineer in writing of the proposed methods in the contractual documents which differ from those described in the standards or reference documents.
- .3 During construction work, coordinate the location as well as the installation or layout of the devices, equipment and accessories and of the openings and gauging fittings necessary to execute TAB operations.
- .4 Follow any specific start-up procedure prescribed elsewhere.

**1.6 OPERATION OF EQUIPMENT AND SYSTEMS DURING TAB ACTIVITIES**

- .1 Run equipment and systems for the required period for the execution of TAB activities and for the verification of TAB reports by the Engineer.

**1.7 BEGINNING OF TAB OPERATION**

- .1 Only proceed with TAB operations when the building is, for the most part, serviceable:
  - .1 The construction of ceilings and the installation of doors, windows and other elements which can have an influence on the results of the TAB operations are completed;
  - .2 The installation of weather-tight products, caulks and weather strips is completed;
  - .3 Trials for pressure, weather-tightness and others prescribed in Section 23 are completed;
  - .4 The material necessary to the execution of TAB operations is installed and ready to run;
  - .5 The mechanical installations and the electrical and related command/regulation systems, which can impact the results of the TAB operations, are running and the following items in regards to proper operation are verified:
    - .1 Thermal protection of electrical equipment against overloads;
    - .2 Aeraulic networks:
      - .1 filters are in place and clean;
      - .2 air ducts are clean;
      - .3 ducts, shafts and plenums are air-tight, within the specified limits;
      - .4 fans are rotating in the proper direction;
      - .5 volumetric dampers and fire-protection shutters are in place and open;
      - .6 coil corrugations are clean and straightened;
      - .7 inspection doors and panels are installed and closed;
      - .8 Exhaust openings are installed and volumetric dampers are open.

**1.8 ADJUSTMENT DIFFERENCES FROM THEORETICAL VALUES**

- .1 Carry out testing, adjusting and balancing of systems until the difference are no larger than the following values:
- .2 HVAC Systems: plus 10 %, minus 0 %.

**1.9 DIFFERENCE BETWEEN MEASURED AND REAL VALUES**

- .1 Measured values must correspond to more or less 2 % of real values.

**1.10 MEASUREMENTS INSTRUMENTS**

- .1 Before starting TAB operations, submit the list of instruments that will be used to the Engineer and include their serial numbers.
- .2 Calibrate the instruments in compliance with the requirements of the standard or reference document, whichever is most rigorous in regards to HVAC systems or to those submitted to TAB operations.
- .3 Calibrate instruments within the three (3) months preceding the start of TAB operations. Submit a calibration attestation to the Engineer.

**1.11 DOCUMENTS/SAMPLES TO SUBMIT**

- .1 Before proceeding with TAB operations, submit the following:
- .2 The proposed method to test, adjust and balance the systems if it differs from the method described in the standard or reference document retained.

**1.12 TAB REPORT**

- .1 The presentation of the report must comply with the requirements of the standard or reference document retained regarding TAB operations.
- .2 The results expressed in the report must be in SI units. The report must contain the following:
  - .1 The drawings to keep in the project's folder.
  - .2 The schematic diagrams of the targeted systems.
- .3 Submit to the engineer, for verification and approbation purposes, the TAB report, in French, in electronic format.

**1.13 DATA VERIFICATION**

- .1 The recorded measurements are likely to be checked by the Engineer.
- .2 Anticipate sufficient personnel and instruments for the verification of, at most, 5% of recorded measurements.
- .3 The Engineer will determine the number of verifications to conduct and the location of gauging points.
- .4 Rerun testing, adjusting and balancing operations until the results are to the satisfaction of the Engineer, and assume the fees for such tasks.

**1.14 CONTROLS**

- .1 Once the TAB operations are completed to the Engineer's satisfaction, reinstall the protective guards on the driving mechanism or transmission device, close the inspection doors and traps, block the control devices in their operating positions and verify whether the sensors are fixed at the required set points.
- .2 Permanently mark the control positions; these must not be erased or covered in any way.

**1.15 END OF TAB OPERATIONS**

- .1 The testing, adjusting and balancing operations of the systems will only be considered as complete when the final report will have been approved by the Engineer.

**1.16 AERAULIC SYSTEMS**

- .1 TAB operations must be executed in compliance with the most rigorous requirements stated in either the present section or in the standards and relevant reference documents from the AABC, NEBB, SMACNA and ASHRAE.
- .2 Proceed with testing, adjusting and balancing of systems, equipment, elements, and command/regulation devices specified in Division 23.
- .3 The persons in charge of executing TAB operations must be entitled to provide the specified services, according to the standards of the AABC or NEBB.
- .4 Testing, adjusting and balancing operations on the systems msut be done under the direction of a supervisor entitled to provide the specified services, according to the standards of the AABC or NEBB.
- .5 The surveys to be done will address the following, according to the systems, equipment, elements or command/regulation devices targeted: air speed, static pressure, flow, head loss, temperature (dry bulb, wet bulb, dew point), air duct cross-section, rotation speed, demand set-up, pressure.
- .6 Depending on the situation, measuring points, in the case of systems, will be situated in the following locations: primary and secondary air ducts, supply ducts of terminal elements (grilles, damper or diffuser grilles).

**Part 2 Products**

**2.1 NOT USED**

**Part 3 Execution**

**3.1 NOT USED**

**END OF SECTION**



**Part 1            General**

**1.1                REFERENCE STANDARDS**

- .1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
  - .1 ANSI/ASHRAE/IESNA 90.1-04, SI; Energy Standard for Buildings Except Low-Rise Residential Buildings.
- .2 ASTM International (ASTM)
  - .1 ASTM B209M-07, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric).
  - .2 ASTM C335-05ae1, Standard Test Method for Steady State Heat Transfer Properties of Pipe Insulation.
  - .3 ASTM C411-05, Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
  - .4 ASTM C449/C449M-00, Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.
  - .5 ASTM C547-07e1, Standard Specification for Mineral Fiber Pipe Insulation.
  - .6 ASTM C553-02e1, Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
  - .7 ASTM C612-04e1, Standard Specification for Mineral Fiber Block and Board Thermal Insulation.
  - .8 ASTM C795-03, Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
  - .9 ASTM C921-03a, Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
- .3 Canadian General Standards Board (CGSB)
  - .1 CGSB 51-GP-52Ma-89, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
- .4 Green Seal Environmental Standards (GSES)
  - .1 Standard GS-36-00, Commercial Adhesives.
- .5 South Coast Air Quality Management District (SCAQMD), California State
  - .1 SCAQMD Rule 1168-A2005, Adhesive and Sealant Applications.
- .6 Thermal Insulation Association of Canada (TIAC): National Insulation Standards (2005).
- .7 Underwriters Laboratories of Canada (ULC)
  - .1 CAN/ULC-S102-03, Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.

- .2 CAN/ULC-S701-05, Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering.

## 1.2 DEFINITIONS

- .1 For purposes of this section:
  - .1 "CONCEALED" - insulated mechanical services and equipment in suspended ceilings and non-accessible chases and furred-in spaces.
  - .2 "EXPOSED" - means "not concealed" as previously defined.
  - .3 Insulation systems - insulation material, fasteners, jackets, and other accessories.
- .2 TIAC Codes:
  - .1 CRD: Code Round Ductwork,
  - .2 CRF: Code Rectangular Finish.

## Part 2 Products

### 2.1 FIRE AND SMOKE RATING

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

### 2.2 INSULATION

- .1 Mineral fibre: as specified includes glass fibre, rock wool, slag wool.
  - .1 Recycled content: (Post-Consumer + ½ Post-Industrial).
- .2 Thermal conductivity ("k" factor) not to exceed specified values at 24 degrees C mean temperature when tested in accordance with ASTM C335.
- .3 TIAC Code C-1: Rigid mineral fibre board to ASTM C612, with factory applied vapour retarder jacket to CGSB 51-GP-52Ma (as scheduled in PART 3 of this Section).

### 2.3 JACKETS

- .1 Self-adhesive jacket Rubberized bitumen membrane covered with an aluminum vapor barrier for outdoor installation, overlapped joints.
- .2 Installation on ventilation duct insulation.
- .3 Installation according to manufacturer's recommendations

### 2.4 ACCESSORIES

- .1 Vapour retarder lap adhesive:
  - .1 Water based, fire retardant type, compatible with insulation.

- .1 Maximum VOC limit 200 g/L to SCAQMD Rule 1168.
- .2 Indoor Vapour Retarder Finish:
  - .1 Vinyl emulsion type acrylic, compatible with insulation.
- .3 Tape: self-adhesive, aluminum, reinforced, 75 mm wide minimum.

**Part 3 Execution**

**3.1 APPLICATION**

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

**3.2 PRE-INSTALLATION REQUIREMENTS**

- .1 Pressure test ductwork systems complete, witness and certify.
- .2 Ensure surfaces are clean, dry, free from foreign material.

**3.3 INSTALLATION**

- .1 Install in accordance with TIAC National Standards.
- .2 Apply materials in accordance with manufacturers instructions and as indicated.
- .3 Use 2 layers with staggered joints when required nominal thickness exceeds 75 mm.
- .4 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.
  - .1 Ensure hangers, and supports are outside vapour retarder jacket.
- .5 Hangers and supports in accordance with [Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment].
  - .1 Apply high compressive strength insulation where insulation may be compressed by weight of ductwork.
- .6 Fasteners: install at 300 mm on centre in horizontal and vertical directions, minimum 2 rows each side.

**3.4 DUCTWORK INSULATION SCHEDULE**

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

TIAC Code	Vapour Retarder	Thickness (mm)	
Outside air ducts to mixing plenum	C-1	yes	25
Mixing plenums	C-1	yes	25
Exhaust duct between dampers and louvres	C-1	yes	25

**3.5 CLEANING**

- .1 Clean in accordance with Section 01 74 00 - Cleaning.
  - .1 Remove surplus materials, excess materials, rubbish, tools and equipment.
- .2 Waste Management: separate waste materials for recycling in accordance with Section 01 74 19 - Waste Management and Disposal.

**END OF SECTION**

**Part 1            General**

**1.1                REFERENCE STANDARDS**

- .1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
  - .1 ASHRAE Standard 90.1, Energy Standard for Buildings Except Low-Rise Residential Buildings (IESNA co-sponsored; ANSI approved; Continuous Maintenance Standard).
- .2 ASTM International (ASTM)
  - .1 ASTM B209M, Standard Specification for Aluminum and Aluminum Alloy Sheet and Plate [Metric].
  - .2 ASTM C335, Standard Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.
  - .3 ASTM C411, Standard 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 C533, Calcium Silicate Block and Pipe Thermal Insulation.
  - .6 ASTM C547, Mineral Fiber Pipe Insulation.
  - .7 ASTM C795, Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
  - .8 ASTM C921, Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
- .3 Canadian General Standards Board (CGSB)
  - .1 CGSB 51-GP-52Ma, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
  - .2 CAN/CGSB-51.53, Poly (Vinyl Chloride) Jacketing Sheet, for Insulated Pipes, Vessels and Round Ducts
- .4 Department of Justice Canada (Jus)
  - .1 Canadian Environmental Assessment Act (CEAA), 1995, c. 37.
  - .2 Canadian Environmental Protection Act (CEPA), 1999, c. 33.
  - .3 Transportation of Dangerous Goods Act (TDGA), 1992, c. 34.
- .5 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 Safety Data Sheets (SDS).
- .6 Manufacturer's Trade Associations
  - .1 Thermal Insulation Association of Canada (TIAC): National Insulation Standards (Revised 2004).

- .7 Underwriters' Laboratories of Canada (ULC)
  - .1 CAN/ULC-S102, Surface Burning Characteristics of Building Materials and Assemblies.
  - .2 CAN/ULC-S701, Thermal Insulation, Polystyrene, Boards and Pipe Covering.
  - .3 CAN/ULC-S702, Thermal Insulation, Mineral Fibre, for Buildings
  - .4 CAN/ULC-S702.2, Thermal Insulation, Mineral Fibre, for Buildings, Part 2: Application Guidelines.

## 1.2 DEFINITIONS

- .1 For purposes of this section:
  - .1 "CONCEALED" - insulated mechanical services in suspended ceilings and non-accessible chases and furred-in spaces.
  - .2 "EXPOSED" - will mean "not concealed" as specified.
- .2 TIAC ss:
  - .1 CRF: Code Rectangular Finish.
  - .2 CPF: Code Piping Finish.

## Part 2 Products

### 2.1 FIRE AND SMOKE RATING

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

### 2.2 INSULATION

- .1 Mineral fibre specified includes glass fibre, rock wool, slag wool.
- .2 Thermal conductivity ("k" factor) not to exceed specified values at 24 degrees C mean temperature when tested in accordance with ASTM C335.
- .3 TIAC Code A-1: rigid moulded mineral fibre without factory applied vapour retarder jacket.
  - .1 Mineral fibre: to CAN/ULC-S702 and ASTM C547.
  - .2 Maximum "k" factor: to CAN/ULC-S702.
- .4 TIAC Code A-3: rigid moulded mineral fibre with factory applied vapour retarder jacket.
  - .1 Mineral fibre: to CAN/ULC-S702 and ASTM C547.
  - .2 Jacket: to CGSB 51-GP-52Ma.
  - .3 Maximum "k" factor: to ASTM C547 and CAN/ULC-S702.

- .5 TIAC Code A-6: flexible unicellular tubular elastomer.
  - .1 Insulation: with vapour retarder jacket.
  - .2 Jacket: to CGSB 51-GP-52Ma.
  - .3 Certified by manufacturer: free of potential stress corrosion cracking corrodants.

### **2.3 INSULATION SECUREMENT**

- .1 Tape: self-adhesive, aluminum, reinforced, 50 mm wide minimum.
- .2 Contact adhesive: quick setting.
- .3 Canvas adhesive: washable.
- .4 Tie wire: 1.5 mm diameter stainless steel.
- .5 Bands: stainless steel, 19 mm wide, 0.5 mm thick.

### **2.4 CEMENT**

- .1 Thermal insulating and finishing cement:
  - .1 Air drying on mineral wool, to ASTM C449/C449M.

### **2.5 VAPOUR RETARDER LAP ADHESIVE**

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

### **2.6 INDOOR VAPOUR RETARDER FINISH**

- .1 Vinyl emulsion type acrylic, compatible with insulation.

### **2.7 OUTDOOR VAPOUR RETARDER FINISH**

- .1 Vinyl emulsion type acrylic, compatible with insulation.
- .2 Reinforcing fabric: fibrous glass, untreated 305 g/m<sup>2</sup>.

### **2.8 JACKETS**

- .1 Polyvinyl Chloride (PVC):
  - .1 One-piece moulded type and sheet to CAN/CGSB-51.53 with pre-formed shapes as required.
  - .2 Colours: to match adjacent finish paint by Departmental Representative.
  - .3 Minimum service temperatures: -20 degrees C.
  - .4 Maximum service temperature: 65 degrees C.
  - .5 Moisture vapour transmission: 0.02 perm.
  - .6 Fastenings:
    - .1 Use solvent weld adhesive compatible with insulation to seal laps and joints.
    - .2 Tacks.
    - .3 Pressure sensitive vinyl tape of matching colour.

- .7 Special requirements:
  - .1 Outdoor: UV rated material at least 0.5 mm thick.
- .2 Aluminum:
  - .1 To ASTM B209.
  - .2 Thickness: 0.50 mm sheet.
  - .3 Finish: corrugated.
  - .4 Joining: longitudinal and circumferential slip joints with 50 mm laps.
  - .5 Fittings: 0.5 mm thick die-shaped fitting covers with factory-attached protective liner.
  - .6 Metal jacket banding and mechanical seals: stainless steel, 19 mm wide, 0.5 mm thick at 300 mm spacing.

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

- .1 Caulking to: Section 07 92 00 - Joint Sealants.

## **Part 3 Execution**

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

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

### **3.2 PRE-INSTALLATION REQUIREMENT**

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

### **3.3 INSTALLATION**

- .1 Install in accordance with TIAC National Standards.
- .2 Apply materials in accordance with manufacturers instructions and this specification.
- .3 Use two layers with staggered joints when required nominal wall thickness exceeds 75 mm.
- .4 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.
  - .1 Install hangers, supports outside vapour retarder jacket.
- .5 Supports, Hangers:
  - .1 Apply high compressive strength insulation, suitable for service, at oversized saddles and shoes where insulation saddles have not been provided.

**3.4 INSTALLATION OF ELASTOMERIC INSULATION**

- .1 Insulation to remain dry. Overlaps to manufacturers instructions. Ensure tight joints.
- .2 Provide vapour retarder as recommended by manufacturer.

**3.5 PIPING INSULATION SCHEDULES**

- .1 Includes valves, valve bonnets, strainers, flanges and fittings unless otherwise specified.
- .2 TIAC Code: A-1.
  - .1 Securements: SS bands at 300 mm on centre.
  - .2 Seals: lap seal adhesive, lagging adhesive.
  - .3 Installation: TIAC Code 1501-H.
- .3 TIAC Code: A-6.
  - .1 Seals: lap seal adhesive, lagging adhesive.
  - .2 Installation: TIAC Code.
- .4 TIAC Code: C-2 with vapour retarder jacket.
  - .1 Seals: lap seal adhesive, lagging adhesive.
  - .2 Installation: TIAC Code: 1501-C.
- .5 Thickness of insulation as listed in following table.
  - .1 Run-outs to individual units and equipment not exceeding 4000 mm long.
  - .2 Do not insulate exposed runouts to plumbing fixtures, chrome plated piping, valves, fittings.

Applica-tion	Temp degrees C	TIAC code	Pipe sizes (NPS) and insulation thickness (mm)					
Run out	to 1	1 1/4 to 2	2 1/2 to 4	5 to 6	8 & over			
Steam	up to 175	A-1	38	50	65	75	90	90
Domestic HWS	A-1	25	25	25	38	38	38	
Domestic CWS with vapour retarder	C-2	25	25	25	25	25	25	
Refrigerant suction liquid hot gas	4 - 13	A-6	25	25	25	25	25	25

Refrigerant suction liquid hot gas	below 4	A-6	25	25	38	38	38	38
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.6 Finishes:

- .1 Exposed indoors: PVC jacket.
- .2 Outdoors: water-proof aluminum jacket.
- .3 Installation: to appropriate TIAC code CRF/1 through CPF/5.

**3.6 FIELD QUALITY CONTROL**

.1 Verification requirements in accordance with Section 01 33 29 - Sustainable Design Reporting, include:

- .1 Materials and resources.
- .2 Storage and collection of recyclables.
- .3 Construction waste management.
- .4 Resource reuse.
- .5 Recycled content.
- .6 Local/regional materials.
- .7 Certified wood.
- .8 Low-emitting materials.

**3.7 REMOVABLE, PRE-FABRICATED, INSULATION AND ENCLOSURES**

- .1 Application: at expansion joints, valves, flanges and unions at equipment and other accessories.
- .2 Design: to permit movement of expansion joint and to permit periodic removal and replacement without damage to adjacent insulation.
- .3 Insulation:
  - .1 Insulation, fastenings and finishes: same as system.
  - .2 Jacket: PVC.

**3.8 CLEANING**

- .1 Proceed in accordance with Section 01 74 00 - Cleaning.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

**END OF SECTION**

**Part 1        General**

**1.1        REFERENCE STANDARDS**

- .1 ASME
  - .1 ASME B16.22, Wrought Copper and Copper Alloy Solder - Joint Pressure Fittings.
  - .2 ASME B16.24, Cast Copper Pipe Flanges and Flanged Fittings: Class 150, 300, 600, 900, 1500 and 2500.
  - .3 ASME B16.26, Cast Copper Alloy Fittings for Flared Copper Tubes.
  - .4 ASME B31.5, Refrigeration Piping and Heat Transfer Components.
- .2 ASTM International (ASTM)
  - .1 ASTM A307, Standard Specification for Carbon Steel Bolts and Studs, and Threaded Rod 60,000 PSI Tensile Strength.
  - .2 ASTM B280, Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.
- .3 CSA Group (CSA)
  - .1 CSA B52, B52 Package, Mechanical Refrigeration Code.
- .4 Environment Canada (EC)
  - .1 EPS 1/RA/1, Environmental Code of Practice for the Elimination of Fluorocarbon Emissions from Refrigeration and Air Conditioning Systems.

**Part 2        Products**

**2.1        TUBING**

- .1 Processed for refrigeration installations, deoxidized, dehydrated and sealed.
  - .1 Hard copper: to ASTM B280, type ACR.
  - .2 Annealed copper: to ASTM B280, with minimum wall thickness as per CSA B52 and ASME B31.5.

**2.2        FITTINGS**

- .1 Service: design pressure 2070 kPa and temperature 121 degrees C.
- .2 Brazed:
  - .1 Fittings: wrought copper to ASME B16.22.
  - .2 Joints: silver solder, 15 % Ag-80 % Cu-5 %P, copper-phosphorous, 95 % Cu-5 %P and non-corrosive flux.
- .3 Flanged:
  - .1 Bronze or brass, to ASME B16.24, Class 150 and Class 300.
  - .2 Gaskets: suitable for service.
  - .3 Bolts, nuts and washers: to ASTM A307, heavy series.

- .4 Flared:
  - .1 Bronze or brass, for refrigeration, to ASME B16.26.

### **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 refrigerant piping 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 MANUFACTURER'S INSTRUCTIONS**

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

#### **3.3 GENERAL**

- .1 Install in accordance with CSA B52, EPS1/RA/1 and ASME B31.5 Section 23 05 05 - Installation of Pipework.

#### **3.4 BRAZING PROCEDURES**

- .1 Bleed inert gas into pipe during brazing.
- .2 Remove valve internal parts, solenoid valve coils, sight glass.
- .3 Do not apply heat near expansion valve and bulb.

#### **3.5 PIPING INSTALLATION**

- .1 General:
  - .1 Hard drawn copper tubing: do not bend. Minimize use of fittings.
- .2 Hot gas lines:
  - .1 Pitch at least 1:240 down in direction of flow to prevent oil return to compressor during operation.
  - .2 Provide trap at base of risers greater than 2400 mm high and at each 7600 mm thereafter.
  - .3 Provide inverted deep trap at top of risers.
  - .4 Provide double risers for compressors having capacity modulation.
    - .1 Large riser: install traps as specified.

- .2 Small riser: size for 5.1 m<sup>3</sup>/s at minimum load. Connect upstream of traps on large riser.

### **3.6 PRESSURE AND LEAK TESTING**

- .1 Close valves on factory charged equipment and other equipment not designed for test pressures.
- .2 Leak test to CSA B52 before evacuation to 2 MPa and 1 MPa on high and low sides respectively.
- .3 Test procedure: build pressure up to 35 kPa with refrigerant gas on high and low sides. Supplement with nitrogen to required test pressure. Test for leaks with electronic or halide detector. Repair leaks and repeat tests.

### **3.7 FIELD QUALITY CONTROL**

- .1 Site Tests/Inspection:
  - .1 Close service valves on factory charged equipment.
  - .2 Ambient temperatures to be at least 13 degrees C for at least 12 hours before and during dehydration.
  - .3 Use copper lines of largest practical size to reduce evacuation time.
  - .4 Use two-stage vacuum pump with gas ballast on 2nd stage capable of pulling 5 Pa absolute and filled with dehydrated oil.
  - .5 Measure system pressure with vacuum gauge. Take readings with valve between vacuum pump and system closed.
  - .6 Triple evacuate system components containing gases other than correct refrigerant or having lost holding charge as follows:
    - .1 Twice to 14 Pa absolute and hold for 4 hours.
    - .2 Break vacuum with refrigerant to 14 kPa.
    - .3 Final to 5 Pa absolute and hold for at least 12 hours.
    - .4 Isolate pump from system, record vacuum and time readings until stabilization of vacuum.
    - .5 Submit test results to Departmental Representative.
- .7 Charging:
  - .1 Charge system through filter-drier and charging valve on high side. Low side charging not permitted.
  - .2 With compressors off, charge only amount necessary for proper operation of system. If system pressures equalize before system is fully charged, close charging valve and start up. With unit operating, add remainder of charge to system.
  - .3 Re-purge charging line if refrigerant container is changed during charging process.

- .8 Checks:
  - .1 Make checks and measurements as per manufacturer's operation and maintenance instructions.
  - .2 Record and report measurements to Departmental Representative.
- .9 Manufacturer's Field Services:
  - .1 Have manufacturer of products, supplied under this Section, review Work involved in the handling, installation/application, protection and cleaning, of its products and submit written reports, in acceptable format, to verify compliance of Work with Contract.
  - .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
  - .3 Schedule site visits, to review Work, at stages listed:
    - .1 After delivery and storage of products, and when preparatory Work, or other Work, on which the Work of this Section depends, is complete but before installation begins.
    - .2 Twice during progress of Work at 25 % and 60 % complete.
    - .3 Upon completion of the Work, after cleaning is carried out.
  - .4 Obtain reports, within 3 days of review, and submit, immediately, to Departmental Representative.

**3.8 DEMONSTRATION**

- .1 Instructions:
  - .1 Post instructions in frame with glass cover in accordance with Section 01 78 00 - Closeout Submittals and CSA B52.

**3.9 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - 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 00 - Cleaning.

**END OF SECTION**

## Part 1 General

### 1.1 REFERENCE STANDARDS

- .1 American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)
- .2 ASTM International (ASTM)
  - .1 ASTM A480/A480M-12, Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet and Strip.
  - .2 ASTM A635/A635M-09b, Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Hot-Rolled, Alloy, Carbon, Structural, High-Strength Low-Alloy, and High-Strength Low-Alloy with Improved Formability, General Requirements for.
  - .3 ASTM A653/A653M-11, Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.
- .3 Green Seal Environmental Standards (GS)
  - .1 GS-36-[11], Standard for Adhesives for Commercial Use.
- .4 National Fire Protection Association (NFPA)
  - .1 NFPA 90A-[12], Standard for the Installation of Air-Conditioning and Ventilating Systems.
  - .2 NFPA 90B-[12], Standard for the Installation of Warm Air Heating and Air-Conditioning Systems.
  - .3 NFPA 96-[11], Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.
- .5 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)
  - .1 SMACNA HVAC Duct Construction Standards - Metal and Flexible, [2005].
  - .2 SMACNA HVAC Air Duct Leakage Test Manual, 2012.
  - .3 IAQ Guideline for Occupied Buildings Under Construction 2007.
- .6 South Coast Air Quality Management District (SCAQMD), California State, Regulation XI. Source Specific Standards
  - .1 SCAQMD Rule 1168-A2005, Adhesives and Sealants Applications.

## Part 2 Products

### 2.1 SEAL CLASSIFICATION

- .1 Classification as follows:

Maximum Pressure Pa	SMACNA Seal Class
>500	A
250	B
125	C
<125	Unsealed

- .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] [tape] [or combination thereof].
  - .3 Class C: transverse joints and connections made air tight with [tape] [sealant] [gaskets] [or combination thereof]. Longitudinal seams unsealed.
  - .4 Unsealed seams and joints.

## 2.2 SEALANT

- .1 Sustainability Characteristics:
  - .1 Adhesives and sealants: in accordance with Section 07 92 00 - Joint Sealants.
  - .2 Adhesives and sealants: VOC limit 250 g/L maximum to SCAQMD Rule 1168.
- .2 Sealant: oil resistant, polymer type flame resistant duct sealant. Temperature range of minus 30 degrees C to plus 93 degrees C.

## 2.3 TAPE

- .1 Tape: polyvinyl treated, open weave fiberglass tape, 50 mm wide.

## 2.4 DUCT LEAKAGE

- .1 In accordance with SMACNA HVAC Air Duct Leakage Test Manual.

## 2.5 FITTINGS

- .1 Fabrication: to SMACNA.
- .2 Radiused elbows:
  - .1 Rectangular: standard radius.
  - .2 Round: centreline radius: 1.5 times diameter.
- .3 Branches:
  - .1 Rectangular main and branch: with 45 degrees entry on branch.
  - .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.
- .4 Transitions:
  - .1 Diverging: 20 degrees maximum included angle.
  - .2 Converging: 30 degrees maximum included angle.
- .5 Offsets:
  - .1 As indicated radiused elbows.

- .6 Obstruction deflectors: maintain full cross-sectional area.
  - .1 Maximum included angles: as for transitions.

## 2.6 FIRE STOPPING

- .1 Retaining angles around duct, on both sides of fire separation in accordance with Section 07 84 00 - Fire Stopping.
- .2 Coordinate with 07 84 00 - Fire Stopping to ensure fire stopping materials and installation does not distort duct.

## 2.7 GALVANIZED STEEL

- .1 Lock forming quality: to ASTM A653/A653M, Z90 zinc coating.
- .2 Thickness, fabrication and reinforcement: to SMACNA.
- .3 Joints: to SMACNA. Proprietary manufactured flanged duct joint to be considered to be a class A seal.
- .4 Equipped with a conductive metal wire.

## 2.8 HANGERS AND SUPPORTS

- .1 Hangers and Supports: in accordance with Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.
  - .1 Strap hangers: of same material as duct.
    - .1 Maximum size duct supported by strap hanger: 500.
  - .2 Hanger configuration: to SMACNA.
  - .3 Hangers: galvanized steel angle with galvanized 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].
  - .3 For steel beams: manufactured beam clamps:

## Part 3 Execution

### 3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for metal duct installation in accordance with manufacturer's written instructions.

- .1 Visually inspect substrate in presence of 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 GENERAL**

- .1 Do work in accordance with NFPA 90A, NFPA 90B, ASHRAE, SMACNA and as indicated.
- .2 Do not break continuity of insulation vapour barrier with hangers or rods.
  - .1 Insulate strap hangers 100 mm beyond insulated duct. Ensure diffuser is fully seated.
- .3 Support risers in accordance with SMACNA, ASHRAE and as indicated.
- .4 Install breakaway joints in ductwork on sides of fire separation.
- .5 Install proprietary manufactured flanged duct joints in accordance with manufacturer's instructions.
- .6 Manufacture duct in lengths and diameter to accommodate installation of acoustic duct lining.

**3.3 HANGERS**

- .1 Strap hangers: install in accordance with SMACNA.
- .2 Angle hangers: complete with locking nuts and washers.
- .3 Hanger spacing: in accordance with as follows:

Duct Size (mm)	Spacing (mm)
to 1500	3000
1501 and over	2500

**3.4 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 1 coat of sealant to manufacturers 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 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 test before performance insulation or concealment Work.

### **3.6 WATERTIGHT DUCT**

- .1 Provide watertight duct for:
  - .1 Fresh air intake.
  - .2 Minimum 3000 mm from duct mounted humidifier in all directions.
  - .3 As indicated.
- .2 Form bottom of horizontal duct without longitudinal seams.
  - .1 Solder or Weld joints of bottom and side sheets.
  - .2 Seal other joints with duct sealer.

### **3.7 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - 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 00 - Cleaning.
- .3 Waste Management: separate waste materials for recycling in accordance with Section 01 74 00 - Cleaning.

**END OF SECTION**



**Part 1        General**

**1.1            REFERENCE STANDARDS**

- .1 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)
  - .1 SMACNA - HVAC Duct Construction Standards - Metal and Flexible, 2005.

**Part 2        Products**

**2.1            GENERAL**

- .1 Manufacture in accordance with SMACNA - HVAC Duct Construction Standards.

**2.2            FLEXIBLE CONNECTIONS**

- .1 Frame: galvanized sheet metal frame with fabric clenched by means of double locked seams.
- .2 Material:
  - .1 Fire resistant, self extinguishing, neoprene coated glass fabric, temperature rated at minus 40 degrees C to plus 90 degrees C, density of 1.3 kg/m<sup>2</sup>.

**2.3            ACCESS DOORS IN DUCTS**

- .1 Non-Insulated Ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.6 mm thick complete with sheet metal angle frame.
- .2 Insulated Ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.6 mm thick complete with sheet metal angle frame and 25 mm thick rigid glass fibre insulation.
- .3 Gaskets: neoprene.
- .4 Hardware:
  - .1 Up to 300 x 300 mm: two sash locks complete with safety chain.
  - .2 301 to 450 mm: four sash locks [complete with safety chain].
  - .3 451 to 1000 mm: piano hinge and minimum two sash locks.
  - .4 Doors over 1000 mm: piano hinge and two handles operable from both sides.
  - .5 Hold open devices.

**2.4            TURNING VANES**

- .1 Factory or shop fabricated single thickness, to recommendations of SMACNA and as indicated.

**2.5 INSTRUMENT TEST**

- .1 1.6 mm thick steel zinc plated after manufacture.
- .2 Cam lock handles with neoprene expansion plug and handle chain.
- .3 28 mm minimum inside diameter. Length to suit insulation thickness.
- .4 Neoprene mounting gasket.

**2.6 SPIN-IN COLLARS**

- .1 Conical galvanized sheet metal spin-in collars with lockable butterfly damper.
- .2 Sheet metal thickness to co-responding round duct standards.

**Part 3 Execution**

**3.1 EXAMINATION**

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for air duct accessories installation in accordance with manufacturer's written instructions.
  - .1 Visually inspect substrate in presence of Consultant.
  - .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 Flexible Connections:
  - .1 Install in following locations:
    - .1 Inlets and outlets to supply air units and fans.
    - .2 Inlets and outlets of exhaust and return air fans.
    - .3 As indicated.
  - .2 Length of connection: 100 mm.
  - .3 Minimum distance between metal parts when system in operation: 75 mm.
  - .4 Install in accordance with recommendations of SMACNA.
  - .5 Install a flat metal braid on either side of the flexible cuff for mass continuity
  - .6 When fan is running:
    - .1 Ducting on sides of flexible connection to be in alignment.
    - .2 Ensure slack material in flexible connection.
- .2 Instrument Test Ports:
  - .1 General:
    - .1 Install in accordance with recommendations of SMACNA and in accordance with manufacturer's instructions.

- .2 Locate to permit easy manipulation of instruments.
- .3 Install insulation port extensions as required.
- .4 Locations:
  - .1 For traverse readings:
    - .1 Ducted inlets to roof and wall exhausters.
    - .2 Inlets and outlets of other fan systems.
    - .3 Main and sub-main ducts.
    - .4 And as indicated.
  - .2 For temperature readings:
    - .1 At outside air intakes.
    - .2 In mixed air applications in locations as approved by Consultant.
    - .3 At inlet and outlet of coils.
    - .4 Downstream of junctions of two converging air streams of different temperatures.
    - .5 And as indicated.
- .3 Turning Vanes:
  - .1 Install in accordance with recommendations of SMACNA and as indicated.

### 3.3 **CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - 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 00 - Cleaning.
- .3 Waste Management: separate waste materials for recycling in accordance with Section 01 74 19 - 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            REFERENCE STANDARDS**

- .1        ASTM International (ASTM)
  - .1        ASTM A653/A653M-11, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by Hot-Dip Process.

**Part 2        Products**

**2.1            MULTI-LEAF DAMPERS**

- .1        Factory made of the same material as the air duct.
- .2        Opposite blades made of 16 gauge sheet metal with a maximum height of 100 mm (4 ") and in configuration in accordance with SMACNA recommendations.
- .3        Bearings: self-lubricating bronze bearings.
- .4        Control linkage: shaft extension with locking sector.
- .5        Corner frame with corner stop.
- .6        Performance:
  - .1        Leakage: in closed position less than 2% of rated air flow at 500 Pa differential across damper.
  - .2        Pressure drop: at full open position less than 25 Pa differential across damper.

**2.2            BACK DRAFT DAMPERS**

- .1        Automatic gravity operated, leaf, steel construction with nylon bearings, counterweighted.

**2.3            MOTORIZED DAMPER WITH THERMAL INSULATION**

- .1        Extruded aluminum frame with rigid insulation on the inside and thermal break.
- .2        Extruded aluminum blades (6063T5) with rigid thermal insulation and rubber trim (blades and sides).
- .3        Linkage outside air flow, aluminum and corrosion resistant materials.
- .4        Operating ducts from - 40 to 71 ° C (- 40 to 160 ° F), maximum leakage of 41 l/s/m<sup>2</sup> (8 pcm / ft ca) for a static pressure of 1 kPa (4 " of water).

**Part 3 Execution**

**3.1 EXAMINATION**

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for damper installation in accordance with manufacturer's written instructions.
  - .1 Visually inspect substrate in presence of Consultant.
  - .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 where indicated.
- .2 Install in accordance with recommendations of SMACNA and manufacturer's instructions.
- .3 Seal multiple damper modules with silicon sealant.
- .4 Install access door adjacent to each damper. See Section 23 33 00 - Air Duct Accessories.
- .5 Ensure dampers are observable and accessible.

**3.3 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - 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 00 - Cleaning.
- .3 Waste Management: separate waste materials for recycling in accordance with Section 01 74 19 - 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            REFERENCE STANDARDS**

- .1        National Fire Protection Association (NFPA)
  - .1        NFPA 90A, Standard for the Installation of Air Conditioning and Ventilating Systems.
- .2        Underwriters Laboratories of Canada (ULC)
  - .1        CAN/ULC-S112, Standard Test Method of Fire Test of Fire Damper Assemblies.
  - .2        CAN/ULC-S112.2, Standard Method of Fire Test of Ceiling Fire Stop Flap Assemblies.
  - .3        ULC-S505, Standard for Fusible Links for Fire Protection Service.

## **Part 2        Products**

### **2.1            FIRE DAMPERS**

- .1        Fire dampers: arrangement bear label of UL or ULC, meet requirements of Fire Commissioner of Canada (FCC) and NFPA 90A, provincial fire authority.
- .2        Factory-made registers, designed not to reduce the degree of fire resistance of the wall or bulkhead crossed. The fire resistance duration of the registers must be as required by the National Building Code.
- .3        When the damper is installed outside the assembly having a degree of fire resistance, use the sleeve approved by the damper manufacturer with insulation applied at the factory.
- .4        In open position, the free area of the damper must be 100 % of the surface of the duct.
- .5        Damper must close at 74 ° C (165 ° F) or when the temperature in the network is 28 ° C (50 ° F) higher than the maximum service temperature

## **Part 3        Execution**

### **3.1            EXAMINATION**

- .1        Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for fire and smoke damper installation in accordance with manufacturer's written instructions.
  - .1        Visually inspect substrate in presence of Consultant.
  - .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 in accordance with NFPA 90A and in accordance with conditions of ULC listing.
- .2     Maintain integrity of fire separation.
- .3     After completion and prior to concealment obtain approvals of complete installation from authority having jurisdiction.
- .4     Install access door adjacent to each damper. See Section 23 33 00 - Air Duct Accessories.
- .5     Coordinate installation of fire stopping with Section 07 84 00 - Fire Stopping.
- .6     Ensure access doors/panels, fusible links, damper operators are easily observed and accessible.
- .7     Install break-away joints of approved design on each side of fire separation.

### **3.3           CLEANING**

- .1     Progress Cleaning: clean in accordance with Section 01 74 00 - 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 00 - Cleaning.
- .3     Waste Management: separate waste materials for recycling in accordance with Section 01 74 19 - 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 REFERENCE STANDARDS**

- .1 American National Standards Institute/Air Movement and Control Association (ANSI/AMCA)
  - .1 ANSI/AMCA Standard 99, Standards Handbook.
  - .2 ANSI/ASHRAE 51 (ANSI/AMCA 210), Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.
  - .3 ANSI/AMCA Standard 300, Reverberant Room Method for Sound Testing of Fans.
  - .4 ANSI/AMCA Standard 301, Methods for Calculating Fan Sound Ratings from Laboratory Test Data.
- .2 The Master Painters Institute (MPI)
  - .1 Architectural Painting Specification Manual - [current edition].
    - .1 MPI #18, Primer, Zinc Rich, Organic.

**1.2 MAINTENANCE MATERIAL SUBMITTALS**

- .1 Extra Materials:
  - .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
    - .1 Provide:
      - .1 Matched sets of belts.
      - .2 Furnish list of individual manufacturer's recommended spare parts for equipment, include:
        - .1 Bearings and seals.
        - .2 Addresses of suppliers.
        - .3 List of specialized tools necessary for adjusting, repairing or replacing.

**Part 2 Products**

**2.1 SYSTEM DESCRIPTION**

- .1 Performance Requirements:
  - .1 Catalogued or published ratings for manufactured items: obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency signifying adherence to codes and standards in force.
  - .2 Capacity: flow rate, static total pressure, bhp, efficiency, revolutions per minute, power, model, size, sound power data and as indicated on schedule.

- .3 Fans: statically and dynamically balanced, constructed in conformity with ANSI/AMCA Standard 99.
- .4 Sound ratings: comply with ANSI/AMCA Standard 301, tested to ANSI/AMCA Standard 300. Supply unit with ANSI/AMCA certified sound rating seal.
- .5 Performance ratings: based on tests performed in accordance with ANSI/AMCA Standard 210. Supply unit with ANSI/AMCA certified rating seal, except for propeller fans smaller than 300 mm diameter.

## 2.2 FANS GENERAL

- .1 Motors:
  - .1 In accordance with Section 23 05 13 - Common Motors Requirements for HVAC Equipment supplemented as specified herein.
  - .2 For use with variable speed controllers.
  - .3 Sizes as indicated.
- .2 Accessories and hardware: direct drive, adjustable motor bases, belt guards, coupling guards fan safety screens as indicated and as specified in Section 23 05 13 - Common Motor Requirements for HVAC Equipment, dampers and vanes and as indicated.
- .3 Factory primed before assembly in colour standard to manufacturer.
- .4 Scroll casing drains: as indicated.
- .5 Bearing lubrication systems plus extension lubrication tubes where bearings are not easily accessible.
- .6 Vibration isolation: to Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment.
- .7 Flexible connections: to Section 23 33 00 - Air Duct Accessories.

## 2.3 CENTRIFUGAL FANS, IN LINE, SQUARE TYPE BELT DRIVE

- .1 Square box, constructed of thick gauge galvanized steel, with square collars for connection to conduits. The two panels perpendicular to the engine mounting panel are removable to allow easy access to all internal components. The centrifugal impeller with backward inclined blades, statically and dynamically balanced, is made of aluminum and includes a cone precisely matching the shape of the suction cone.
- .2 Extra robust motor with ball bearings carefully chosen for the fan load. Motor and drive mounted outside the air stream and easily accessible for maintenance. Fan shaft mounted in bearings with permanently sealed and lubricated ball bearings. Choose bearings for a minimum service life (L50) of 200,000 hours at maximum operating speed. Adjustable pulleys chosen for a minimum of 150% of the power of the installed motor; provide the fans with the pulleys installed and adjusted to the speed specified in TPM.
- .3 Factory fitted junction box and safety switch, and factory made electrical motor connections.

- .4 Accessories and options.
- .5 2 mm (½ ") aluminum grids providing suction and discharge protection on ductless applications.
- .6 VA-01 : flow 1 231 L/s; static pressure 550 Pa; speed rotation 1650 RPM; power 2 HP; 208 V; 1 phase.
- .7 VE-01 : flow 1 231 L/s; static pressure 315 Pa; speed rotation 1480 RPM; power 1,5 HP; 208 V; 1 phase.
- .8 VE-02 : flow 730 L/s; static pressure 315 Pa; speed rotation 2 160 RPM; power 1 HP; 208 V; 1 phase.
- .9 VE-05 : flow 304 L/s; static pressure 125 Pa; speed rotation 1959 RPM; power 1/4 HP; 208 V; 1 phase.

### **Part 3 Execution**

#### **3.1 EXAMINATION**

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for HVAC fans installation in accordance with manufacturer's written instructions.
  - .1 Visually inspect substrate in presence of Consultant.
  - .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 FAN INSTALLATION**

- .1 Install fans as indicated, complete with resilient mountings specified in Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment, flexible electrical leads and flexible connections in accordance with Section 23 33 00 - Air Duct Accessories.
- .2 Provide sheaves and belts required for final air balance.
- .3 Bearings and extension tubes to be easily accessible.
- .4 Access doors and access panels to be easily accessible.

#### **3.3 ANCHOR BOLTS AND TEMPLATES**

- .1 Size anchor bolts to withstand seismic acceleration and velocity forces.

#### **3.4 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - 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 00 - Cleaning.
- .3 Waste Management: separate waste materials for recycling in accordance with Section 01 74 19 - 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 REFERENCE STANDARDS**

- .1 American National Standards Institute/Air Movement and Control Association (ANSI/AMCA)
  - .1 ANSI/AMCA Standard 99, Standards Handbook.
  - .2 ANSI/ASHRAE 51 (ANSI/AMCA 210), Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.
  - .3 ANSI/AMCA Standard 300, Reverberant Room Method for Sound Testing of Fans.
  - .4 ANSI/AMCA Standard 301, Methods for Calculating Fan Sound Ratings from Laboratory Test Data.

**Part 2 Products**

**2.1 SYSTEM DESCRIPTION**

- .1 Performance Requirements:
  - .1 Catalogued or published ratings for manufactured items: obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency signifying adherence to codes and standards in force. Provide confirmation of testing.
  - .2 Capacity: low rate, bhp static total, model and size and sound ratings.
- .2 Statically and dynamically balanced. Constructed to ANSI/AMCA Standard 99.
- .3 Sound ratings: comply with ANSI/AMCA Standard 301, tested to ANSI/AMCA Standard 300. Unit shall bear AMCA certified sound rating seal.
- .4 Performance ratings: based on tests performed in accordance with ANSI/AMCA Standard 210, unit to bear AMCA certified rating seal.
- .5 Bearings: heavy duty grease lubricated ball or roller bearings, ball, oilite of self aligning type with oil retaining, dust excluding seals and a certified minimum rated life of 80,000 hours.

**2.2 WALL EXHAUSTERS**

- .1 Centrifugal backward inclined fan units, direct driven.
  - .1 Spun aluminum housings, complete with resilient mounted motor and fan.
  - .2 12 mm mesh 2.0 mm diameter aluminum birdscreen.
  - .3 Insulated and gravity gasketed aluminum backdraft dampers.
  - .4 Disconnect switch within fan housing.
  - .5 Cadmium plated securing bolts and screws.
- .2 Eisenheiss coated wheel for fume service with motor out of air stream.

- .3 Housings:
  - .1 Provide with rubber or neoprene grommets for wiring passages, integral attachment collar, or angle ring mounted to mating flanged wall sleeve with full gasketting.
  - .2 Discharge pattern: away from building.
- .4 Fan motor: single speed single winding, operating at manufacturer standard design speed.
- .5 VE-03: flow 615 L/s; static pressure 95 Pa; speed rotation 1370 RPM; power 1/4 HP; 120 V; 1 phase
- .6 VE-04: flow 145 L/s; static pressure 95 Pa; speed rotation 1710 RPM; power 1/8 HP; 120 V; 1 phase

### **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 roof and wall exhausters installation in accordance with manufacturer's written instructions.
  - .1 Visually inspect substrate in presence of Consultant.
  - .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 in accordance with manufacturer's instructions.
- .2 Adjust the pressure according to the maximum pressure loss of the network.

#### **3.3 ANCHOR BOLTS AND TEMPLATES**

- .1 Size anchor bolts to withstand seismic acceleration and velocity forces.

#### **3.4 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - 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 00 - Cleaning.

- .3 Waste Management: separate waste materials for recycling in accordance with Section 01 74 19 - 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            REFERENCE STANDARDS**

- .1        National Fire Protection Association (NFPA)
  - .1        NFPA 664, Prevention of Fires and Explosions in Wood Processing and Woodworking facilities.
- .2        Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)
  - .1        SMACNA - HVAC Duct Construction Standards - Metal and Flexible, 2005.

## **Part 2        Products**

### **2.1            DUST COLLECTOR**

- .1        Indoor dust collector with motor shaker type filters and the following characteristics:
  - .1        Fan 5 HP; flow 377 l/s; total static pressure 2 250 Pa.
  - .2        Shaker motor 1/3 HP.
  - .3        Dust storage container with quick release levers.
  - .4        Control pannel with timer.
  - .5        Acoustic diffuser silencer.
  - .6        Acces doors for motors and filters.
- .2        When the fan stops, the timer starts the cleaning sequence.
- .3        The dust collector is design for maximum two simultaneous uses.

### **2.2            BAROMETRIC DAMPER**

- .1        Install a barometric damper at the end of the main duct to mechanically modulate the speed in the duct.
- .2        Maintain 20 m/s (4 000 fpm) in the duct.

### **2.3            CONDUCTS**

- .1        Generalities
  - .1        SMACNA, Round industrial duct Construction Standards (RIDCS).
  - .2        SMACNA, Rectangular industrial duct construction standards
  - .3        SMACNA, Accepted industry practice for industrial duct construction standards.
  - .4        ASTM A480/A480M-04a, Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet and Strip.

- .5 ASTM A653/A653M-04a, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.
  - .6 ASTM A924/A924M-04 Standard Specification for General Requirements for Steel Sheet, Metallic Coated by the Hot-Dip Process.
  - .7 ASTM A1011/A1011M-04a Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.
  - .8 All ducts, connection and accessories should be fabricating by the SMACNA standards RIDCS, chapters:
    - .1 Chapter 12;
    - .2 Chapter 13;
    - .3 Chapter 14;
    - .4 Chapter 15
  - .9 All ducts, connection and accessories should be designed for a suction negative pressure of 15" H<sub>2</sub>O, equivalent to 1,5 times the standard operation pressure (9" H<sub>2</sub>O).
- .2 Ducting
- .1 Thickness, fabrication and reinforcement: SMACNA.
  - .2 Conducting metal wire.
- 2.4 MATERIAL**
- .1 All ducts, connection and accessories should be galvanised steal ASTM A924, standard caliber.
- 2.5 WELDING**
- .1 Supply the full penetration welding for every joints. Fournir des soudures à pleine pénétration pour tous les joints (longitudinal and transversal) conform to the standards :
    - .1 SMACNA's Managers guide to welding, 2<sup>e</sup> edition, 1993;
    - .2 AWS D9.1;
    - .3 RIDCS, Chapter 12.
- 2.6 ELBOW**
- .1 Every elbow should have a minimal curve of 1,5 times the diameter.
- 2.7 SEAL**
- .1 Every demountable housing should have neoprene seal for operation between 29 °C and 121 °C.
  - .2 Joints: standard to SMACNA. Every prefabricated housing should be class A.
  - .3 Sealant product (for transversal joints non welded)
    - .1 For air duct polymer base, fire retardant, oil resistant and sustaining temperature from -30 °C to 93 °C.

- .2 Color : aluminium gray
- .4 Sealing tape (for transversal joints non welded)
  - .1 fiberglass, loose armor, treated with polyvinyl, 50 mm wide.
  - .2 Color : aluminium gray.
- 2.8 BRIDES ET RENFORT**
  - .1 Provide bridles or reinforcements to the dust collector and hood.
  - .2 Materials that are compliant and compatible with the adjacent duct or equipment.
- 2.9 ACCESS DOORS**
  - .1 Every access doors should be fabricated to the standards Chapter 15 of RIDCS of SMACNA.
  - .2 Provide access door for inspection and cleaning.
  - .3 Provide every access doors on the plans and at every 4 m. They should be installed at proximity of elbows, transitions, branch and direction changing (from horizontal to vertical).
  - .4 Dimensions following the indications, without exceeding the half of the duct's diameter or 600 mm.
  - .5 Access doors should be installed on the top or the side of the ducts.
  - .6 Materials conform and compatible to the duct or adjacent equipment.
- 2.10 BALANCING DAMPER**
  - .1 Provide every balancing dampers on the plans and at every 4 m. They should be installed at proximity of elbows, transitions, branch and direction changing (from horizontal to vertical).
  - .2 Every balancing damper should be guillotine type installed at 48° to avoid dust accumulation.
  - .3 Conform to indications and of the standard's table 15-23 and 15-25 of RIDCS of SMACNA.
  - .4 Materials conform and compatible to the duct or adjacent equipment.
- 2.11 FLEXIBLE CONNECTION AND EXPANSION JOINTS**
  - .1 Every flexible connection and expansion joints have to be conform to indications and of the standard's table 15-28 of RIDCS of SMACNA.
  - .2 Materials conform and compatible to the duct or adjacent equipment.
- Part 3 Execution**
  - 3.1 SUPPORT AND SUSPENSION**
    - .1 All supports and suspension will have to be made from the structure of the building. No duct support made from the process equipment will be accepted.

### **3.2 DUCT DIMENSIONS**

- .1 As plan.
- .2 Except otherwise, it should be conform to the SMACNA Chapter 15 du RIDCS de la SMACNA.

### **3.3 SEALANT**

- .1 Apply the sealant on the outside surface of the joints as the fabricant recommandation.
- .2 Drown the tape in the sealant product, and then cover with one layer as the product's recommendation.

### **3.4 LEAKAGE TEST**

- .1 Execute the leaking test conform to the requirement of «HVAC Duct Leakage Test Manual » of SMACNA.
- .2 Test by sections.
- .3 Execute preliminary leakage tests following the instructions to verify the work execution quality.
- .4 Do not install other ducts until the preliminary test is concluding. .
- .5 Testing sections should be at least 30 m long and have a minimum of 3 derivations and two 90° elbows.
- .6 Do not insulate the ducts before the end of the tests.

**END OF SECTION**

## **Part 1 General**

### **1.1 REFERENCE STANDARDS**

- .1 American National Standards Institute/Air Movement and Control Association (ANSI/AMCA)
  - .1 ANSI/ASHRAE 51 (ANSI/AMCA 210), Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.
- .2 International Organization of Standardization (ISO)
  - .1 ISO 3741, Acoustics-Determination of Sound Power Levels of Noise Sources Using Sound Pressure - Precision Methods for Reverberation Rooms.
- .3 Underwriter's Laboratories (UL)
  - .1 UL 181, Factory-Made Air Ducts and Air Connectors.

## **Part 2 Products**

### **2.1 SYSTEM DESCRIPTION**

- .1 Performance Requirements:
  - .1 Catalogued or published ratings for manufactured items: obtained from tests carried out by manufacturer or those ordered by manufacturer from certified ADC (Air Diffusion Council) testing agency signifying adherence to codes and standards.

### **2.2 MANUFACTURED UNITS**

- .1 Terminal units of the same type to be product of one manufacturer.

### **2.3 ELECTRONIC VARIABLE AIR VOLUME BOXES**

- .1 Pressure independent, reset to air flow between zero and maximum air volume.
- .2 At inlet velocity of 10 m/s, differential static pressure not to exceed 25 Pa.
- .3 Air velocity sensor pitot rack as standard to manufacturer.
- .4 Signals between temperature sensing device, velocity controller, velocity sensor and damper actuator digital as indicated. Shielded or twisted wire requirements is not acceptable.
- .5 Electronic control package factory calibrated and set at factory. Features to accommodate field calibration and readjustment of air volume settings to include:
  - .1 Metre taps for balancing with digital DC voltmeter.
  - .2 Adjustable flow settings at thermostat.
- .6 Factory installed 20 VA transformer, 115 V to 24 V. Power consumption of terminal not to exceed 15 VA.

- .7 Terminal unit to be CSA certified.
- .8 Casing: galvanized steel, internally lined with 25 mm. 0.7 kg density fibrous glass, to NFPA 90A & UL 181. Mount control components inside protective metal shroud.
- .9 Damper: steel with peripheral gasket and self lubricating bearings. Air leakage past closed damper not to exceed 2 % of nominal rating at 750 Pa inlet static pressure, in accordance with Air Diffusion Council test procedure.
- .10 Sizes and capacity: as indicated.

### **Part 3 Execution**

#### **3.1 EXAMINATION**

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for air terminal units installation in accordance with manufacturer's written instructions.

#### **3.2 INSTALLATION**

- .1 Install in accordance with manufacturers recommendations.
- .2 Support independently of ductwork.
- .3 Install with at least 1000 mm of flexible inlet ducting and minimum of four duct diameters of straight inlet duct, same size as inlet.
- .4 Locate controls, dampers and access panels for easy access.

**END OF SECTION**

**Part 1        General**

**1.1            MAINTENANCE MATERIAL SUBMITTALS**

- .1    Extra Materials:
  - .1    Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.
  - .2    Include:
    - .1    Keys for volume control adjustment.
    - .2    Keys for air flow pattern adjustment.

**Part 2        Products**

**2.1            SYSTEM DESCRIPTION**

- .1    Performance Requirements:
  - .1    Catalogued or published ratings for manufactured items: obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency signifying adherence to codes and standards.

**2.2            GENERAL**

- .1    To meet capacity, pressure drop, terminal velocity, throw, noise level, neck velocity as indicated.
- .2    Frames:
  - .1    Full perimeter gaskets.
  - .2    Plaster frames and as specified.
  - .3    Concealed fasteners.
- .3    Concealed manual volume control damper operators.
- .4    Colour: standard.

**2.3            MANUFACTURED UNITS**

- .1    Grilles, registers and diffusers of same generic type, products of one manufacturer.

**2.4            SUPPLY GRILLES (C7)**

- .1    Spacing between 19 mm ( $\frac{3}{4}$  ") slats and aerodynamically shaped double deflection flaps, mounted vertically on horizontal support rods, registers with opposite flaps with concealed operating device, and fitted with a sealing.

**2.5 EVACUATION AND RETURN GRILLES (S7 & S50)**

- .1 Spacing between 19 mm ( $\frac{3}{4}$  ") slats and aerodynamically shaped double deflection flaps, mounted vertically on horizontal support rods, registers with opposite flaps with concealed operating device, and fitted with a sealing.

**2.6 DOOR GRILLES (Z1)**

- .1 Steel frames and vanes, double inverted herringbone model; useful surface equal to 65% of the opening surface; frames that can be adapted to doors of different thicknesses, in accordance with the manufacturer's standards.

**2.7 SPIRAL MOUNTED SUPPLY & RETURN GRILLES (C14)**

- .1 Extruded aluminum frames, designed to be mounted on spiral ducts without transition, adjustable double deflection shutters, fitted with a gasket.

**Part 3 Execution**

**3.1 EXAMINATION**

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for diffuser, register and grille installation in accordance with manufacturer's written instructions.
  - .1 Visually inspect substrate in presence of Consultant.
  - .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 in accordance with manufacturers instructions.
- .2 Install with flat head, screws in countersunk holes where fastenings are visible.

**3.3 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - 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 00 - Cleaning.
- .3 Waste Management: separate waste materials for recycling in accordance with Section 01 74 19 - 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            REFERENCE STANDARDS**

- .1    ASTM International (ASTM)
  - .1        ASTM E90, Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
- .2    National Research Council Canada (NRC)
  - .1        National Building Code of Canada 2015 (NBC).
- .3    Sheet Metal and Air Conditioning Contractors' National Association (SMACNA).
- .4    Society of Automotive Engineers (SAE).

**Part 2        Products**

**2.1            SYSTEM DESCRIPTION**

- .1    Performance Requirements:
  - .1        Catalogued or published ratings for manufactured items: obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency signifying adherence to codes and standards.

**2.2            ADJUSTABLE LOUVRES**

- .1    Construction: welded with exposed joints ground flush and smooth.
- .2    Material: extruded aluminum alloy 6063-T5.
- .3    Blade: stormproof pattern with centre watershed in blade, reinforcing bosses and maximum blade length of 3000 mm.
- .4    Frame, head, sill and jamb: 100 mm deep one piece extruded aluminum, minimum 2 mm thick.
- .5    Mullions: at 3000 mm maximum centres.
- .6    Fastenings: stainless steel SAE-194-8F with SAE-194-SFB nuts and resilient neoprene washers between aluminum and head of bolt, or between nut, ss washer and aluminum body.
- .7    Screen: 12 mm exhaust, 19 mm intake mesh, 2 mm diameter wire aluminum birdscreen on inside face of louvres in formed U-frame.

**Part 3 Execution**

**3.1 EXAMINATION**

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for louvres, intakes and vents installation in accordance with manufacturer's written instructions.
  - .1 Visually inspect substrate in presence of Consultant.
  - .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 In accordance with manufacturer's and SMACNA recommendations.
- .2 Reinforce and brace as indicated.
- .3 Anchor securely into opening. Seal with caulking to ensure weather tightness.

**3.3 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - 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 00 - Cleaning.
- .3 Waste Management: separate waste materials for recycling in accordance with Section 01 74 19 - 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                REFERENCE STANDARDS**

- .1 American National Standard Institute (ANSI)/American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)
  - .1 ANSI/ASHRAE 52.2, Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particulate Size (ANSI approved).
- .2 Canadian General Standards Board (CGSB)
  - .1 CAN/CGSB-115.10, Disposable Air Filters for the Removal of Particulate Matter from Ventilating Systems.
  - .2 CAN/CGSB-115.15-M91, High Efficiency Rigid Type Air Filters for Removal of Particulate Matter from Ventilating Systems.
- .3 Underwriters' Laboratories of Canada (ULC)
  - .1 ULC -S111, Standard Method of Fire Tests for Air Filter Units.

**Part 2            Products**

**2.1                GENERAL**

- .1 Media: suitable for air at 100% RH and air temperatures between -40 and 50 degrees C.
- .2 Number of units, size and thickness of panels, overall dimensions of filter bank, configuration and capacities.
- .3 Pressure drop when clean and dirty, sizes and thickness: as indicated on schedule.

**2.2                ACCESSORIES**

- .1 Holding frames: permanent construction of extruded aluminum, 1.6 mm thick, except where specified.
- .2 Seals: to ensure leakproof operation.
- .3 Blank-off plates: as required, to fit all openings and of same material as holding frames.
- .4 Access and servicing: through doors/panels on each side from **amont des filtres**.

**2.3                CARTRIDGE TYPE FILTERS, MERV 8 EFFICIENCY**

- .1 Media: deep pleated, disposable, high efficiency, to CAN/CGSB-115.14.
- .2 Holding frame: galvanized steel with bracing.
- .3 Media support: welded wire grid.

- .4 Performance: average atmospheric dust spot efficiency MERV 8.
- .5 Fire rated: to ULC -S111.

**2.4 CARTRIDGE TYPE FILTERS MERV 14 EFFICIENCY**

- .1 Media: disposable, high efficiency, to CAN/CGSB-115.15.
- .2 Holding frame: galvanized steel with bracing.
- .3 Media support: welded wire grid.
- .4 Performance: average atmospheric dust spot efficiency MERV 14.
- .5 Fire rated: to ULC-S111.

**2.5 FILTER GAUGES - DIAL TYPE**

- .1 Diaphragm actuated, direct reading.
- .2 Range: 0 to 2 times initial pressure.

**Part 3 Execution**

**3.1 EXAMINATION**

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for filter installation in accordance with manufacturer's written instructions.

**3.2 INSTALLATION GENERAL**

- .1 Install in accordance with manufacturer's recommendations and with adequate space for access, maintenance and replacement.

**3.3 REPLACEMENT MEDIA**

- .1 Replace media with new upon acceptance.
- .2 Filter media new and clean, as indicated by pressure gauge, at time of acceptance.

**3.4 FILTER GAUGES**

- .1 Install type as indicated across each filter bank (pre-filter and final filter) in approved and easy readable location.
- .2 Mark each filter gauge with value of pressure drop for clean condition and manufacturer's recommended replacement (dirty) value.

**END OF SECTION**

**Part 1        General**

**1.1            REFERENCE STANDARDS**

- .1        American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE)
  - .1        ASHRAE 84, Method of Testing Air-to-Air Heat/Energy Exchangers (ANSI approved).

**Part 2        Products**

**2.1            GENERAL**

- .1        Comply with ASHRAE 84.

**2.2            AIR TO AIR FIXED PLATE EXCHANGER**

- .1        Casing: 0.8 mm thick galvanized steel.
- .2        Heat transfer surfaces: corrugated aluminum, edge sealed and bonded to casing.
- .3        Cross contamination: not permitted.
- .4        Condensate drain: NPS 2.
- .5        Merv 8 filter
- .6        Removable access panels.
- .7        Water wash.
- .8        Performance characteristics: 724 l/s air exchanger.
- .9        Maximum pressure drop of 175 Pa (0,7 inch of water) at 724 l/s

**Part 3        Execution**

**3.1            EXAMINATION**

- .1        Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for energy recovery equipment installation in accordance with manufacturer's written instructions.
  - .1        Visually inspect substrate in presence of Consultant.
  - .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 in accordance with manufacturers recommendations.

- .2 Support independently of adjacent ductwork with flexible connections.
- .3 Install access doors in accordance with Section 23 33 00 - Air Duct Accessories.

### **3.3 FIELD QUALITY CONTROL**

- .1 Tests:
  - .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.

### **3.4 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - 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 00 - Cleaning.
- .3 Waste Management: separate waste materials for recycling in accordance with Section 01 74 19 - 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        REFERENCE STANDARDS**

- .1        CSA Group (CSA)
  - .1        CSA C22.2 No.155-M1986 (R2017), Electric Duct Heaters.

**Part 2        Products**

**2.1        OPEN COIL DUCT HEATERS**

- .1        Duct heater approved to CSA C22.2 No.155 and listed for zero clearance to combustible material.
- .2        Design/Performance Criteria:
  - .1        Refer to duct heater schedule for size, electrical requirements (volts, phases), capacity (kW), operating airflow, controller type, number of stages and special accessories.
  - .2        Heater Element Watt/Density: maximum 242 W/mm<sup>2</sup>.
    - .1        Provide derated coils with low-watt density and low airflow controls when faced velocities are lower than 2.0 m/s or duct heaters are used in variable-air-volume applications.
  - .3        Heater Rated Load: provide built-in load fuses for duct heaters with rated load exceeding 48 Amps.
  - .4        Modular Construction: when duct heater modules are assembled on site for large applications, design and construct assembly to operate as a single heater.
  - .5        Disconnect Switch: provide main disconnect for each duct heater assembly.
  - .6        The electric coils located in rooms 101 and 104 must be certified for a compliant installation of class 2 division 2.
- .3        Construction:
  - .1        Frame: corrosion-resistant galvanized steel.
  - .2        Heating elements: helical coils of high grade nickel-chrome alloy resistance wire supported and insulated by floating ceramic bushings fastened to the frame and supporting brackets.
  - .3        Coil terminal pins: mechanically secured and insulated from the frame with high temperature ceramic bushings.
  - .4        Mounting: flanged type.
  - .5        Protective Screens: installed on both sides of heater.
- .4        Safety Controls:
  - .1        High Temperature Cutouts: include fail-safe thermal protection devices which automatically de-energize the heater on overheating condition.

- .1 Primary High Limit Switch: automatic reset disc type thermal cutout.
- .2 Secondary High-Limit Switch: additional manual reset disc type thermal cutout for duct heaters of 30 kW and less.
- .2 Airflow Proving Switch: diaphragm type air pressure switch with automatic reset, screw type setpoint adjustment and static pressure probe; switch to de-energize duct heater circuits in case of insufficient air flow.
- .5 Panel:
  - .1 Factory mounted NEMA 1 enclosure with terminal blocks for single point power connections and connection of wiring to thermostat, airflow proving switch and/or external controls.
  - .2 Remote mounted NEMA 1 panel as indicated with terminal strips in heater terminal box for power and control wiring.
  - .3 All built-in controls and electrical components to be factory mounted and wired inside the panel; wiring to be terminated on clearly identified terminal blocks.
  - .4 Provide unit specific wiring diagram permanently attached inside the panel.
- .6 Controls:
  - .1 Duct heater to include the following built-in controls: magnetic contactors, control transformer, safety controls and controllers.
  - .2 Controller Type: as indicated on duct heater schedule.
    - .1 Proportional Control: single-stage proportional control providing full modulation of the heater's capacity.
      - .1 Silicon Controlled Rectifier (SCR) or Solid State Relay (SSR) controller with integrated heatsink.
      - .2 Control Input: 0-10 VDC, 4-20 mA.

## 2.2 ACCESSORIES

- .1 Provide accessories where indicated on duct heater schedule.
- .2 Thermostats: low voltage electronic thermostat compatible with duct heater controller.
  - .1 Room Thermostats: ventilated casing with adjustable setpoint.
  - .2 Duct Thermostats: insertion type with casing and adjustable setpoint.

## Part 3 Execution

### 3.1 EXAMINATION

- .1 Verification of Conditions: verify site conditions are acceptable for duct heater installation in accordance with manufacturer's written instructions.
  - .1 Inform Departmental Representative of unacceptable conditions immediately upon discovery.

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

### **3.2 INSTALLATION**

- .1 Perform installation in accordance with manufacturer's instructions.
- .2 Locate duct heater in accordance with manufacturer's minimum recommended distances for operation, service access and unit removal.
- .3 Provide additional hangers and supports in accordance with Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment where duct heater weight cannot be supported solely by existing duct.
- .4 Make power and control connections to CSA C22.2 No.155.
- .5 Verify that ductwork and casings are free of debris before operating and testing duct heaters.

### **3.3 FIELD QUALITY CONTROL**

- .1 Perform tests in accordance with Section 01 91 13 - General Commissioning Requirements and Section 26 05 00 - Common Work Results for Electrical.
- .2 Duct Heater Controls: test operation of safety controls and duct heater staging/modulation by simulating a demand from the local thermostat or external control signal.
- .3 Field Adjustments: test and adjust airflow controls during system testing, adjusting and balancing in coordination with Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
- .4 Perform tests in presence of Consultant.
  - .1 Provide test report and include copy with Operations and Maintenance Manuals.

**END OF SECTION**



**Part 1            General**

**1.1                RELATED REQUIREMENTS**

- .1        Section 23 09 33 - Electric and Electronic Control System for HVAC.
- .2        Section 26 05 00 - Common Work Results for Electrical

**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 fan coil units and include product characteristics, performance criteria, physical size, finish and limitations.
  - .2        Product data to include:
    - .1        Filters, fan accessibility.
    - .2        Thermostat, transformer, controls where integral.
    - .3        kW rating, voltage, phase.
    - .4        Cabinet material thicknesses.
  - .3        Shop Drawings:
    - .1        Submit drawings stamped and signed by professional engineer registered or licensed in Province, Canada.
  - .4        Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

**1.3                DELIVERY, STORAGE AND HANDLING**

- .1        Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
- .2        Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3        Storage and Handling Requirements:
  - .1        Store materials off ground, indoors, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2        Store and protect fan coil units from nicks, scratches, and blemishes.
  - .3        Replace defective or damaged materials with new.

**Part 2            Products**

**2.1                FAN COIL UNITS**

- .1        Cabinet: steel, 1.2 mm thick, wallmounting, surface. Front inlet/top bottom outlet.
- .2        Elements: stainless steel sheathed with corrosion protected steel fins covering full length of element.
- .3        Blower motors: single phase.

- .4 Built-in thermostat with integral relay. 23 09 33 - Electric and Electronic Control System for HVAC.
- .5 Fan delay switch.
- .6 On-Off switch (for wall mount unit only).
- .7 Two position selector switch (for wall mount unit only).
- .8 Fresh air duct adapter.
- .9 Trim for flush semi-recessed installation.
- .10 Finish: 3 stage phosphatized treatment followed by coats baked air dry enamel with final coatwhite colour.
- .11 Assembly fully wired to one outlet location.
- .12 Multiple knockoutsfor up to 38 mm diameter up to 1 ½" conduit.

### **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 fan coil units 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 Mountunits.
- .2 Make electrical and control connections.
- .3 Co-ordinate ducting of fresh air with Division 23.

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

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.

#### **3.4 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - 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 00 - Cleaning.

**END OF SECTION**

## **Part 1        General**

### **1.1        REFERENCE STANDARDS**

- .1        American National Standards Institute/Air-Conditioning and Refrigeration Institute (ANSI/ARI)
  - .1        ANSI/ARI 350, Sound Rating of Non-Ducted Indoor Air-Conditioning Equipment.
  - .2        ARI 840, Unit Ventilators.
- .2        ASTM International (ASTM)
  - .1        ASTM C1071, Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material).
- .3        Environment Canada (EC)/Environmental Protection Services (EPS)
  - .1        EPS 1/RA/2, Code of Practice for Elimination of Fluorocarbon Emissions from Refrigeration and Air Conditioning Systems.

## **Part 2        Products**

### **2.1        GENERAL**

- .1        Piping systems to comply with EPS 1/RA/2.

### **2.2        SELF CONTAINED UNIT VENTILATORS**

- .1        General: factory assembled, prewired, piped, with manufacturer supplying controls for self-contained refrigeration unit, air cooled.
  - .1        Sound performance to ANSI/ARI 350.
- .2        Capacity: R410A. 35 170 W cooling. 1 600 L/s on high speed; 730 L/s outdoor air.
- .3        Fan : flow 1 600 l/s; external static pressure 625 Pa; speed 2570 RPM; power 5 HP
- .4        Cabinet:
  - .1        1.2 mm thick steel with baked enamel, colour manufacturer's standard.
    - .1        Smooth surfaces, with no exposed fasteners.
    - .2        Sliding fit front panel casing with manually set discharge louvres.
    - .3        Cabinet assembly: internal components assembled on slide-in chassis.
    - .4        Cabinet insulated for noise control to maintain NC rating 41 dB maximum.
    - .5        Insulation: 13 mm minimum thick, coated glass fiber to ASTM C1071.
- .5        Filters: throw-away. Merv 14 specified

- .6 Cooling section:
  - .1 Comply with EPS 1/RA/2.
  - .2 Frame: 1.2 mm thick minimum zinc coated steel frame, baked prime coat finish housing.
  - .3 Cooling coil: comprising an evaporator coil made of copper tubes fitted with aluminum fins, a hermetic piston compressor, operating with R-410A refrigerant, an evaporator fan-condensate recovery tank assembly, made of galvanized steel at least 1.2 mm thick covered with a non-metallic sealant.
  - .4 Drain pan:
    - .1 Condensate drain pan
  - .5 Evaporator fan motor: two speed, shaded pole thermally protected, 600 V, 3 phase, 60 Hertz with single forward curved blower wheels, statically and dynamically balanced.
  - .6 Compressor: hermetic, internally and externally vibration isolated with permanent split capacitor motor, and overload protection.
- .7 Controls:
  - .1 Complete factory installed package type electronic.
  - .2 Manual:
    - .1 Top of chassis, with integral thermostat and push button station marked "Off-Heat-Vent-Cool"
  - .3 Automatic: remote thermostat for cooling and heating with selected room temperature, 18 degrees C to 35 degrees C, summer auto-on-manual sub base with dead band on automatic changeover thermostat.
- .8 Outdoor air: Outdoor air damper to allow up to 46 % outdoor air, manually adjusted to control at front of unit.
  - .1 Include outside casing and outside louvres.

## **2.3 VARIABLE FLOW REFRIGERANT COOLING UNIT**

- .1 Variable speed condensing unit
  - .1 One section unit.
  - .2 Factory assembled and prewired, including every electronics components and the refrigerant control. Including also :
    - Corrosion and severe weather's proof casing, enamelled steel.
    - Multiple compressors, scroll, hermetically, spring mounted; fan condenseur and variable speed motors; condensing coils with copper tube and aluminium fin mechanically assembled. The whole covered by a corrosion resistant coating; electronic expansion valve, solenoid and four ways; distribution tube and capillaries; filters; stop valve; oil separator; access doors; refrigerant regulator; under cooling liquid refrigerant unit; oil recuperation cycle; heat exchanger on the condenser's circuit.
    - Intern protection against high refrigerant gas pressure, fuse on the control circuit, heat carter, over load relay, overload protection on the variable speed compressors, thermal protection on the compressors and fans, anti-short circuit timer.

- Internal persistent program to assure the maintain of the settings after a power cut
- .3 Each compressor can operate independantly of the others to provide a low capacity operation in case of a break or service stop. At least one compressor by unit has a variable speed direct drive to modulate the capacity of the unit to 15% of the nominal power.
- .4 Sequential operation of the different module in a same unit to equilibize the usury and alternative operation on the defrost demand and oil return.
- .5 Maximum sound power 63 dB(A) at 1 m.
- .6 Precharge unit in refrigerant at the factory. Load of refrigerant to complete on the site according to the size of the piping network.
- .7 Cooling operation
  - Inside range conditions BH : 12,8 °C at 25 °C (55 °F at 77 °F);
  - Outside range conditions BS : -20 °C at 43,3 °C (-4 °F at 110 °F).
- .8 Provide the required accessories for the operation range defined, including the protective cover on the exhaust air condensing coil, etc.
- .9 Total cooling capacity of 33.4 kW (10 tons). Heating capacity of 37.8 kW at 8 ° C and 27.0 kW at -8 ° C. Electrical connection of 600 V, 3phase, 60 hz.
- .2 Connections, collectors/distributors, gaskets and piping accessories
  - .1 « Y » connections and collectors/distributors provided and recommanded by the manufacturer ensuring an appropriated distribution of the refrigerant in the branches and according to the flow rat in each of them.
    - no generic « T » connections allowed.
    - Provide with heat insulating for on site installation.
  - .2 Every gaskets and accessories conform to the manufacturer's requirements.
- .3 Additional refrigerant
  - .1 Provide all the required quantity associate to the lentgh of the piping installed on site. In addition of the precharged refrigerant quantity in the compressor/condenser units when necessary.
- .4 Individual controlers and accessories
  - .1 Simplified individual wall controler with direct connection. Limited display and control of the operation parameters of the inside units.
    - Operation parameters : stop/start, room temperature, operation mode, fan speed and alarm.
    - Possibility to program the unavailability of some parameters by the central controler ou forbid local interaction.
  - .2 Control interface Bacnet-MSTP by evaporator for connection to the building management system.

- .5 Bridge BACNet IP
  - .1 Bridge allowing the DRV system integration via the open protocol BACnet IP.
  - .2 Bridge allowing the bi-directional transmission (reading and writing) of operational information, including the operation points and the supervision of :
    - Order temperature ;
    - Manual stop/ fans;
    - Working condition/alarm and error code.
- .6 Electrical wire control, connections and accessories
  - .1 Control connection between the inside units, the compressors/condensers units, the repartition boxes and the control accessories by a chain connection system.
  - .2 Empty duct for the wires.
  - .3 If required, provide the control transformers 120 V/24 V or other, according to the demand and finishing the electrical connections.
  - .4 Materials conform to the manufacturer requirements and applicable requirements section 25.

### **Part 3 Execution**

#### **3.1 EXAMINATION**

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for unit ventilators installation in accordance with manufacturer's written instructions.
  - .1 Visually inspect substrate in presence of Consultant.
  - .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 Locate plumb and level and make secure.
- .2 Install in accordance with manufacturer's written recommendations.
- .3 Allow for pipe movement during normal operation.
- .4 Pipe drains and blow off connections to nearest drain.
- .5 Maintain clearances in accordance with manufacturer's written recommendations to permit performance of service maintenance.
- .6 Check final location with Consultant prior to installation.
  - .1 Should deviations beyond allowable clearances arise, request and follow Consultant's written instructions.

- .7 Piping:
  - .1 Piping hook up in accordance with manufacturer's written recommendations.
  - .2 Install flexible connections, vibration and expansion connectors as indicated.
  - .3 Allow clearance for installation of insulation and for access to, and maintenance of, strainers, valves, air vents, drains, cleanouts, unions, expansion joints, flex connectors, and trap assemblies.

### 3.3 **CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - 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 00 - Cleaning.
- .3 Waste Management: separate waste materials for recycling in accordance with Section 01 74 19 - Waste Management and Disposal.
  - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

### 3.4 **PROTECTION**

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

**END OF SECTION**



**Part 1            General**

**1.1                RELATED REQUIREMENTS**

- .1            N/A.

**1.2                REFERENCE STANDARDS**

- .1            CSA Group (CSA)
  - .1            CSA C22.2 No.46-M1988 (R2006), Electric Air-Heaters.
- .2            Underwriters' Laboratories (UL)
  - .1            UL 1042-2009, Standard for Electric Baseboard Heating Equipment.

**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 convectors and include product characteristics, performance criteria, physical size, finish and limitations.
- .3            Manufacturer's Instructions: provide to indicate special handling criteria, installation sequence, cleaning procedures.

**1.4                CLOSEOUT SUBMITTALS**

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

**1.5                DELIVERY, STORAGE AND HANDLING**

- .1            Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2            Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3            Storage and Handling Requirements:
  - .1            Store materials off ground indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2            Store and protect convectors from nicks, scratches, and blemishes.
  - .3            Replace defective or damaged materials with new.
- .4            Packaging Waste Management: remove for reuse by manufacturer of packaging materials as specified in Waste Reduction Workplan in accordance with Section 01 74 19 - Waste Management and Disposal.

**Part 2 Products**

**2.1 BASEBOARD CONVECTORS**

- .1 Heaters: to high CSA C22.2 No.46 wattage density as indicated with connection box both ends.
- .2 Element: locked to cabinet and supported at additional points throughout length to allow for linear expansion.
- .3 Cabinet: as indicated
- .4 Blank cabinet sections and inside corners complete with wireway in sections including splice plates, to match heater cabinets in respects for continuous baseboard effect as indicated.

**2.2 CONTROLS**

- .1 Wall mounted thermostats: type electronic, in accordance with Section 23 09 33 - Electric and Electronic Control System for HVAC.
- .2 Relays contactors to switch loads in excess of thermostat rating.
- .3 Double pole, double throw switch and receptacle terminal box assembly for combination heater and air conditioner power supply.

**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 convectors installation in accordance with manufacturer's written instructions.
  - .1 Visually inspect substrate in presence of Consultant.
  - .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 baseboard convector heaters, blank sections and controls.
- .2 When wireway is used, remove knock-outs and insert insulating bushing between units.
- .3 Install grounding wire to maintain ground integrity between heating, blank, and auxiliary sections.
- .4 Install thermostats in locations indicated.
- .5 Make power and control connections.

**3.3 FIELD QUALITY CONTROL**

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Ensure heaters and controls operate correctly.

**3.4 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - 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 00 - Cleaning.
- .3 Waste Management: separate waste materials for recycling in accordance with Section 01 74 19 - 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 commercial convectors installation.

**END OF SECTION**



**Part 1        General**

**1.1            RELATED REQUIREMENTS**

- .1        N/A.

**1.2            REFERENCE STANDARDS**

- .1        CSA Group (CSA)
  - .1        CSA C22.2 No.46-M1988 (R2006), Electric Air-Heaters.
- .2        National Electrical Manufacturers Association (NEMA)
  - .1        NEMA 250-08, Enclosures for Electrical Equipment (1000 V Maximum).

**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 unit heaters and include product characteristics, performance criteria, physical size, finish and limitations.
- .3        Manufacturer's Instructions: provide to indicate special handling criteria, installation sequence, cleaning procedures.

**1.4            CLOSEOUT SUBMITTALS**

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

**1.5            DELIVERY, STORAGE AND HANDLING**

- .1        Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
- .2        Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3        Storage and Handling Requirements:
  - .1        Store materials indoors, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2        Store and protect unit heaters from nicks, scratches, and blemishes.
  - .3        Replace defective or damaged materials with new.
- .4        Packaging Waste Management: remove for reuse by manufacturer of packaging materials as specified in Waste Reduction Workplan in accordance with Section 01 74 19 - Waste Management and Disposal.

**Part 2 Products**

**2.1 UNIT HEATERS**

- .1 Unit heater: to CSA C22.2 No.46, explosion proofs indicated.
- .2 Fan type unit heaters with built-in high-heat limit protection, fan-delay switches.
- .3 Fan motor: permanently lubricated ball bearing type with resilient mount.
  - .1 Built-in fan motor thermal overload protection.
- .4 Hangers: as indicated.
- .5 Elements: as indicated.
  - .1 Explosion proof with sealed steel tube core with aluminum fin.

**2.2 CONTROLS**

- .1 Built in thermostat and support controls.

**Part 3 Execution**

**3.1 EXAMINATION**

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for unit heaters installation in accordance with manufacturer's written instructions.
  - .1 Visually inspect substrate in presence of Consultant.
  - .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 Suspend unit heaters from ceiling or mount on wall as indicated.
- .2 Install thermostats in locations indicated.
- .3 Make power and control connections.

**3.3 FIELD QUALITY CONTROL**

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Test cut-out protection when air movement is obstructed.
- .3 Test fan delay switch to assure dissipation of heat after element shut down.
- .4 Test unit cut-off when fan motor overload protection has operated.
- .5 Ensure heaters and controls operate correctly.

**3.4 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - 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 00 - Cleaning.
- .3 Waste Management: separate waste materials for recycling in accordance with Section 01 74 19 - 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 unit heaters installation.

**END OF SECTION**



**Part 1            General**

**1.1                N/A**

**Part 2            Products**

**2.1                ELECTRODE STEAM GENERATOR HUMIDIFIERS**

- .1    Electrode type humidifier for humidity distribution in an air duct and electronically controlled.
- .2    The capacity of the humidifier must be adjustable on site between 20 and 100%
- .3    Maximum humidification power must remain constant throughout the life of the cylinder.
- .4    Removable type generator to facilitate inspection or replacement.
- .5    Adjustable electrodes to meet different water conditions.
- .6    The device must incorporate a basin water conductivity detector to drain the generators and a high level switch if necessary.
- .7    Electronic humidity control capable of complete modulation of vapor flow.
- .8    Each generator of the humidifier must be equipped with stainless steel dispersion tubes. Collector tube outside the air stream.
- .9    The appliance must be started up by the manufacturer
- .10   Provide with
  - .1    Water cooling system ensuring condensate return to a maximum temperature of 75 ° C (167 ° F).
  - .2    Double stage line filter (pre-filter and carbon filter).
  - .3    Bacnet communication protocol.
  - .4    Two (2) additional cylinders.
  - .5    High limit humidistat.
  - .6    Air flow switch.
- .11   HU-1: Selected for an air flow 1 230 L / s at 55 ° F and 56 % RH. With a capacity of 80 lbs / hr.
- .12   HU-2: Selected for an air flow of 1 600L / s at 55 ° F and 56 % RH. With a capacity of 45 lbs / hr
- .13   Electrical connection 600 V / 3 ph.

**Part 3 Execution**

**3.1 EXAMINATION**

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for humidifiers installation in accordance with manufacturer's written instructions.
  - .1 Visually inspect substrate in presence of 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 in accordance with manufacturers instructions.
- .2 Humidifier and evaporator media to be new and clean when project is accepted.
- .3 Install humidistat as indicated.
- .4 Water service overflow drain: to manufacturers' recommendation.
- .5 Install access doors or panels in adjacent ducting.
- .6 When installing in ducting, provide waterproof duct up and downstream in accordance with Section 23 31 13.01 - Metal Ducts - Low Pressure to 500 Pa.
- .7 Install capped drain connection at low point in duct.

**3.3 FIELD QUALITY CONTROL**

- .1 Manufacturer's Field Services:
  - .1 Have manufacturer of products, supplied under this Section, review Work involved in the handling, installation/application, protection and cleaning, of its products and submit written reports, in acceptable format, to verify compliance of Work with Contract.
  - .2 Manufacturer's Field Services: provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
  - .3 Schedule site visits, to review Work, at stages listed:
    - .1 After delivery and storage of products, and when preparatory Work, or other Work, on which the Work of this Section depends, is complete but before installation begins.
    - .2 Twice during progress of Work at 25 % and 60 % complete.
    - .3 Upon completion of the Work, after cleaning is carried out.
  - .4 Obtain reports, within 3 days of review, and submit immediately to Departmental Representative.

- .2 Performance Verification (PV):
  - .1 General: in accordance with Section 01 91 13 - General Commissioning Requirements: General Requirements, supplemented as specified.
  - .2 Application tolerances: 5 %.
  - .3 Timing:
    - .1 After TAB of ducted air systems.
    - .2 At same time as PV of related air handling units.
  - .4 PV procedures:
    - .1 Direct Steam Injection Humidifiers.
- .3 Start-up:
  - .1 General: in accordance with Section 01 91 13 - General Commissioning Requirements: General Requirements, supplemented as specified.
  - .2 Verify:
    - .1 Steam lines are sloped to ensure steam condensate is drained away from the humidifier.
    - .2 Vapour lines and manifolds are sloped to ensure condensate is drained away from the duct system.
    - .3 Visually check distribution manifold to ensure:
      - .1 Even distribution of vapour.
      - .2 Freedom from water deposits.
- .4 Commissioning Reports:
  - .1 General: in accordance with Section 01 91 13 - General Commissioning Requirements: reports, supplemented as specified. Include:
    - .1 PV results on approved PV Report Forms.
    - .2 Product Information Report Forms.

### **3.4 DEMONSTRATION**

- .1 Training: in accordance with Section 01 91 13 - General Commissioning Requirements: Training of O&M Personnel.

### **3.5 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - 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 00 - Cleaning.
- .3 Waste Management: separate waste materials for recycling in accordance with Section 01 74 19 - 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                DEFINITIONS**

- .1 For additional acronyms and definitions refer to Section 25 05 01 - EMCS: General Requirements.
- .2 AEL: ratio between total test period less any system downtime accumulated within that period and test period.
- .3 Downtime: results whenever EMCS is unable to fulfill required functions due to malfunction of equipment defined under responsibility of EMCS contractor. Downtime is measured by duration, in time, between time that Contractor is notified of failure and time system is restored to proper operating condition. Downtime not to include following:
  - .1 Outage of main power supply in excess of back-up power sources, provided that:
    - .1 Automatic initiation of back-up was accomplished.
    - .2 Automatic shut-down and re-start of components was as specified.
  - .2 Failure of communications link, provided that:
    - .1 Controller automatically and correctly operated in stand-alone mode.
    - .2 Failure was not due to failure of any specified EMCS equipment.
  - .3 Functional failure resulting from individual sensor inputs or output devices, provided that:
    - .1 System recorded said fault.
    - .2 Equipment defaulted to fail-safe mode.
    - .3 AEL of total of all input sensors and output devices is at least 99 % during test period.

### **1.2                COMMISSIONING**

- .1 Do commissioning in accordance with Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.
- .2 Carry out commissioning under direction of Departmental Representative.
- .3 Inform, and obtain approval from, Departmental Representative in writing at least 14 days prior to commissioning or each test. Indicate:
  - .1 Location and part of system to be tested or commissioned.
  - .2 Testing/commissioning procedures, anticipated results.
  - .3 Names of testing/commissioning personnel.
- .4 Correct deficiencies, re-test in presence of Departmental Representative until satisfactory performance is obtained.
- .5 Acceptance of tests will not relieve Contractor from responsibility for ensuring that complete systems meet every requirement of Contract.

.6 Load system with project software.

.7 Perform tests as required.

### **1.3 COMPLETION OF COMMISSIONING**

.1 Commissioning to be considered as satisfactorily completed when objectives of commissioning have been achieved and reviewed by Departmental Representative and PWGSC Commissioning Manager.

### **1.4 ISSUANCE OF FINAL CERTIFICATE OF COMPLETION**

.1 Final Certificate of Completion will not be issued until receipt of written approval indicating successful completion of specified commissioning activities including receipt of commissioning documentation.

## **Part 2 Products**

### **2.1 EQUIPMENT**

.1 Provide sufficient instrumentation to verify and commission the installed system. Provide two-way radios.

.2 Instrumentation accuracy tolerances: higher order of magnitude than equipment or system being tested.

.3 Independent testing laboratory to certify test equipment as accurate to within approved tolerances no more than 2 months prior to tests.

.4 Locations to be approved, readily accessible and readable.

.5 Application: to conform to normal industry standards.

## **Part 3 Execution**

### **3.1 PROCEDURES**

.1 Test each system independently and then in unison with other related systems.

.2 Debug system software.

.3 Optimize operation and performance of systems by fine-tuning PID values and modifying CDLs as required.

.4 Test full scale emergency evacuation and life safety procedures including operation and integrity of smoke management systems under normal and emergency power conditions as applicable.

### **3.2 FIELD QUALITY CONTROL**

.1 Pre-Installation Testing.

.1 General: consists of field tests of equipment just prior to installation.

.2 Testing may be on site or at Contractor's premises as approved by Departmental Representative.

- .3 Configure major components to be tested in same architecture as designed system. Include BECC equipment and 2 sets of Building Controller's including MCU's, LCU's, and TCU's.
- .4 Equip each Building Controller with sensor and controlled device of each type (AI, AO, DI, DO).
- .5 Additional instruments to include:
  - .1 DP transmitters.
  - .2 VAV supply duct SP transmitters.
  - .3 DP switches used for dirty filter indication and fan status.
- .6 In addition to test equipment, provide inclined manometer, digital micro-manometer, milli-amp meter, source of air pressure infinitely adjustable between 0 and 500 Pa, to hold steady at any setting and with direct output.
- .7 After setting, test zero and span in 10 % increments through entire range while both increasing and decreasing pressure.
- .8 Transmitters above 0.5 % error will be rejected.
- .9 DP switches to open and close within 2 % of setpoint.
- .2 Completion Testing.
  - .1 General: test after installation of each part of system and after completion of mechanical and electrical hook-ups, to verify correct installation and functioning.
  - .2 Include following activities:
    - .1 Test and calibrate field hardware including stand-alone capability of each controller.
    - .2 Verify each A-to-D convertor.
    - .3 Test and calibrate each AI using calibrated digital instruments.
    - .4 Test each DI to ensure proper settings and switching contacts.
    - .5 Test each DO to ensure proper operation and lag time.
    - .6 Test each AO to ensure proper operation of controlled devices. Verify tight closure and signals.
    - .7 Test operating software.
    - .8 Test application software and provide samples of logs and commands.
    - .9 Verify each CDL including energy optimization programs.
    - .10 Debug software.
    - .11 Blow out flow measuring and static pressure stations with high pressure air at 700 kPa.
    - .12 Provide point verification list in table format including point identifier, point identifier expansion, point type and address, low and high limits and engineering units. Include space on commissioning technician and Departmental Representative. This document will be used in final startup testing.

- .3 Final Startup Testing: Upon satisfactory completion of tests, perform point-by-point test of entire system under direction of Departmental Representative and PWGSC Commissioning Manager and provide:
  - .1 2 technical personnel capable of re-calibrating field hardware and modifying software.
  - .2 Detailed daily schedule showing items to be tested and personnel available.
  - .3 Departmental Representative's acceptance signature to be on executive and applications programs.
  - .4 Commissioning to commence during final startup testing.
  - .5 O&M personnel to assist in commissioning procedures as part of training.
  - .6 Commissioning to be supervised by qualified supervisory personnel and Departmental Representative.
  - .7 Commission systems considered as life safety systems before affected parts of the facility are occupied.
  - .8 Operate systems as long as necessary to commission entire project.
  - .9 Monitor progress and keep detailed records of activities and results.
- .4 Final Operational Testing: to demonstrate that EMCS functions in accordance with contract requirements.
  - .1 Prior to beginning of 30 day test demonstrate that operating parameters (setpoints, alarm limits, operating control software, sequences of operation, trends, graphics and CDL's) have been implemented to ensure proper operation and operator notification in event of off-normal operation.
    - .1 Repetitive alarm conditions to be resolved to minimize reporting of nuisance conditions.
  - .2 Test to last at least 30 consecutive 24 hour days.
  - .3 Tests to include:
    - .1 Demonstration of correct operation of monitored and controlled points.
    - .2 Operation and capabilities of sequences, reports, special control algorithms, diagnostics, software.
  - .4 System will be accepted when:
    - .1 EMCS equipment operates to meet overall performance requirements. Downtime as defined in this Section must not exceed allowable time calculated for this site.
    - .2 Requirements of Contract have been met.
  - .5 In event of failure to attain specified AEL during test period, extend test period on day-to-day basis until specified AEL is attained for test period.
  - .6 Correct defects when they occur and before resuming tests.
- .5 Departmental Representative to verify reported results.

**3.3 ADJUSTING**

- .1 Final adjusting: upon completion of commissioning as reviewed by Departmental Representative, set and lock devices in final position and permanently mark settings.

**END OF SECTION**



**Part 1        General**

**1.1            DEFINITIONS**

- .1    CDL - Control Description Logic.
- .2    For additional acronyms and definitions refer to Section 25 05 01 - EMCS: General Requirements.

**1.2            INSTRUCTIONS**

- .1    Provide instruction to designated personnel in adjustment, operation, maintenance and pertinent safety requirements of EMCS installed.
- .2    Training to be project-specific.

**1.3            TIME FOR TRAINING**

- .1    Number of days of instruction to be as specified in this section (1 day = 8 hours including two 15 minute breaks and excluding lunch time).

**1.4            TRAINING MATERIALS**

- .1    Provide equipment, visual and audio aids, and materials for classroom training.
- .2    Supply manual for each trainee, describing in detail data included in each training program.
  - .1    Review contents of manual in detail to explain aspects of operation and maintenance (O&M).

**1.5            TRAINING PROGRAM**

- .1    To be in 2 phases over 6 month period.
- .2    Phase 1: 1 day program to begin before 30 day test period at time mutually agreeable to Contractor et Departmental Representative.
  - .1    Train O&M personnel in functional operations and procedures to be employed for system operation.
  - .2    Supplement with on-the-job training during 30 days test period.
  - .3    Include overview of system architecture, communications, operation of computer and peripherals, report generation.
  - .4    Include detailed training on operator interface functions for control of mechanical systems, CDL's for each system, and elementary preventive maintenance.
- .3    Phase 2: 1 day program to begin 8 weeks after acceptance for operators, equipment maintenance personnel and programmers.
  - .1    Provide multiple instructors on pre-arranged schedule. Include at least following:

- .1 Operator training: provide operating personnel, maintenance personnel and programmers with condensed version of Phase 1 training.
- .2 Equipment maintenance training: provide personnel with 1 day training in maintenance of EMCS equipment, including general equipment layout, trouble shooting and preventive maintenance of EMCS components, maintenance and calibration of sensors and controls.
- .3 Programmers: provide personnel with 1 day training.

**1.6 ADDITIONAL TRAINING**

- .1 List courses offered by name, duration and approximate cost per person per week. Note courses recommended for training supervisory personnel.

**1.7 MONITORING OF TRAINING**

- .1 Departmental Representative to monitor training program and may modify schedule and content.

**Part 2 Products**

**2.1 NOT USED**

- .1 Not Used.

**Part 3 Execution**

**3.1 NOT USED**

- .1 Not Used.

**END OF SECTION**

## **Part 1        General**

### **1.1        REFERENCE STANDARDS**

- .1 American National Standards Institute (ANSI)/The Instrumentation, Systems and Automation Society (ISA).
  - .1 ANSI/ISA 5.5, Graphic Symbols for Process Displays.
- .2 American National Standards Institute (ANSI)/Institute of Electrical and Electronics Engineers (IEEE).
  - .1 ANSI/IEEE 260.1, American National Standard Letter Symbols Units of Measurement (SI Units, Customary Inch-Pound Units, and Certain Other Units).
- .3 American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE).
  - .1 ASHRAE STD 135, BACNET - Data Communication Protocol for Building Automation and Control Network.
- .4 CSA Group (CSA).
  - .1 CAN/CSA-Z234.1, Canadian Metric Practice Guide.
- .5 Consumer Electronics Association (CEA).
  - .1 CEA-709.1, Control Network Protocol Specification.
- .6 Department of Justice Canada (Jus).
  - .1 Canadian Environmental Assessment Act (CEAA), 1995, c. 37.
  - .2 Canadian Environmental Protection Act (CEPA), 1999, c. 33.
- .7 Electrical and Electronic Manufacturers Association (EEMAC).
  - .1 EEMAC 2Y-1, Light Grey Colour for Indoor Switch Gear.
- .8 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
  - .1 Safety Data Sheets (SDS).
- .9 Transport Canada (TC).
  - .1 Transportation of Dangerous Goods Act (TDGA), 1992, c. 34.

### **1.2        ABBREVIATIONS AND ACRONYMS**

- .1 Acronyms used in EMCS:
  - .1 AEL - Average Effectiveness Level
  - .2 AI - Analog Input
  - .3 AIT - Agreement on International Trade
  - .4 AO - Analog Output
  - .5 BACnet - Building Automation and Control Network.
  - .6 BC(s) - Building Controller(s).

- .7 BECC - Building Environmental Control Centre.
- .8 CAD - Computer Aided Design.
- .9 CDL - Control Description Logic.
- .10 CDS - Control Design Schematic.
- .11 COSV - Change of State or Value.
- .12 CPU - Central Processing Unit.
- .13 DI - Digital Input.
- .14 DO - Digital Output.
- .15 DP - Differential Pressure.
- .16 ECU - Equipment Control Unit.
- .17 EMCS - Energy Monitoring and Control System.
- .18 HVAC - Heating, Ventilation, Air Conditioning.
- .19 IDE - Interface Device Equipment.
- .20 I/O - Input/Output.
- .21 ISA - Industry Standard Architecture.
- .22 LAN - Local Area Network.
- .23 LCU - Local Control Unit.
- .24 MCU - Master Control Unit.
- .25 NAFTA - North American Free Trade Agreement.
- .26 NC - Normally Closed.
- .27 NO - Normally Open.
- .28 OS - Operating System.
- .29 O&M - Operation and Maintenance.
- .30 OWS - Operator Work Station.
- .31 PC - Personal Computer.
- .32 PCI - Peripheral Control Interface.
- .33 PCMCIA - Personal Computer Micro-Card Interface Adapter.
- .34 PID - Proportional, Integral and Derivative.
- .35 RAM - Random Access Memory.
- .36 SP - Static Pressure.
- .37 ROM - Read Only Memory.
- .38 TCU - Terminal Control Unit.
- .39 USB - Universal Serial Bus.
- .40 UPS - Uninterruptible Power Supply.
- .41 VAV - Variable Air Volume.

### **1.3 DEFINITIONS**

- .1 Point: may be logical or physical.
  - .1 Logical points: values calculated by system such as setpoints, totals, counts, derived corrections and may include, but not limited to result of and statements in CDL's.

- .2 Physical points: inputs or outputs which have hardware wired to controllers which are measuring physical properties, or providing status conditions of contacts or relays which provide interaction with related equipment (stop, start) and valve or damper actuators.
- .2 Point Name: composed of two parts, point identifier and point expansion.
  - .1 Point identifier: comprised of three descriptors, "area" descriptor, "system" descriptor and "point" descriptor, for which database to provide 25 character field for each point identifier. "System" is system that point is located on.
    - .1 Area descriptor: building or part of building where point is located.
    - .2 System descriptor: system that point is located on.
    - .3 Point descriptor: physical or logical point description. For point identifier "area", "system" and "point" will be shortforms or acronyms. Database must provide 25 character field for each point identifier.
  - .2 Point expansion: comprised of three fields, one for each descriptor. Expanded form of shortform or acronym used in "area", "system" and "point" descriptors is placed into appropriate point expansion field. Database must provide [32] character field for each point expansion.
  - .3 Bilingual systems to include additional point identifier expansion fields of equal capacity for each point name for second language.
    - .1 System to support use of numbers and readable characters including blanks, periods or underscores to enhance user readability for each of the above strings.
- .3 Point Object Type: points fall into following object types:
  - .1 AI (analog input).
  - .2 AO (analog output).
  - .3 DI (digital input).
  - .4 DO (digital output).
  - .5 Pulse inputs.
- .4 Symbols and engineering unit abbreviations utilized in displays: to ANSI/ISA S5.5.
  - .1 Printouts: to ANSI/IEEE 260.1.

#### **1.4 SYSTEM DESCRIPTION**

- .1 Refer to control schematics for system architecture.
- .2 Work covered by sections referred to above consists of fully operational EMCS, including, but not limited to, following:
  - .1 Building Controllers.
  - .2 Control devices as listed in I/O point summary tables.
  - .3 OWS(s).

- .4 Data communications equipment necessary to effect EMCS data transmission system.
- .5 Field control devices.
- .6 Software/Hardware complete with full documentation.
- .7 Complete operating and maintenance manuals.
- .8 Training of personnel.
- .9 Acceptance tests, technical support during commissioning, full documentation.
- .10 Wiring interface co-ordination of equipment supplied by others.
- .11 Miscellaneous work as specified in these sections and as indicated.
- .3 Design Requirements:
  - .1 Design and provide conduit and wiring linking elements of system.
  - .2 Supply sufficient programmable controllers of types to meet project requirements. Quantity and points contents as reviewed by Departmental Representative prior to installation.
  - .3 Location of controllers as reviewed by Departmental Representative prior to installation.
  - .4 Provide utility power to EMCS as indicated.
  - .5 Metric references: in accordance with CAN/CSA Z234.1.
- .4 Language Operating Requirements:
  - .1 Provide French operator selectable access codes.
  - .2 Use non-linguistic symbols for displays on graphic terminals. Other information to be in French.
  - .3 Operating system executive: provide primary hardware-to-software interface specified as part of hardware purchase with associated documentation to be in French.
  - .4 System manager software: include in French system definition point database, additions, deletions or modifications, control loop statements, use of high level programming languages, report generator utility and other OS utilities used for maintaining optimal operating efficiency.
  - .5 Include, in French:
    - .1 Alarms as defined in CDL's or assigned limits (i.e. commands relating to day-to-day operating functions and not related to system modifications, additions, or logic re-definitions).
    - .2 Graphic "display" functions, point commands to turn systems on or off, manually override automatic control of specified hardware points. To be in French at specified OWS and to be able to operate one terminal in English and second in French. Point name expansions in both languages.
    - .3 Reporting function such as trend log, trend graphics, alarm report logs, energy report logs, maintenance generated logs.

**1.5 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Make submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Quality Control:
  - .1 Provide equipment and material from manufacturer's regular production, CSA certified, manufactured to standard quoted plus additional specified requirements.
  - .2 Where CSA certified equipment is not available submit such equipment to inspection authorities for special inspection and approval before delivery to site.
  - .3 Submit proof of compliance to specified standards with shop drawings and product data. Label or listing of specified organization is acceptable evidence.
  - .4 In lieu of such evidence, submit certificate from testing organization, certifying that item was tested in accordance with their test methods and that item conforms to their standard/code.
  - .5 Permits and fees: in accordance with general conditions of contract.
  - .6 Submit certificate of acceptance from authority having jurisdiction to Departmental Representative.
  - .7 Existing devices intended for re-use: submit test report.

**1.6 QUALITY ASSURANCE**

- .1 Have local office within 50 km of project staffed by trained personnel capable of providing instruction, routine maintenance and emergency service on systems,
- .2 Provide record of successful previous installations submitting tender showing experience with similar installations utilizing computer-based systems.
- .3 Have access to local supplies of essential parts and provide 7 year guarantee of availability of spare parts after obsolescence.
- .4 Ensure qualified supervisory personnel continuously direct and monitor Work and attend site meetings.

**Part 2 Products**

**2.1 ADAPTORS**

- .1 Provide adaptors between metric and imperial components.

**Part 3 Execution**

**3.1 MANUFACTURER'S RECOMMENDATIONS**

- .1 Installation: to manufacturer's recommendations.

### 3.2 SEISMIC PROTECTION

- .1 General
  - .1 Contractor is responsible to evaluate, furnish and install seismic protection for all new technical components as well as all relocated or modified technical components under his responsibility.
  - .2 Hire an Engineer, member in good standing of the Ordre des ingénieurs du Québec, for the evaluation of the seismic risk and calculation of seismic force resisting systems. The hired Engineering shall demonstrate recognized expertise in seismic protection. Contractor shall provide his contact details no more than two (2) weeks after contract signature.
  - .3 During an earthquake, seismic protection devices shall prevent permanent displacements and damages caused by vertical and horizontal motions and overturns.
- .2 Design criterias
  - .1 Site class and Importance category of the building is to be determined.
- .3 Evaluation and mitigation of seismic effects
  - .1 Evaluation of seismic effects shall be done as per requirements of sub-section 4.1.8 of the Quebec Construction Code, Chapter I – Building, and National Building Code of Canada (amended).
  - .2 Seismic force resisting systems shall be designed as per following standards:
    - .1 NFPA 13 et 20;
    - .2 SMACNA – Seismic Restraint Manual Guidelines for Mechanical System;
    - .3 ASHRAE – Seismic and Wind Design;
    - .4 FEMA;
    - .5 Engineering documents from earthquake-resistant devices manufacturers.
- .4 Evaluation and mitigation of seismic effects report
  - .1 Submit to the Engineer the evaluation and mitigation of seismic effects report before beginning the installation of the technical components.
  - .2 The report shall include, at least, the following information:
    - .1 General data for the project:
      - .1 Location of the building;
      - .2 General description of the building including height of the building ( $h_n$ );
      - .3 Site class at the location of the building;
      - .4 Importance category of the building;
      - .5 Value of  $S_a$  (0.2);
      - .6 Value of  $F_a$ ;
      - .7 Value of  $I_e$ .

- .2 List of all technical components included in the contract which need to be have an evaluation of the seismic effects.
- .3 List of all technical components which may be exempted with the justifications.
- .4 For each technical component (CT) the evaluation of the seismic effect and the seismic force resisting system applied. Include following elements:
  - .1 Identification of the CT;
  - .2 Location of the CT including height ( $h_x$ );
  - .3 Description of CT including:
    - .1 Type of equipment;
    - .2 Make and model;
    - .3 Dimensions;
    - .4 Weight;
    - .5 Category and values of  $C_p$ ,  $A_r$  et  $R_p$ .
  - .4 Calculation of lateral force  $V_p$ , and forces on building structure;
  - .5 Description of the resisting system applied, including:
    - .1 Make and model of chosen material;
    - .2 Installation drawing specific for this project;
    - .3 Drawing showing the location of the seismic resisting systems.
- .5 For each CT located on the ground, on a slab or on an equipment base, the overturn force calculation and description of the resisting system. Included following elements:
  - .1 Identification of the CT;
  - .2 Location of the CT including height ( $h_x$ );
  - .3 Description of CT including:
    - .1 Type of equipment;
    - .2 Make and model;
    - .3 Dimensions;
    - .4 Weight;
    - .5 Location of gravity center;
  - .4 Calculation of the overturn force;
  - .5 Description of the resisting system applied, including:
    - .1 Mark and model of chosen material;
    - .2 Installation drawing specific for this project;
    - .3 Drawing showing the location of the seismic resisting systems.

- .5 Installation
  - .1 Install seismic force resisting system as per the indications of the evaluation and mitigation of seismic effects report.
  - .2 Any modification to the seismic force resisting system for any reason, shall be subject to a new calculation by the Engineer responsible for the seismic protection, and issued as an amendment to the report.
  - .3 Following requirements apply to the installation of electrical and mechanical material:
    - .1 Power-driven and drop-in anchors are not permitted for traction loads;
    - .2 C-clamps are not allowed to support CT unless they have a retainer mechanism;
    - .3 C-clamps are not allowed for seismic resisting systems;
    - .4 Equipment base shall be anchored to the slab;
    - .5 All vibration isolators shall be designed for seismic protection;
    - .6 Oval bolt adjusting hole are prohibited.
  - .4 Seismic protection systems must be designed in a manner not to compromise the performance of vibration isolation or thermal expansion components designed to allow piping and equipments movements. In these cases, flexible or lose anchors and ties must be used rather than rigid structures.
- .6 Work approval
  - .1 The Engineer who prepared the evaluation and mitigation of seismic effects report shall inspect the work related to the seismic force resisting systems.
  - .2 Obtain from the seismic protection engineer a written and signed certification indicating that the seismic force resisting systems have been installed as per the report and the amendments to the report. Submit this certification before submitting of the work certificate of compliance.
  - .3 Include in the operation and maintenance manual all documents issued by the seismic protection engineer.

**END OF SECTION**

## **Part 1        General**

### **1.1            REFERENCE STANDARDS**

- .1        CSA Group (CSA).
  - .1        CSA C22.1, The Canadian Electrical Code, Part I (19th Edition), Safety Standard for Electrical Installations.

### **1.2            DEFINITIONS**

- .1        For acronyms and definitions refer to Section 25 05 01 - EMCS: General Requirements.

## **Part 2        Products**

### **2.1            NAMEPLATES FOR PANELS**

- .1        Identify by Plastic laminate, 3 mm thick, black core, square corners, lettering accurately aligned and engraved into core.
- .2        Sizes: 25 x 67 mm minimum.
- .3        Lettering: minimum 7 mm high, black.
- .4        Inscriptions: machine engraved to identify function.

### **2.2            NAMEPLATES FOR FIELD DEVICES**

- .1        Identify by plastic encased cards attached by chain.
- .2        Sizes: 50 x 100 mm minimum.
- .3        Lettering: minimum 5 mm high produced from laser printer in black.
- .4        Data to include: point name and point address.
- .5        Companion cabinet: identify interior components using plastic enclosed cards with point name and point address.

### **2.3            NAMEPLATES FOR ROOM SENSORS**

- .1        Identify by stick-on labels using point identifier.
- .2        Location: as directed by Departmental Representative.
- .3        Letter size: to suit, clearly legible.

### **2.4            WARNING SIGNS**

- .1        Equipment including motors, starters under remote automatic control: supply and install orange coloured signs warning of automatic starting under control of EMCS.
- .2        Sign to read: "Caution: This equipment is under automatic remote control of EMCS" as reviewed by Departmental Representative's.

**2.5 WIRING**

- .1 Supply and install numbered tape markings on wiring at panels, junction boxes, splitters, cabinets and outlet boxes.
- .2 Colour coding: to CSA C22.1. Use colour coded wiring in communications cables, matched throughout system.
- .3 Power wiring: identify circuit breaker panel/circuit breaker number inside each EMCS panel.

**2.6 CONDUIT**

- .1 Colour code EMCS conduit.
- .2 Pre-paint box covers and conduit fittings.
- .3 Coding: use fluorescent orange paint and confirm colour with Departmental Representative during "Preliminary Design Review";.

**Part 3 Execution**

**3.1 NAMEPLATES AND LABELS**

- .1 Ensure that manufacturer's nameplates, CSA labels and identification nameplates are visible and legible at all times.

**END OF SECTION**

**Part 1            General**

**1.1                REFERENCE STANDARDS**

- .1        Canada Labour Code (R.S. 1985, c. L-2)/Part I - Industrial Relations.
- .2        CSA Group (CSA).
  - .1        CSA Z204, Guidelines for Managing Indoor Air Quality in Office Buildings.

**1.2                MAINTENANCE SERVICE DURING WARRANTY PERIOD**

- .1        Provide services, materials, and equipment to maintain EMCS for specified warranty period. Provide detailed preventative maintenance schedule for system components as described in Submittal article.
- .2        Emergency Service Calls:
  - .1        Initiate service calls when EMCS is not functioning correctly.
  - .2        Qualified control personnel to be available during warranty period to provide service to &quot;CRITICAL&quot; components whenever required at no extra cost.
  - .3        Furnish Departmental Representative with telephone number where service personnel may be reached at any time.
  - .4        Service personnel to be on site ready to service EMCS within 2 hours after receiving request for service.
  - .5        Perform Work continuously until EMCS restored to reliable operating condition.
- .3        Operation: foregoing and other servicing to provide proper sequencing of equipment and satisfactory operation of EMCS based on original design conditions and as recommended by manufacturer.
- .4        Work requests: record each service call request, when received separately on approved form and include:
  - .1        Serial number identifying component involved.
  - .2        Location, date and time call received.
  - .3        Nature of trouble.
  - .4        Names of personnel assigned.
  - .5        Instructions of work to be done.
  - .6        Amount and nature of materials used.
  - .7        Time and date work started.
  - .8        Time and date of completion.
- .5        Provide system modifications in writing.
  - .1        No system modification, including operating parameters and control settings, to be made without prior written approval of Departmental Representative.

**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            REFERENCE STANDARDS**

- .1    CSA Group (CSA).
  - .1    CSA T529, Telecommunications Cabling Systems in Commercial Buildings (Adopted ANSI/TIA/EIA-568-A with modifications).
  - .2    CSA T530, Commercial Building Standard for Telecommunications Pathways and Spaces (Adopted ANSI/TIA/EIA-569-A with modifications).
- .2    Institute of Electrical and Electronics Engineers (IEEE)/Standard for Information technology - Telecommunications and information exchange between systems - Local and metropolitan area networks - Specific requirements.
  - .1    IEEE Std 802.3TM-, Part 3: Carrier sense multiple access with collision detection (CSMA/CD) access method and physical layer specifications.
- .3    Telecommunications Industries Association (TIA)/Electronic Industries Alliance (EIA)
  - .1    TIA/EIA-568, Commercial Building Telecommunications Cabling Standards Set, Part 1 General Requirements Part 2 Balanced Twisted-Pair Cabling Components Part 3 Optical Fiber Cabling Components Standard.
  - .2    TIA/EIA-569-A, Commercial Building Standard for Telecommunications Pathways and Spaces.
- .4    Treasury Board Information Technology Standard (TBITS).
  - .1    TBITS 6.9, Profile for the Telecommunications Wiring System in Government Owned and Leased Buildings - Technical Specifications.

**1.2            SYSTEM DESCRIPTION**

- .1    Data communication network to link Operator Workstations and Master Control Units (MCU) in accordance with [TBITS 6.9, CSA T530, TIA/EIA-568, TIA/EIA-569-A and CSA T529].
  - .1    Provide reliable and secure connectivity of adequate performance between different sections (segments) of network.
  - .2    Allow for future expansion of network, with selection of networking technology and communication protocols.
- .2    Data communication network to include, but not limited to:
  - .1    EMCS-LAN.
  - .2    Modems.
  - .3    Network interface cards.
  - .4    Network management hardware and software.
  - .5    Network components necessary for complete network.

**1.3 DESIGN REQUIREMENTS**

- .1 EMCS Local Area Network (EMCS-LAN).
  - .1 High speed, high performance, local area network over which MCUs and OWSs communicate with each other directly on peer to peer basis in accordance with IEEE 802.3/Ethernet Standard.
  - .2 EMCS-LAN to: BACnet.
  - .3 Each EMCS-LAN to be capable of supporting at least 50 devices.
  - .4 Support of combination of MCUs and OWSs directly connected to EMCS-LAN.
  - .5 High speed data transfer rates for alarm reporting, quick report generation from multiple controllers, upload/download information between network devices. Bit rate to be 10 Megabits per second minimum.
  - .6 Detection and accommodation of single or multiple failures of either OWSs, MCUs or network media. Operational equipment to continue to perform designated functions effectively in event of single or multiple failures.
  - .7 Commonly available, multiple sourced, networking components and protocols to allow system to co-exist with other networking applications including office automation.
- .2 Dynamic Data Access.
  - .1 LAN to provide capabilities for OWSs, either network resident or connected remotely, to access point status and application report data or execute control functions for other devices via LAN.
  - .2 Access to data to be based upon logical identification of building equipment.
- .3 Network Medium.
  - .1 Network medium: shielded twisted cable, compatible with network protocol to be used within buildings.

**Part 2 Products**

**2.1 NOT USED**

- .1 Not Used.

**Part 3 Execution**

**3.1 NOT USED**

- .1 Not Used.

**END OF SECTION**

**Part 1            General**

**1.1                REFERENCE STANDARDS**

- .1 American Society of Heating, Refrigeration and Air-Conditioning Engineers, Inc. (ASHRAE).
  - .1 ASHRAE, Applications Handbook, SI Edition.
- .2 Institute of Electrical and Electronics Engineers (IEEE).
  - .1 IEEE C37.90.1, Surge Withstand Capabilities (SWC) Tests for Relays and Relay Systems Associated with Electric Power Apparatus.
- .3 Public Works and Government Services Canada (PWGSC)/Real Property Branch/Architectural and Engineering Services.
  - .1 MD13800, Energy Management and Control Systems (EMCS) Design Manual. English: <ftp://ftp.pwgsc.gc.ca/rps/docentre/mechanical/me214-e.pdf>

**1.2                DEFINITIONS**

- .1 Acronyms and definitions: refer to Section 25 05 01 - EMCS: General Requirements.

**1.3                DESCRIPTION**

- .1 General: Network of controllers comprising of MCU('s), LCU('s), ECU('s) or TCU('s) to be provided as indicated in System Architecture Diagram to support building systems and associated sequence(s) of operations as detailed in these specifications.
  - .1 Provide sufficient controllers to meet intents and requirements of this section.
  - .2 Controller quantity, and point contents to be approved by Departmental Representative at time of preliminary design review.
- .2 Controllers: stand-alone intelligent Control Units.
  - .1 Incorporate programmable microprocessor, non-volatile program memory, RAM, power supplies, as required to perform specified functions.
  - .2 Incorporate communication interface ports for communication to LANs to exchange information with other Controllers.
  - .3 Capable of interfacing with operator interface device.
  - .4 Execute its logic and control using primary inputs and outputs connected directly to its onboard input/output field terminations or slave devices, and without need to interact with other controller. Secondary input used for reset such as outdoor air temperature may be located in other Controller(s).
    - .1 Secondary input used for reset such as outdoor air temperature may be located in other Controller(s).

- .3 Interface to include provisions for use of dial-up modem for interconnection with remote modem.
  - .1 Dial-up communications to use 56 Kbit modems and voice grade telephone lines.
  - .2 Each stand-alone panel may have its own modem or group of stand-alone panels may share modem.

#### 1.4 DESIGN REQUIREMENTS

- .1 To include:
  - .1 Scanning of AI and DI connected inputs for detection of change of value and processing detection of alarm conditions.
  - .2 Perform On-Off digital control of connected points, including resulting required states generated through programmable logic output.
  - .3 Perform Analog control using programmable logic, (including PID) with adjustable dead bands and deviation alarms.
  - .4 Control of systems as described in sequence of operations.
  - .5 Execution of optimization routines as listed in this section.
- .2 Total spare capacity for MCUs and LCUs: at least 25 % of each point type distributed throughout the MCUs and LCUs.
- .3 Field Termination and Interface Devices:
  - .1 To: CSA C22.2 No.205.
  - .2 Electronically interface sensors and control devices to processor unit.
  - .3 Include, but not be limited to, following:
    - .1 Programmed firmware or logic circuits to meet functional and technical requirements.
    - .2 Power supplies for operation of logics devices and associated field equipment.
    - .3 Lockable wall cabinet.
    - .4 Required communications equipment and wiring (if remote units).
    - .5 Leave controlled system in "fail-safe" mode in event of loss of communication with, or failure of, processor unit.
    - .6 Input Output interface to accept as minimum AI, AO, DI, DO functions as specified.
    - .7 Wiring terminations: use conveniently located screw type or spade lug terminals.
  - .4 AI interface equipment to:
    - .1 Convert analog signals to digital format with 10 bit analog-to-digital resolution.
    - .2 Provide for following input signal types and ranges:
      - .1 4 - 20 mA;
      - .2 0 - 10 V DC;
      - .3 100/1000 ohm RTD input;

- .3 Meet IEEE C37.90.1 surge withstand capability.
- .4 Have common mode signal rejection greater than 60 dB to 60 Hz.
- .5 Where required, dropping resistors to be certified precision devices which complement accuracy of sensor and transmitter range specified.
- .5 AO interface equipment:
  - .1 Convert digital data from controller processor to acceptable analog output signals using [8] bit digital-to-analog resolution.
  - .2 Provide for following output signal types and ranges:
    - .1 4 - 20 mA.
    - .2 0 - 10 V DC.
  - .3 Meet IEEE C37.90.1 surge withstand capability.
- .6 DI interface equipment:
  - .1 Able to reliably detect contact change of sensed field contact and transmit condition to controller.
  - .2 Meet IEEE C37.90.1 surge withstand capability.
  - .3 Accept pulsed inputs up to 2 kHz.
- .7 DO interface equipment:
  - .1 Respond to controller processor output, switch respective outputs. Each DO hardware to be capable of switching up to 0.5 amps at 24 V AC.
  - .2 Switch up to 5 amps at 220 V AC using optional interface relay.
- .4 Controllers and associated hardware and software: operate in conditions of 0 degrees C to 44 degrees C and 20 % to 90 % non-condensing RH.
- .5 Controllers (MCU, LCU): mount in wall mounted cabinet with hinged, keyed-alike locked door.
  - .1 Provide for conduit entrance from top, bottom or sides of panel.
  - .2 ECUs and TCUs to be mounted in equipment enclosures or separate enclosures.
  - .3 Mounting details as approved by Departmental Representative for ceiling mounting.
- .6 Cabinets to provide protection from water dripping from above, while allowing sufficient airflow to prevent internal overheating.
- .7 Provide surge and low voltage protection for interconnecting wiring connections.

## **1.5 MAINTENANCE**

- .1 Provide manufacturers recommended maintenance procedures for insertion.

**Part 2 Products**

**2.1 MASTER CONTROL UNIT (MCU)**

- .1 General: primary function of MCU is to provide co-ordination and supervision of subordinate devices in execution of optimization routines such as demand limiting or enthalpy control.
- .2 Include high speed communication LAN Port for Peer to Peer communications with OWS(s) and other MCU level devices.
  - .1 MCU must support BACnet.
- .3 MCU local I/O capacity as follows:
  - .1 MCU I/O points as allocated in I/O Summary Table referenced in MD13800.
  - .2 LCUs may be added to support system functions.
- .4 Central Processing Unit (CPU).
  - .1 Processor to consist of minimum 16 bit microprocessor capable of supporting software to meet specified requirements.
  - .2 CPU idle time to be more than 30 % when system configured to maximum input and output with worst case program use.
  - .3 Minimum addressable memory to be at manufacturer's discretion but to support at least performance and technical specifications to include but not limited to:
    - .1 Non-volatile EEPROM to contain operating system, executive, application, sub-routine, other configurations definition software. Tape media not acceptable.
    - .2 Battery backed (72 hour minimum capacity) RAM (to reduce the need to reload operating data in event of power failure) to contain CDLs, application parameters, operating data or software that is required to be modifiable from operational standpoint such as schedules, setpoints, alarm limits, PID constants and CDL and hence modifiable on-line through operator panel or remote operator's interface. RAM to be downline loadable from OWS.
  - .4 Include uninterruptible clock accurate to plus or minus 5 secs/month, capable of deriving year/month/day/hour/minute/second, with rechargeable batteries for minimum 72 hour operation in event of power failure.
- .5 Local Operator Terminal (OT): Provide OT for each MCU unless otherwise specified in Section 25 90 01 - EMCS: Site Requirements, Applications and System Sequences of Operation.
  - .1 Mount access/display panel in MCU or in suitable enclosure beside MCU as approved by Departmental Representative.
  - .2 Support operator's terminal for local command entry, instantaneous and historical data display, programs, additions and modifications.

- .3 Display simultaneously minimum of 16 point identifiers to allow operator to view single screen dynamic displays depicting entire mechanical systems. Point identifiers to be in French.
- .4 Functions to include, but not be limited to, following:
  - .1 Start and stop points.
  - .2 Modify setpoints.
  - .3 Modify PID loop parameters.
  - .4 Override PID control.
  - .5 Change time/date.
  - .6 Add/modify/start/stop weekly scheduling.
  - .7 Add/modify setpoint weekly scheduling.
  - .8 Enter temporary override schedules.
  - .9 Define holiday schedules.
  - .10 View analog limits.
  - .11 Enter/modify analog warning limits.
  - .12 Enter/modify analog alarm limits.
  - .13 Enter/modify analog differentials.
- .5 Provide access to real and calculated points in controller to which it is connected or to other controller in network. This capability not to be restricted to subset of predefined "global points" but to provide totally open exchange of data between OT and other controller in network.
- .6 Operator access to OTs: same as OWS user password and password changes to automatically be downloaded to controllers on network.
- .7 Provide prompting to eliminate need for user to remember command format or point names. Prompting to be consistent with user's password clearance and types of points displayed to eliminate possibility of operator error.
- .8 Identity of real or calculated points to be consistent with network devices. Use same point identifier as at OWS's for access of points at OT to eliminate cross-reference or look-up tables.

## 2.2 SOFTWARE

- .1 General.
  - .1 Include as minimum: operating system executive, communications, application programs, operator interface, and systems sequence of operation - CDL's.
  - .2 Include "firmware" or instructions which are programmed into ROM, EPROM, EEPROM or other non-volatile memory.
  - .3 Include initial programming of Controllers, for entire system.
- .2 Program and data storage.
  - .1 Store executive programs and site configuration data in ROM, EEPROM or other non-volatile memory.

- .2 Maintain CDL and operating data including setpoints, operating constants, alarm limits in battery-backed RAM or EEPROM for display and modification by operator.
- .3 Programming languages.
  - .1 Program Control Description Logic software (CDL) using English like or graphical, high level, general control language.
  - .2 Structure software in modular fashion to permit simple restructuring of program modules if future software additions or modifications are required. GO TO constructs not allowed unless approved by Departmental Representative.
- .4 Operator Terminal interface.
  - .1 Operating and control functions include:
    - .1 Multi-level password access protection to allow user/manager to limit workstation control.
    - .2 Alarm management: processing and messages.
    - .3 Operator commands.
    - .4 Reports.
    - .5 Displays.
    - .6 Point identification.
- .5 Pseudo or calculated points.
  - .1 Software to provide access to value or status in controller or other networked controller in order to define and calculate pseudo point. When current pseudo point value is derived, normal alarm checks must be performed or value used to totalize.
  - .2 Inputs and outputs for process: include data from controllers to permit development of network-wide control strategies. Processes also to permit operator to use results of one process as input to number of other processes (e.g. cascading).
- .6 Control Description Logic (CDL):
  - .1 Capable of generating on-line project-specific CDLs which are software based, programmed into RAM or EEPROM and backed up to OWS. Owner must have access to these algorithms for modification or to be able to create new ones and to integrate these into CDLs on BC(s) from OWS.
  - .2 Write CDL in high level language that allows algorithms and interlocking programs to be written simply and clearly. Use parameters entered into system (e.g. setpoints) to determine operation of algorithm. Operator to be able to alter operating parameters on-line from OWS and BC(s) to tune control loops.
  - .3 Perform changes to CDL on-line.
  - .4 Control logic to have access to values or status of points available to controller including global or common values, allowing cascading or interlocking control.

- .5 Energy optimization routines including enthalpy control, supply temperature reset, to be LCU or MCU resident functions and form part of CDL.
- .6 MCU to be able to perform following pre-tested control algorithms:
  - .1 Two position control.
  - .2 Proportional Integral and Derivative (PID) control.
- .7 Control software to provide ability to define time between successive starts for each piece of equipment to reduce cycling of motors.
- .8 Provide protection against excessive electrical-demand situations during start-up periods by automatically introducing time delays between successive start commands to heavy electrical loads.
- .9 Power Fail Restart: upon detection of power failure system to verify availability of Emergency Power as determined by emergency power transfer switches and analyse controlled equipment to determine its appropriate status under Emergency power conditions and start or stop equipment as defined by I/O Summary. Upon resumption of normal power as determined by emergency power transfer switches, MCU to analyse status of controlled equipment, compare with normal occupancy scheduling, turn equipment on or off as necessary to resume normal operation.
- .7 Event and Alarm management: use management by exception concept for Alarm Reporting. This is system wide requirement. This approach will ensure that only principal alarms are reported to OWS. Events which occur as direct result of primary event to be suppressed by system and only events which fail to occur to be reported. Such event sequence to be identified in I/O Summary and sequence of operation. Examples of above are, operational temperature alarms limits which are exceeded when main air handler is stopped, or General Fire condition shuts air handlers down, only Fire alarm status shall be reported. Exception is, when air handler which is supposed to stop or start fails to do so under event condition.
- .8 Energy management programs: include specific summarizing reports, with date stamp indicating sensor details which activated and or terminated feature.
  - .1 MCU in coordination with subordinate LCU, TCU, ECU to provide for the following energy management routines:
    - .1 Time of day scheduling.
    - .2 Calendar based scheduling.
    - .3 Holiday scheduling.
    - .4 Temporary schedule overrides.
    - .5 Optimal start stop.
    - .6 Night setback control.
    - .7 Enthalpy (economizer) switchover.
    - .8 Peak demand limiting.
    - .9 Fan speed/flow rate control.

- .2 Programs to be executed automatically without need for operator intervention and be flexible enough to allow customization.
- .3 Apply programs to equipment and systems as specified or requested by the Departmental Representative.
- .9 Function/Event Totalization: features to provide predefined reports which show daily, weekly, and monthly accumulating totals and which include high rate (time stamped) and low rate (time stamped) and accumulation to date for month.
  - .1 MCUs to accumulate and store automatically run-time for binary input and output points.
  - .2 MCU to automatically sample, calculate and store consumption totals on daily, weekly or monthly basis for user-selected analog or binary pulse input-type points.
  - .3 MCU to automatically count events (number of times pump is cycled off and on) daily, weekly or monthly basis.
  - .4 Totalization routine to have sampling resolution of 1 min or less for analog inputs.
  - .5 Totalization to provide calculations and storage of accumulations up to [99,999.9] units (eg. kWh, litres, tonnes, etc.).
  - .6 Store event totalization records with minimum of 9,999,999 events before reset.
  - .7 User to be able to define warning limit and generate user-specified messages when limit reached.

### **2.3 LEVELS OF ADDRESS**

- .1 Upon operator's request, EMCS to present status of any single 'point', 'system' or point group, entire 'area', or entire network on printer or OWS as selected by operator.
  - .1 Display analog values digitally to 1 place of decimals with negative sign as required.
  - .2 Update displayed analog values and status when new values received.
  - .3 Flag points in alarm by blinking, reverse video, different colour, bracketed or other means to differentiate from points not in alarm.
  - .4 Updates to be change-of-value (COV)-driven or if polled not exceeding 2 second intervals.

### **2.4 POINT NAME SUPPORT**

- .1 Controllers (MCU, LCU) to support PWGSC point naming convention as defined in Section 25 05 01 - EMCS: General Requirements.

**Part 3 Execution**

**3.1 LOCATION**

- .1 Location of Controllers to be approved by Departmental Representative.

**3.2 INSTALLATION**

- .1 Install Controllers in secure locking enclosures.
- .2 Provide necessary power from local 120 V branch circuit panel for equipment.
- .3 Install tamper locks on breakers of circuit breaker panel.
- .4 Use uninterruptible Power Supply (UPS) and emergency power when equipment must operate in emergency and co-ordinating mode.

**END OF SECTION**



**Part 1        General**

**1.1            REFERENCE STANDARDS**

- .1 American National Standards Institute (ANSI).
  - .1 ANSI C12.7, Requirements for Watthour Meter Sockets.
  - .2 ANSI/IEEE C57.13, Standard Requirements for Instrument Transformers.
- .2 ASTM International (ASTM)
  - .1 ASTM B148, Standard Specification for Aluminum-Bronze Sand Castings.
- .3 National Electrical Manufacturer's Association (NEMA).
  - .1 NEMA 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
- .4 Air Movement and Control Association, Inc. (AMCA).
  - .1 AMCA Standard 500-D, Laboratory Method of Testing Dampers For Rating.
- .5 CSA Group CSA Group
  - .1 CSA-C22.1, Canadian Electrical Code, Part 1 (19th Edition), Safety Standard for Electrical Installations.

**1.2            DEFINITIONS**

- .1 Acronyms and Definitions: refer to Section 25 05 01 - EMCS: General Requirements.

**Part 2        Products**

**2.1            GENERAL**

- .1 Control devices of each category to be of same type and manufacturer.
- .2 External trim materials to be corrosion resistant. Internal parts to be assembled in watertight assembly.
- .3 Operating conditions: 0 - 32 degrees C with 10 - 90 % RH (non-condensing) unless otherwise specified.
- .4 Terminations: use standard conduit box with slot screwdriver compression connector block unless otherwise specified.
- .5 Transmitters and sensors to be unaffected by external transmitters including walkie talkies.
- .6 Account for hysteresis, relaxation time, maximum and minimum limits in applications of sensors and controls.
- .7 Outdoor installations: use weatherproof construction in NEMA 4 enclosures.

- .8 Devices installed in user occupied space not exceed Noise Criteria (NC) of 35. Noise generated by any device must not be detectable above space ambient conditions.
- .9 Range: including temperature, humidity, pressure, as indicated in I/O summary in Section 25 90 01 - EMCS: Site Requirements, Applications and System Sequences of Operation.

## 2.2 TEMPERATURE TRANSMITTERS

- .1 Requirements:
  - .1 Input circuit: to accept 3-lead, 100 or 1000 ohm at 0 degrees C, platinum resistance detector type sensors.
  - .2 Power supply: 24 V DC into load of 575 ohms. Power supply effect less than 0.01 degrees C per volt change.
  - .3 Output signal: 4 - 20 mA into 500 ohm maximum load.
  - .4 Input and output short circuit and open circuit protection.
  - .5 Output variation: less than 0.2 % of full scale for supply voltage variation of plus or minus 10 %.
  - .6 Combined non-linearity, repeatability, hysteresis effects: not to exceed plus or minus 0.5 % of full scale output.
  - .7 Maximum current to 100 or 1000 ohm RTD sensor: not to exceed 25 mA.
  - .8 Integral zero and span adjustments.
  - .9 Temperature effects: not to exceed plus or minus 1.0 % of full scale/50 degrees C.
  - .10 Long term output drift: not to exceed 0.25 % of full scale/6 months.
  - .11 Transmitter ranges: select narrowest range to suit application from following:
    - .1 0 to 50 degrees C, plus or minus 0.25 degrees C.

## 2.3 HUMIDITY SENSORS

- .1 Room and Duct Requirements:
  - .1 Range: 5 – 90 % RH minimum.
  - .2 Operating temperature range: 0 - 60 degrees C.
  - .3 Absolute accuracy:
    - .1 Duct sensors: plus or minus 3 %.
  - .4 Sheath: stainless steel with integral shroud for specified operation in air streams of up to 10 m/s.
  - .5 Maximum sensor non-linearity: plus or minus 2% RH with defined curves.
  - .6 Duct mounted sensors: locate so that sensing element is in air flow in duct.

## **2.4 PRESSURE TRANSDUCERS**

### **.1 Requirements:**

- .1 Combined sensor and transmitter measuring pressure.
  - .1 Internal materials: suitable for continuous contact with industrial standard instrument air, compressed air, water, steam, as applicable.
- .2 Output signal: 4 - 20 mA into 500 ohm maximum load.
- .3 Output variations: less than 0.2 % full scale for supply voltage variations of plus or minus 10 %.
- .4 Combined non-linearity, repeatability, and hysteresis effects: not to exceed plus or minus 0.5 % of full scale output over entire range.
- .5 Temperature effects: not to exceed plus or minus 1.5 % full scale/50 degrees C.
- .6 Over-pressure input protection to at least twice rated input pressure.
- .7 Output short circuit and open circuit protection.
- .8 Accuracy: plus or minus 1 % of Full Scale.

## **2.5 PRESSURE AND DIFFERENTIAL PRESSURE SWITCHES**

### **.1 Requirements:**

- .1 Internal materials: suitable for continuous contact with compressed air, water, steam, etc., as applicable.
- .2 Visual indicator
- .3 Adjustable setpoint and differential.
- .4 Switch: snap action type, rated at 24 V DC.
- .5 Switch assembly: to operate automatically and reset automatically when conditions return to normal. Over-pressure input protection to at least twice rated input pressure.
- .6 Accuracy: within 2 % repetitive switching.
- .7 Provide switches with isolation valve and snubber, where code allows, between sensor and pressure source.
- .8 Switches on steam and high temperature hot water service: provide pigtail syphon.

## **2.6 TEMPERATURE SWITCHES**

### **.1 Requirements:**

- .1 Adjustable setpoint and differential.
- .2 Accuracy: plus or minus 1 degrees C.
- .3 Snap action rating: 24V DC, 120V, 15 amps as required. Switch to be DPST for hardwire and EMCS connections.

## **2.7 ELECTROMECHANICAL RELAYS**

- .1 Requirements:
  - .1 Double voltage, DPDT, plug-in type with termination base.
  - .2 Coils: rated for 24V DC, 120V AC. Other voltage: provide transformer.
  - .3 Contacts: rated at 5 amps at 120 V AC.
  - .4 Relay to have visual status indication

## **2.8 SOLID STATE RELAYS**

- .1 General:
  - .1 Relays to be socket or rail mounted.
  - .2 Relays to have LED Indicator
  - .3 Input and output Barrier Strips to accept 14 to 28 AWG wire.
  - .4 Operating temperature range to be -20 degrees C to 70 degrees C.
  - .5 Relays to be CSA Certified.
  - .6 Input/output Isolation Voltage to be 4000 VAC at 25 degrees C for 1 second maximum duration.
  - .7 Operational frequency range, 45 to 65 HZ.
- .2 Input:
  - .1 Control voltage, 3 to 32 VDC.
  - .2 Drop out voltage, 1.2 VDC.
  - .3 Maximum input current to match AO (Analog Output) board.
- .3 Output.
  - .1 AC or DC Output Model to suit application.

## **2.9 CURRENT TRANSDUCERS**

- .1 Requirements:
- .2 Purpose: combined sensor/transducer, to measure line current and produce proportional signal in one of following ranges:
  - .1 4-20 mA DC.
  - .2 0-1 volt DC.
  - .3 0-10 volts DC.
  - .4 0-20 volts DC.
- .3 Frequency insensitive from 10 - 80 hz.
- .4 Accuracy to 0.5 % full scale.
- .5 Zero and span adjustments. Field adjustable range to suit motor applications.
- .6 Adjustable mounting bracket to allow for secure/safe mounting inside MCC.

## **2.10 CURRENT SENSING RELAYS**

- .1 Requirements:
  - .1 Suitable to detect belt loss or motor failure.
  - .2 Trip point adjustment, output status LED.
  - .3 Split core for easy mounting.
  - .4 Induced sensor power.
  - .5 Relay contacts: capable of handling 0.5 amps at 30 VAC/DC. Output to be NO solid state.
  - .6 Suitable for single or 3 phase monitoring. For 3-Phase applications: provide for discrimination between phases.
  - .7 Adjustable latch level.

## **2.11 ELECTRONIC CONTROL DAMPER ACTUATORS**

- .1 Requirements:
  - .1 Direct mount proportional type as indicated.
  - .2 Spring return for "fail-safe" in Normally Open or Normally Closed position as indicated.
  - .3 Operator: size to control dampers against maximum pressure and dynamic closing/opening pressure, whichever is greater.
  - .4 Power requirements: 5 VA maximum at 24 V AC.
  - .5 Operating range: 0 - 10 V DC or 4 - 20 mA DC.
  - .6 For VAV box applications floating control type actuators may be used.
  - .7 Damper actuator to drive damper from full open to full closed in less than 120 seconds.

## **2.12 PANELS**

- .1 Free-standing enamelled steel cabinets with hinged and key-locked front door.
- .2 Multiple panels as required to handle requirements with additional space to accommodate 25 % additional capacity as required by Departmental Representative without adding additional cabinets.
- .3 Panels to be lockable with same key.

## **2.13 ELECTRIC SWITCHES**

- .1 General
  - .1 Switches consisting essentially of a sealed electrical switch, which is actuated by an adjustable mechanism connected to a detection device.
- .2 Humidity (IH)
  - .1 The switch must open its circuit when the humidity rises above the set point. The adjustment range varies from 15% R.H. to 95% R.H. with a differential of 5% R.H.

- .3 Pressure (IP)
  - .1 Adjustable set point switch with SPDT contact. This switch operates on a rise or fall in pressure. If necessary, thermally isolate the detector element from the pressure source (steam, hot water, etc.).
  - .2 Inlet protection against overpressure up to at least twice the nominal inlet pressure.
  - .3 Pigtail siphon protection for high temperature steam and hot water pressure switches.
- .4 Air flow condition (IDA)
  - .1 This switch is actuated in the presence of an air flow. It is of the diaphragm type.
- .5 Water flow condition (IDO)
  - .1 This SPDT switch is activated in the presence of a water flow.

## **2.14 ELECTRONIC ACTUATORS**

- .1 General
  - .1 These actuators must be equipped with the necessary fastening devices according to the requirements of each case.
  - .2 Proportional action with operating range from 0 to 10 V DC or from 4 to 20 mA DC as applicable.
- .2 Damper actuator
  - .1 Install sufficient quantity of actuators to ensure accurate operation at all times. Choose the actuators taking into account the operating pressures and the dimensions of the registers. Actuators installed on fresh air and stale air registers must have a capacity exceeding by at least 50% the area of the corresponding register.
  - .2 They must have a return spring allowing the opening or closing of the damper at rest for security purposes despite failure, as indicated.
  - .3 Provide a set of auxiliary contacts to confirm the full opening and closing of the registers.
- .3 VAV Actuator
  - .1 These actuators can be of the electric or electronic modulating or floating type.

## **2.15 ELECTRICAL RELAY**

- .1 Plug-in type relay with appropriate connection base. CSA approved. Contacts of sufficient capacity depending on the application. Relay fitted with a dust-proof protective cover and a status indicator.

## **2.16 WIRING**

- .1 In accordance with Division 26.

## 2.17 VARIABLE FREQUENCY SPEED CONTROLLERS

- .1 Certifications
  - .1 Variable speed controllers shall be CSA or cUL approved.
  - .2 The complete unit including the cabinet, the speed controller, the bypass circuit and other components shall be CSA approved.
- .2 Type of load
  - .1 The load is made up of variable torque centrifugal fans.
  - .2 The speed controller shall operate adequately at all speeds. Verify the motor starting torque and running torque at different speeds.
  - .3 The speed controller shall be capable of starting the system when the system is in forward or reverse rotation, at any speed. Should the controller not be capable of starting the unit when in reverse rotation, install braking resistors on the D.C. bus to prevent system rotation when not energized.
- .3 Cabinet
  - .1 Speed controllers and bypass shall be installed in a NEMA 3R enclosure.
  - .2 The cabinet shall have ventilation slots with replaceable filters to eliminate the internal heat build-up.
  - .3 The cabinet shall be wall mount or free standing.
  - .4 It shall have hinged door with handle and lock and key.
  - .5 Equipped with disconnect switch complete with the possibility to lock the lever in the "open" position with padlocks.
  - .6 2-way selector "AUTO-OFF" which allows operation to be set as automatic control, or off-line for servicing.
  - .7 The following information shall be shown and the following commands shall be accessible on LCD display on the outer face of the door:
    - .1 Indications :
      - .1 "CONTROLLER RUNNING";
      - .2 "CONTROLLER FAULT";
      - .3 "BYPASS FAULT";
      - .4 "AUTO-OFF-BYPASS";
      - .5 "SPEED".
    - .2 Commandes :
      - .1 "AUTO";
      - .2 "OFF";
      - .3 "STOP";
      - .4 "START";
      - .5 "SPEED PREFERENCE".
  - .8 Keyboard moved to front of the cabinet door.

- .4 Speed controller
  - .1 Input characteristics:
    - .1 Voltage : 600 V a.c.  $\pm$  10 %;
    - .2 Number of phases : 3;
    - .3 Frequency : 60 Hz  $\pm$  2 Hz;
    - .4 Input power factor minimum at any speed : 0.95;
    - .5 Efficiency : 0.95.
  - .2 Output characteristics:
    - .1 Power : HP according to indications;
    - .2 Voltage : 575 V;
    - .3 Frequency : 0 to 120 Hz;
    - .4 Maximum carrier frequency : 2 kHz ;
    - .5 Waveform type : PWM;
    - .6 Direct current : 100 %;
    - .7 One-minute peak current : 110 %.
  - .3 The unit to be of the programmable microprocessor type with control panel and alphanumeric display.
  - .4 The following functions to be programmable:
    - .1 Starting and running frequencies;
    - .2 V/Hz ratio;
    - .3 Acceleration/deceleration;
    - .4 Overvoltage;
    - .5 Speed.
  - .5 The following information to be displayed:
    - .1 Output voltage;
    - .2 % load;
    - .3 % speed;
    - .4 Ready to start;
    - .5 Operation in automatic mode or local mode.
  - .6 Unit protected against the following events which are displayed on the alphanumeric panel:
    - .1 Loss of phase;
    - .2 Under voltage;
    - .3 Over voltage;
    - .4 Overload;
    - .5 Short circuit;
    - .6 Ground fault;
    - .7 Overheating;
    - .8 Internal component failure.

- .7 The following control elements stop the motor when the speed controller drives it. Provide the necessary control circuits:
  - .1 Signal from the control panel:
    - .1 Start/stop signal.
  - .2 Protection elements directly connected to the speed controller:
    - .1 Motor thermistors (Thermistor trip circuits to be compatible with the motor thermistors);
    - .2 Fire alarm contact;
    - .3 Other external protections (frost detection, disconnect auxiliary contact closing).
- .8 The speed controller accepts the 0 to 10 V d.c. or 4 to 20 mA speed signal from the control panel and communicates with the control panel according to the BACnet MS/TP protocol.
- .9 The following signals shall be transmitted to the control panel:
  - .1 Speed;
  - .2 Output frequency;
  - .3 Unit fault contact;
  - .4 Proof of operation contact obtained by a current reading on one phase of the motor circuit.
- .10 Environmental operating conditions:
  - .1 Ambient temperature : 0 to 40 °C (32 to 104 °F);
  - .2 Relative humidity (non condensing) : 20 to 90 % R.H.;
  - .3 Altitude : 3300 feet (1000 m).
- .5 Inductors
  - .1 A 3 % smoothing inductor on the d.c. bus or a 5 % input inductance shall be supplied on all variable speed drives. Shunt type filters shall not be accepted. The total current harmonic distortion not to exceed 30 % at the a.c. input of each speed controller.
- .6 Motor characteristics
  - .1 Motor characteristics may be found in Division 23.

## **2.18 REFRIGERANT GAS DETECTION**

- .1 Monitor with infrared sensor, microprocessor, temperature compensation, analog output, scale of 0-1000 ppm, resolution of 1 ppm. Control unit with display, keypad, local sound alarm and alarm relay. Use enough sensors to ensure adequate coverage.
- .2 Designed for R410A refrigerant used in condenser.
- .3 Visual indication to the control unit:
  - .1 normal operation;
  - .2 1st level alarm;
  - .3 2nd level alarm;

- .4 Defect;
- .5 Refrigerant level measured at each detector (analog input).
- .4 Alarm relay to the control panel for remote control and supervision:
  - .1 1st level alarm: to activate emergency ventilation;
  - .2 2nd level alarm: to control the evacuation of the room via the audible alarm and the remote strobe;
  - .3 defect: maintenance alarm.
- .5 Remote audible alarm
  - .1 the sound level is 10 dB higher than the ambient level;
  - .2 the frequency is separate from that of the fire alarm system.
- .6 Remote strobe
  - .1 red color, distinct from those of the fire alarm system.
- .7 Locating remote audible alarms and strobes
  - .1 in the mechanical room, near the ventilation unit containing the direct expansion coil;
  - .2 at the entrance door of the mechanical room.

### **Part 3 Execution**

#### **3.1 INSTALLATION**

- .1 Install equipment, components so that manufacturer's and CSA labels are visible and legible after commissioning is complete.
- .2 Install field control devices in accordance with manufacturers recommended methods, procedures and instructions.
- .3 Temperature transmitters, humidity transmitters, current-to-pneumatic transducers, solenoid air valves, controllers, relays: install in NEMA I enclosure or as required for specific applications. Provide for electrolytic isolation in cases when dissimilar metals make contact.
- .4 Support field-mounted panels, transmitters and sensors on pipe stands or channel brackets.
- .5 Fire stopping: provide space for fire stopping in accordance with Section 07 84 00 - Fire stopping. Maintain the fire-resistance rating integrity of the fire separation.
- .6 Electrical:
  - .1 Complete installation in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .7 Pneumatic: provide Pneumatic tubing, valves and fittings for field control devices in accordance with Section [23 09 43 - Pneumatic Control System for HVAC].
- .8 VAV Terminal Units: supply, install and adjust as required.

- .1 Air probe, actuator and associated vav controls.
- .2 Tubing from air probe to dp sensor as well as installation and adjustment of air flow sensors and actuators.
- .3 Co-ordinate air flow adjustments with balancing trade.

### **3.2 TEMPERATURE AND HUMIDITY SENSORS**

- .1 Stabilize to ensure minimum field adjustments or calibrations.
- .2 Readily accessible and adaptable to each type of application to allow for quick easy replacement and servicing without special tools or skills.
- .3 Duct installations:
  - .1 Do not mount in dead air space.
  - .2 Locate within sensor vibration and velocity limits.
  - .3 Securely mount extended surface sensor used to sense average temperature.
  - .4 Thermally isolate elements from brackets and supports to respond to air temperature only.
  - .5 Support sensor element separately from coils, filter racks.
- .4 Averaging duct type temperature sensors.
  - .1 Install averaging element horizontally across the ductwork starting 305 mm from top of ductwork. Each additional horizontal run to be no more than 305 mm from one above it. Continue until complete cross sectional area of ductwork is covered. Use multiple sensors where single sensor does not meet required coverage.
  - .2 Wire multiple sensors in series for low temperature protection applications.
  - .3 Wire multiple sensors separately for temperature measurement.
  - .4 Use software averaging algorithm to derive overall average for control purposes.
- .5 Thermowells: install for piping installations.
  - .1 Locate well in elbow where pipe diameter is less than well insertion length.
  - .2 Thermowell to restrict flow by less than 30 %.
  - .3 Use thermal conducting paste inside wells.

### **3.3 MAGNEHELIC PRESSURE INDICATORS**

- .1 Install adjacent to fan system static pressure sensor and duct system velocity pressure sensor as reviewed by Departmental Representative.

### **3.4 PRESSURE AND DIFFERENTIAL PRESSURE SWITCHES AND SENSORS**

- .1 Install isolation valve and snubber on sensors between sensor and pressure source where code allows.

- .1 Protect sensing elements on steam and high temperature hot water service with pigtail syphon between valve and sensor.

### **3.5 I/P TRANSDUCERS**

- .1 Install air pressure gauge on outlet.

### **3.6 IDENTIFICATION**

- .1 Identify field devices in accordance with Section 25 05 54 - EMCS: Identification.

### **3.7 TESTING AND COMMISSIONING**

- .1 Calibrate and test field devices for accuracy and performance in accordance with Section 25 01 11 - EMCS: Start-up, Verification and Commissioning.

### **3.8 VARIABLE FREQUENCY DRIVES**

- .1 Installation
  - .1 The VFD must be installed according to the manufacturer's recommendations, as stated in the installation guide.
  - .2 Electrical cable must be install according to the VFD manufacturer recommendations, as stated in the installation guide.
  - ~~.3~~ Install the wall-mounted variable frequency drive on plywood mounted on steel profiles attached to the floor and to the building structure.
  - .4 Attach the variable frequency drives to the floor with 40 mm (1½") steel profiles.
  - .5 Connect all the required control circuits to the drives.
  - .6 Connect all interlocks and local protections to ensure that they are functional both under normal operation and on bypass operation.
  - .7 Program and adjust the drive settings according to the Engineer recommendations, including the "COAST-TO-STOP" stop mode instead of using a stop ramp.
  - .8 Provide a means to lock out near the motor if the speed controller's installation safety distance with the motor is exceeded.
  - .9 Program the input for the auxiliary contact on the safety switch to deactivate the VFD controller when an opening operation is performed on the safety switch located near the motor.
  - .10 Provide AutoCad plans of the connections of the speed controllers to the existing infrastructure. Permanently number all wires which are related to the control diagrams.
- .2 Tests
  - .1 The Contractor will include all necessary costs and make arrangements with the distributor to proceed with the verification and commissioning of the speed controllers for every motor according to the "Variable frequency drive test" table found in the appendix.
  - .2 Test all binary inputs such as: auxiliary contact from the safety switch, freeze protection, high or low pressure protection or others.

- .3 Prior to testing, the Engineer must be provided with the calibration certificates of every equipment to be used. Tests will be cancelled and new ones will need to be done to the Contractor's charge if there is a default in providing the certificates.
  - .4 All tests must be coordinated with the interveners of divisions 23, 25 and 26.
  - .5 During testing, for each VFD, the Contractor must use a tachymeter and must be able to compare the requested speed on the VFD with the actual motor speed when the motor is under rated mechanical load. To do so, the tests must be done on each motor by varying the speeds as follows: 30%, 50%, 65%, 80% and 100%. The results obtained must be included in the test report.
  - .6 Once all tests are completed, a report will need to be prepared and signed. The report must include a conclusion covering the results obtained and the corrections made, and must certify the installations as well as the speed controllers' compliance with the manufacturer's requirements. An electronic copy must be provided to the Engineer.
- .3 Product support
- .1 Well-trained support personnel and application engineers who are familiar with the VFD must be locally available and be able to offer service in no more than four (4) hours;
  - .2 A 24 hours a day support line must also be available 365 days a year.
  - .3 A computerized training on electronic support must be handed to the Owner at project completion. This training must include the following elements: installation, programming and utilization of the VFD, bypass functions and BACnet communication.
- .4 Warranty
- .1 The warranty period is 12 additional months, starting at the end of the warranty period provided in the General Conditions.

**END OF SECTION**



## **Part 1        General**

### **1.1        REFERENCE STANDARDS**

- .1        Public Works and Government Services Canada (PWGSC)/Real Property Branch/Architectural and Engineering Services.
  - .1        MD13800, Energy Management and Control Systems (EMCS) Design Manual. English: <ftp://ftp.pwgsc.gc.ca/rps/docentre/mechanical/me214-e.pdf>

### **1.2        SEQUENCING**

- .1        Control mode
  - .1        When equipment is automatically started, the EMCS makes sure that the equipment runs for a minimum time in order to prevent excess start/stops.
  - .2        When a ventilation system is started, let the system run in a recirculation mode for a minimum of 5 minutes.
- .2        Setpoints stated in this Section are given as working assumptions. They shall be fully editable with the EMCS according to actual building operation and experience.
- .3        Setpoint ramping
  - .1        Upon a start of the system or on any changes of setpoint, provide a control algorithm to gradually bring the setpoint from its start value to its desired value.
  - .2        The ramping progression speed must be adjustable.
- .4        Starting sequence following a loss of electrical power
  - .1        On a return of electrical power or on a generator start-up, electromechanical equipment is started one by one based on a predefined sequence to avoid any overload. Provide programmable, appropriate time intervals between each start command. As well, upon a loss of electrical power, open start contacts to allow the start sequence.
- .5        Sequencing of system operations
  - .1        2<sup>nd</sup> floor ventilation system
    - .1        When the system stops:
      - .1        The supply fan is stopped.
      - .2        The exhaust fan is off.
      - .3        Return register is open and outdoor air registers are closed.
      - .4        The condensing unit is stopped.
      - .5        The electric coil is stopped.
      - .6        The humidifier is stopped.

- .2 When the system starts:
  - .1 The supply fan starts at low speed via the UCP according to an occupied schedule. The system can also start on special request.
  - .2 The outdoor air registers open via the UCP according to the occupation schedule.
  - .3 Upon confirmation of opening of the outdoor air registers, the exhaust fan will start via the UCP.
- .3 In normal operation:
  - .1 The speed of the supply fan is modulated via the UCP to maintain the static pressure set point in the supply duct. The duct set point is determined when the network is balanced.
  - .2 The cooling unit is modulated to maintain the calculated supply temperature set point. This set point is readjusted from 20 ° C to a minimum of 13 ° C according to the highest demand for space cooling. Adjust the set point to ensure relative humidity at return to 60% or less.
  - .3 The heating coil is modulated to maintain the calculated supply temperature set point.
  - .4 The humidifier is modulated via the UCP to maintain the humidity set point of 30% R.H. in the return. The UCP limits the humidity level to 85% RH in the supply.
- .4 Local protection:
  - .1 On loss of air flow in the supply duct, the humidifier stops via the flow switch (IDA).
  - .2 On a very high level of humidity in the power supply, the humidifier stops via the humidity switch (IH).
  - .3 On detection of high supply pressure via the pressure switch (IP), the supply fan stops by electrical interlocking.
- .5 Fire:
  - .1 The fans stop on the fire alarm by a fire alarm contact on each fan.
- .6 Alarm:
  - .1 The fans operating status is transmitted to the UCP.
  - .2 The fault of the variable frequency drive of the supply fan is transmitted to the UCP.
  - .3 Filter pressure loss
    - .1 Filter pressure loss alarm will vary with fan speed, using the formula  $DP_x = DP_{100}(x)^{1.4}$ , where  $DP_{100}$  is the high limit for pressure drop at design flow, and  $DP_x$  is the high limit to the speed signal  $x$  expressed as a fraction of the total signal.

- .4 Alarms are given when the following variables exceed their limits:
  - .1 supply temperature:  $PC \pm 2 \text{ }^\circ \text{C}$ ;
  - .2 static supply pressure:  $PC \pm 60 \text{ Pa}$ ;
  - .3 return humidity:  $<25\% \text{ R.H. and } > 70\% \text{ R.H.}$ ;
  - .4 supply humidity:  $> 90\% \text{ R.H.}$  (in humidification mode);
- .2 Ground floor ventilation system
  - .1 When the system stops:
    - .1 The supply fans are stopped.
    - .2 The registers are closed.
    - .3 The electric coil is stopped.
    - .4 The humidifier is stopped.
  - .2 When the system starts:
    - .1 The exhaust air register is opened via the UCP. Upon confirmation of opening, the exhaust fan starts at low speed via the UCP according to an occupation schedule. The system can also start on special request.
    - .2 The outdoor air register is opened via the UCP. On confirmation of opening, the supply fan starts at low speed via the UCP according to an occupancy schedule. The system can also start on special request.
  - .3 In normal operation:
    - .1 The fan speeds are modulated via the UCP in order to maintain the static pressure set points in the ducts. The set points for each duct are determined when the network is balanced.
    - .2 The heating coil is modulated to maintain the calculated supply temperature set point.
    - .3 The humidifier is modulated via the UCP to maintain the humidity set point of 30% R.H. in the return. The UCP limits the humidity level to 85% RH in the supply.
  - .4 Local protection:
    - .1 On loss of air flow in the supply duct, the humidifier stops via the flow switch (IDA).
    - .2 On a very high level of humidity in the power supply, the humidifier stops via the humidity switch (IH).
    - .3 On detection of high supply pressure via the pressure switch (IP), the supply fan stops by electrical interlocking.
    - .4 On detection of high supply pressure via the pressure switch (IP), the supply fan stops by electrical interlocking.
    - .5 On detection of high supply pressure via the pressure switch (IP), the exhaust fan stops by electrical interlocking.

- .5 Fire:
  - .1 The fans stop on the fire alarm by a fire alarm contact on each fan.
- .6 Alarm:
  - .1 The fans operating status is transmitted to the UCP.
  - .2 The fault of the variable frequency fan drives is transmitted to the UCP.
  - .3 Filter pressure loss
    - .1 Filter pressure loss alarm will vary with fan speed, using the formula  $DP_x = DP_{100}(x)^{1.4}$ , where  $DP_{100}$  is the high limit for pressure drop at design flow, and  $DP_x$  is the high limit to the speed signal  $x$  expressed as a fraction of the total signal.
  - .4 Alarms are given when the following variables exceed their limits:
    - .1 supply temperature:  $PC \pm 2^\circ C$ ;
    - .2 static supply or return pressure:  $PC \pm 60 Pa$ ;
    - .3 return humidity:  $<25\% R.H.$  and  $> 70\% R.H.$  ;
    - .4 supply humidity:  $> 90\% R.H.$  (in humidification mode);
- .3 Room control – interior rooms
  - .1 When the system stops:
    - .1 The terminal box register closes completely two (2) minutes after shutting down its ventilation system.
    - .2 The terminal heating coil is stopped.
  - .2 When the system starts:
    - .1 On proof of operation of its ventilation system, the terminal box is started on command of the UCP.
  - .3 In normal operation:
    - .1 The air flow rate of the terminal box is modulated via the UCL in order to maintain the room temperature set point according to the operating mode (occupied, unoccupied, summer and winter).
  - .4 Alarm :
    - .1 Alarms are given when the following variables exceed their limits:
      - .1 Room temperature:  $PC \pm 2^\circ C$ ;
- .4 Room control – perimeter rooms
  - .1 When the system stops:
    - .1 The terminal box register closes completely two (2) minutes after shutting down its ventilation system.
    - .2 The terminal heating coil is stopped.

- .2 When the system starts:
  - .1 On proof of operation of its ventilation system, the terminal box is started on command of the UCP.
- .3 In normal operation:
  - .1 The air flow rate of the terminal box is modulated via the UCL in order to maintain the room temperature set point according to the operating mode (occupied, unoccupied, summer and winter).
  - .2 The operation of the baseboard is authorized only when the terminal box is in the minimum position.
- .4 Alarm :
  - .1 Alarms are given when the following variables exceed their limits:
    - .1 Room temperature:  $PC \pm 2^{\circ} C$ .
- .5 Room control – welding and machining workshop
  - .1 When the system stops:
    - .1 The registers of the terminal boxes close completely two (2) minutes after the shutdown of its ventilation system.
    - .2 The local exhaust fan is off.
    - .3 The terminal heating coil is stopped.
  - .2 When the system starts:
    - .1 On proof of operation of its ventilation system, the terminal boxes are started on command of the UCP.
  - .3 In normal operation:
    - .1 The air flow of the terminal supply box is modulated in sequence with the electric coil to maintain the room temperature set point according to the operating mode (occupied, unoccupied, summer and winter).
    - .2 The air flow of the terminal box is modulated in sequence with the supply terminal box in order to maintain a zero volumetric offset.
    - .3 On evacuation request via the equipment start-up relay, the exhaust fan starts and the air flow rate of the terminal box is modulated in sequence to maintain the volumetric offset.
    - .4 The operation of the baseboard is authorized only when the terminal box is in the minimum position.
  - .4 Alarm :
    - .1 The fans operating status is transmitted to the UCP.
    - .2 Alarms are given when the following variables exceed their limits:
      - .1 Room temperature:  $PC \pm 2^{\circ} C$ .

- .6 Room control – workshops
  - .1 When the system stops:
    - .1 The registers of the terminal boxes close completely two (2) minutes after the shutdown of its ventilation system.
    - .2 The terminal heating coil is stopped.
  - .2 When the system starts:
    - .1 On proof of operation of its ventilation system, the terminal boxes are started on command of the UCP.
  - .3 In normal operation:
    - .1 The air flow of the supply terminal box is maintained at its set points (constant flow) in sequence with the electric coil in order to maintain the room temperature set point according to the operating mode (occupied, unoccupied, summer and winter).
    - .2 The air flow rate of the terminal box is modulated in sequence with the supply terminal box in order to maintain the zero volumetric offset.
    - .3 The operation of the baseboard is authorized only when the terminal box is in the minimum position.
  - .4 Alarm:
    - .1 Alarms are given when the following variables exceed their limits:
      - .1 Room temperature:  $PC \pm 2^{\circ} C$ .
- .6 Emergency shower
  - .1 Integrate the alarm into the building management system.
- .7 Mechanical room systems: detection and evacuation of refrigerant
  - .1 When the system stops:
    - .1 The exhaust fan is off.
    - .2 The outside air damper is closed.
    - .3 The bypass air damper is open.
  - .2 When the system starts:
    - .1 The outside air damper is open in the minimum position.
    - .2 The exhaust fan is started.
  - .3 On a level 1 alarm from a master detection panel:
    - .1 The master detection panel opens the outside air damper and closes the bypass damper by electric interlock.
    - .2 The master detection panel controls the stopping of the condenser by electrical interlocking.
    - .3 A level 1 alarm is sent to the BMS.

- .3 Local protection:
  - .1 On a level 2 alarm:
    - .1 The refrigerant detection master panel activates the audible and visual alarms to evacuate the room.
    - .2 A button controls the silence of the audible alarm.
    - .3 A level 2 alarm is sent to the BMS.
  - .4 BMS/graphics :
    - .1 The following information must be available at the BMS :
      - .1 operating condition of the fan;
      - .2 the condition of each of the air damper;
      - .3 the panel level 1 alarm;
      - .4 the panel level 2 alarm;
      - .5 panel fault;
      - .6 the level of each refrigerant detector.

**Part 2 Products**

**2.1 NOT USED**

**Part 3 Execution**

**3.1 NOT USED**

**END OF SECTION**



**Part 1 General**

**1.1 RELATED REQUIREMENTS**

- .1 Section 26 05 32 – Outlet Boxes, Conduits Boxes and Fittings.

**1.2 REFERENCE STANDARDS**

- .1 CSA Group
  - .1 CSA C22.1-15, Canadian Electrical Code, Part 1 (22nd Edition), Safety Standard for Electrical Installations.
  - .2 CAN/CSA-C22.3 No.1-F18, Overhead Systems.
  - .3 CAN3-C235-F83 (R2015)], Preferred Voltage Levels for AC Systems, 0 to 50,000 V.
- .2 Institute of Electrical and Electronics (IEEE)/National Electrical Safety Code Product Line (NESC)
  - .1 IEEE SP1122-2000, The Authoritative Dictionary of IEEE Standards Terms, 7th Edition.

**1.3 DEFINITIONS**

- .1 Electrical and electronic terms: unless otherwise specified or indicated, terms used in these specifications, and on drawings, are those defined by IEEE SP1122.

**1.4 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Submit for review single line electrical diagrams under plexiglass and locate as indicated.
  - .1 Electrical distribution system in main electrical room.
  - .2 Electrical power generation and distribution systems in power plant rooms.
- .4 Submit for review fire alarm riser diagram, plan and zoning of building under plexiglass at fire alarm control panel and annunciator.
- .5 Shop drawings:
  - .1 Submit wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure co-ordinated installation.
  - .2 Identify on wiring diagrams circuit terminals and indicate internal wiring for each item of equipment and interconnection between each item of equipment.

- .3 Indicate of drawings clearances for operation, maintenance, and replacement of operating equipment devices.
- .4 If changes are required, notify Departmental Representative of these changes before they are made.
- .6 Certificates:
  - .1 Provide CSA certified equipment.
  - .2 Where CSA certified equipment is not available, submit such equipment to authority having jurisdiction for special approval before delivery to site.
  - .3 Submit test results of installed electrical systems and instrumentation.
  - .4 Permits and fees: in accordance with General Conditions of contract.
  - .5 Submit, upon completion of Work, load balance report as described in PART 3 - LOAD BALANCE.
  - .6 Submit certificate of acceptance from authority having jurisdiction upon completion of Work to Departmental Representative.
- .7 Manufacturer's Field Reports: submit to Departmental Representative manufacturer's written report, within 3 days of review, verifying compliance of Work and electrical system and instrumentation testing, as described in PART 3 - FIELD QUALITY CONTROL.

## **1.5 CLOSEOUT SUBMITTALS**

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for incorporation into manual.
  - .1 Provide for each system and principal item of equipment as specified in technical sections for use by operation and maintenance personnel.
  - .2 Operating instructions to include following:
    - .1 Wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment.
    - .2 Start up, proper adjustment, operating, lubrication, and shutdown procedures.
    - .3 Safety precautions.
    - .4 Procedures to be followed in event of equipment failure.
    - .5 Other items of instruction as recommended by manufacturer of each system or item of equipment.
  - .3 Print or engrave operating instructions and frame under glass or in approved laminated plastic.
  - .4 Post instructions where directed.
  - .5 For operating instructions exposed to weather, provide weather-resistant materials or weatherproof enclosures.
  - .6 Ensure operating instructions will not fade when exposed to sunlight and are secured to prevent easy removal or peeling.

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

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

## **Part 2 Products**

### **2.1 DESIGN REQUIREMENTS**

- .1 Operating voltages: to CAN3-C235.
- .2 Motors, electric heating, control and distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits established by above standard.
  - .1 Equipment to operate in extreme operating conditions established in above standard without damage to equipment.
- .3 Language operating requirements: provide identification nameplates for control items in French and English.
- .4 Use one nameplate for each language.

### **2.2 MATERIALS AND EQUIPMENT**

- .1 Provide equipment in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Material to be CSA certified. Where CSA certified material is not available, obtain special approval from authority having jurisdiction before delivery to site and submit such approval as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.
- .3 Factory assemble control panels and component assemblies.

### **2.3 ELECTRIC MOTORS, EQUIPMENT AND CONTROLS**

- .1 Verify installation and co-ordination responsibilities related to motors, equipment and controls, as indicated.

### **2.4 WARNING SIGNS**

- .1 Warning Signs: in accordance with requirements of Departmental Representative.
- .2 Porcelain enamel signs, minimum size 175 x 250 mm.

## 2.5 WIRING TERMINATIONS

- .1 Ensure lugs, terminals, screws used for termination of wiring are suitable for either copper or aluminum conductors.

## 2.6 EQUIPMENT IDENTIFICATION

- .1 Identify electrical equipment with nameplates as follows:
  - .1 Nameplates: lamicoid 3 mm, matt white finish face, black core.
  - .2 Sizes as follows:

NAMEPLATE SIZES			
Size 1	10 x 50 mm	1 line	3 mm high letters
Size 2	12 x 70 mm	1 line	5 mm high letters
Size 3	12 x 70 mm	2 lines	3 mm high letters
Size 4	20 x 90 mm	1 line	8 mm high letters
Size 5	20 x 90 mm	2 lines	5 mm high letters
Size 6	25 x 100 mm	1 line	12 mm high letters
Size 7	25 x 100 mm	2 lines	6 mm high letters

- .2 Wording on nameplates to be approved by Departmental Representative prior to manufacture.
- .3 Allow for minimum of twenty-five (25) letters per nameplate.
- .4 Nameplates for terminal cabinets and junction boxes to indicate system and/or voltage characteristics.
- .5 Identify equipment with Size 3 labels engraved "ASSET INVENTORY NO. [\_\_\_\_\_]"; as directed by Departmental Representative.
- .6 Disconnects, starters and contactors: indicate equipment being controlled and voltage.
- .7 Terminal cabinets and pull boxes: indicate system and voltage.
- .8 Transformers: indicate capacity, primary and secondary voltages.

## 2.7 WIRING IDENTIFICATION

- .1 Identify wiring with permanent indelible identifying markings, 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 coding: to CSA C22.1.
- .4 Use colour coded wires in communication cables, matched throughout system.

## 2.8 CONDUIT AND CABLE IDENTIFICATION

- .1 Colour code conduits, boxes and metallic sheathed cables.
- .2 Code with plastic tape or paint at points where conduit or cable enters wall, ceiling, or floor, and at 15 m intervals.

.3 Colours: 25 mm wide prime colour and 20 mm wide auxiliary colour.

Type	Prime	Auxiliary
up to 250 V	Yellow	
up to 600 V	Yellow	Green
up to 5 kV	Yellow	Blue
up to 15 kV	Yellow	Red
Telephone	Green	
Other Communication Systems	Green	Blue
Fire Alarm	Red	
Emergency Voice	Red	Blue
Other Security Systems	Red	Yellow

### Part 3 Execution

#### 3.1 EXAMINATION

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

#### 3.2 INSTALLATION

- .1 Do complete installation in accordance with CSA C22.1 except where specified otherwise.
- .2 Do overhead and underground systems in accordance with CAN/CSA-C22.3 No.1 except where specified otherwise.

#### 3.3 NAMEPLATES AND LABELS

- .1 Ensure manufacturer's nameplates, CSA labels and identification nameplates are visible and legible after equipment is installed.

#### 3.4 CONDUIT AND CABLE INSTALLATION

- .1 Install conduit and sleeves prior to pouring of concrete.
  - .1 Sleeves through concrete: schedule 40 steel pipe, 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 embedded or plastered over, close to building structure so furring can be kept to minimum.

### **3.5 LOCATION OF OUTLETS**

- .1 Locate outlets in accordance with Section 26 05 32 - Outlet Boxes, Conduit Boxes and Fittings.
- .2 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.
  - .1 Locate disconnect devices in mechanical and elevator machine rooms on latch side of floor.

### **3.6 MOUNTING HEIGHTS**

- .1 Mounting height of equipment is from finished floor to centreline of equipment unless specified or indicated otherwise.
- .2 If mounting height of equipment is not specified or indicated, verify before proceeding with installation.
- .3 Unless otherwise specified, install electrical equipment at the height indicated in the Electrical Legend.

### **3.7 CO-ORDINATION OF PROTECTIVE DEVICES**

- .1 Ensure circuit protective devices such as overcurrent trips, relays and fuses are installed to required values and settings.

### **3.8 FIELD QUALITY CONTROL**

- .1 Load Balance:
  - .1 Measure phase current to panelboards with normal loads (lighting) operating at time of acceptance; adjust branch circuit connections as required to obtain best balance of current between phases and record changes.
  - .2 Measure phase voltages at loads and adjust transformer taps to within 2 % of rated voltage of equipment.
  - .3 Provide upon completion of work, load balance report as directed in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS, phase and neutral currents on panelboards, dry-core transformers and motor control centres, operating under normal load, as well as hour and date on which each load was measured, and voltage at time of test.
- .2 Conduct following tests in accordance with Section 01 45 00 - Quality Control.
  - .1 Power distribution system including phasing, voltage, grounding and load balancing.
  - .2 Circuits originating from branch distribution panels.
  - .3 Lighting and its control.
  - .4 Motors, heaters and associated control equipment including sequenced operation of systems where applicable.

- .5 Systems: fire alarm.
- .6 Insulation resistance testing:
  - .1 Megger circuits, feeders and equipment up to 350 V with a 500 V instrument.
  - .2 Megger 350-600 V circuits, feeders and equipment with a 1000 V instrument.
  - .3 Check resistance to ground before energizing.
- .3 Carry out tests in presence of Departmental Representative.
- .4 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.
- .5 Manufacturer's Field Services:
  - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.
  - .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

### **3.9 SYSTEM STARTUP**

- .1 Instruct operating personnel and Departmental Representative in operation, care and maintenance of systems, system equipment and components.
- .2 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.
- .3 Provide these services for such period, and for as many visits as necessary to put equipment in operation, and ensure that operating personnel are conversant with aspects of its care and operation.

### **3.10 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - 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 00 - Cleaning.

### **3.11 SEISMIC PROTECTION**

- .1 General
  - .1 Contractor is responsible to evaluate, furnish and install seismic protection for all new technical components as well as all relocated or modified technical components under his responsibility.
  - .2 Hire an Engineer, member in good standing of the Ordre des ingénieurs du Québec, for the evaluation of the seismic risk and calculation of seismic force resisting systems. The hired Engineering shall demonstrate

- recognized expertise in seismic protection. Contractor shall provide his contact details no more than two (2) weeks after contract signature.
- .3 During an earthquake, seismic protection devices shall prevent permanent displacements and damages caused by vertical and horizontal motions and overturns.
- .2 Design criterias
    - .1 Site class of the building is should be determined.
  - .3 Evaluation and mitigation of seismic effects
    - .1 Evaluation of seismic effects shall be done as per requirements of sub-section 4.1.8 of the Quebec Construction Code, Chapter I – Building, and National Building Code of Canada (amended).
    - .2 Seismic force resisting systems shall be designed as per following standards:
      - .1 NFPA 13 et 20;
      - .2 SMACNA – Seismic Restraint Manual Guidelines for Mechanical System;
      - .3 ASHRAE – Seismic and Wind Design;
      - .4 FEMA;
      - .5 FM Global – Earthquake Protection for Water Based Fire Protection Systems;
      - .6 Engineering documents from earthquake-resistant devices manufacturers.
  - .4 Evaluation and mitigation of seismic effects report
    - .1 Submit to the Engineer the evaluation and mitigation of seismic effects report before beginning the installation of the technical components.
    - .2 The report shall include, at least, the following information:
      - .1 General data for the project:
        - Location of the building;
        - General description of the building including height of the building ( $h_n$ );
        - Site class at the location of the building;
        - Importance category of the building;
        - Value of  $S_a$  (0.2);
        - Value of  $F_a$ ;
        - Value of  $I_e$ .
      - .2 List of all technical components included in the contract which need to be have an evaluation of the seismic effects.
      - .3 List of all technical components which may be exempted with the justifications.
      - .4 For each technical component (CT) the evaluation of the seismic effect and the seismic force resisting system applied. Include following elements:
        - Identification of the CT;
        - Location of the CT including height ( $h_x$ );
        - Description of CT including:
          - Type of equipment;

- Make and model;
- Dimensions;
- Weight;
- Category and values of  $C_p$ ,  $A_r$  et  $R_p$ .
- Calculation of lateral force  $V_p$ , and forces on building structure;
- Description of the resisting system applied, including:
  - Make and model of chosen material;
  - Installation drawing specific for this project;
  - Drawing showing the location of the seismic resisting systems.

.5 For each CT located on the ground, on a slab or on an equipment base, the overturn force calculation and description of the resisting system. Included following elements:

- Identification of the CT;
- Location of the CT including height ( $h_x$ );
- Description of CT including:
  - Type of equipment;
  - Make and model;
  - Dimensions;
  - Weight;
  - Location of gravity center;
- Calculation of the overturn force;
- Description of the resisting system applied, including:
  - Mark and model of chosen material;
  - Installation drawing specific for this project;
  - Drawing showing the location of the seismic resisting systems.

## .5 Installation

.1 Install seismic force resisting system as per the indications of the evaluation and mitigation of seismic effects report.

.2 Any modification to the seismic force resisting system for any reason, shall be subject to a new calculation by the Engineer responsible for the seismic protection, and issued as an amendment to the report.

.3 Following requirements apply to the installation of electrical and mechanical material:

.1 Power-driven and drop-in anchors are not permitted for traction loads;

.2 C-clamps are not allowed to support CT unless they have a retainer mechanism;

.3 C-clamps are not allowed for seismic resisting systems;

.4 Equipment base shall be anchored to the slab;

.5 All vibration isolators shall be designed for seismic protection;

.6 Oval bolt adjusting hole are prohibited.

.4 Seismic protection systems must be designed in a manner not to compromise the performance of vibration isolation or thermal expansion components designed to allow piping and equipments movements. In these cases, flexible or lose anchors and ties must be used rather than rigid structures.

- .6 Work approval
  - .1 The Engineer who prepared the evaluation and mitigation of seismic effects report shall inspect the work related to the seismic force resisting systems.
  - .2 Obtain from the seismic protection engineer a written and signed certification indicating that the seismic force resisting systems have been installed as per the report and the amendments to the report. Submit this certification before submitting of the work certificate of compliance.
  - .3 Include in the operation and maintenance manual all documents issued by the seismic protection engineer.

**END OF SECTION**

**Part 1        General**

**1.1            RELATED REQUIREMENTS**

- .1        Section 02 41 19.16 - Selective Interior Demolition

**1.2            REFERENCE STANDARDS**

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

**1.3            DEFINITIONS**

- .1        Demolish: Detach items from existing construction and legally dispose of items off site, unless indicated as removed and salvaged, or removed and reinstalled.
- .2        Remove: Planned deconstruction and disassembly of electrical items from existing construction including removal of conduit, junction boxes, cabling and wiring from electrical component to panel taking care not to damage adjacent assemblies designated to remain; legally dispose of items off site, unless indicated as removed and salvaged, or removed and reinstalled.
- .3        Remove and Salvage: Detach items from existing construction and deliver them to Departmental Representative ready for reuse.
- .4        Remove and Reinstall: Detach items from existing construction, prepare them for reuse, and reinstall them where indicated.
- .5        Existing to Remain: Existing items of construction that are not removed and that are not otherwise indicated as being removed and salvaged, or removed and reinstalled.
- .6        Hazardous Substances: Dangerous substances, dangerous goods, hazardous commodities and hazardous products may include asbestos, mercury and lead, PCB's, poisons, corrosive agents, flammable substances, radioactive substances, or other material that can endanger human health or wellbeing or environment if handled improperly as defined by Federal Hazardous Products Act (RSC 1985) including latest amendments.

**1.4            ACTION AND INFORMATIONAL SUBMITTALS**

- .1        Action Submittals: Provide in accordance with Section 01 33 00- Submittal Procedures before starting work of this Section:
  - .1        Construction Waste Management Plan (CWM Plan): Submit plan addressing opportunities for reduction, reuse, or recycling of materials prepared in accordance with Section 01 74 21 - Waste Management and Disposal.
  - .2        Landfill Records: Indicate receipt and acceptance of selective demolition waste and hazardous wastes by a landfill facility licensed to accept hazardous wastes.

## **1.5 ADMINISTRATIVE REQUIREMENTS**

- .1 Coordination: Coordinate work of this Section to avoid interference with work by other Sections.
- .2 Scheduling: Account for Departmental Representative 's continued occupancy requirements during selective demolition with Section 02 41 19.16 - Selective Interior Demolition and schedule staged occupancy and worksite activities as a defined at the critical path

## **1.6 QUALITY ASSURANCE**

- .1 Regulatory Requirements: Perform work of this Section in accordance with:
  - .1 Federal Workers' Compensation Service
  - .2 Government of Canada, Labour Program: Workplace Safety.

## **1.7 SITE CONDITIONS**

- .1 Existing Conditions: Condition of materials identified as being salvaged or demolished are based on their observed condition on date that tender is accepted.
- .2 Existing Hazardous Substances: Departmental Representative performed a hazardous substances assessment and it is not expected that hazardous substances will be encountered in Work.
  - .1 Hazardous substances will be removed by a hazardous abatement specialist engaged by Departmental Representative before start of Work.
- .3 Existing Hazardous Substances: Departmental Representative has performed a hazardous substances assessment and identified materials requiring abatement as follows:
  - .1 Hazardous substances are as defined in Hazardous Products Act.
  - .2 Hazardous substances will be removed by Contractor as a part of Contract before starting Work in accordance with work results described in Related Requirements listed above.
- .4 Discovery of Hazardous Substances: It is not expected that Hazardous Substances will be encountered in Work; immediately notify Departmental Representative if materials suspected of containing hazardous substances are encountered and perform following activities:
  - .1 Refer to Section 01 41 00 - Regulatory Requirements for directives associated with specific material types.
  - .2 Hazardous substances will be as defined in Hazardous Products Act.
  - .3 Stop work in area of suspected hazardous substances.
  - .4 Take preventative measures to limit users' and workers' exposure, provide barriers and other safety devices and do not disturb.
  - .5 Hazardous substances will be removed by Departmental Representative under a separate contract or as a change to Work.
  - .6 Proceed only after written instructions have been received from Departmental Representative.

## **1.8 SALVAGE AND DEBRIS MATERIALS**

- .1 Demolished items become Contractor 's property and will be removed from Project site; except for items indicated as being reused, salvaged, or otherwise indicated to remain Departmental Representative 's property.
- .2 Carefully remove materials and items designated for salvage and store in a manner to prevent damage or devaluation of materials in accordance with Section 02 42 00- Removal and Salvage of Construction Materials.
  - .1 Leave main electrical distribution panel in place; panel can be used for temporary construction power for this and subsequent contracts; coordinate temporary power connections with Departmental Representative.
  - .2 Leave main telephone terminal backboard in place; panel can be used for temporary construction telephone system for this and subsequent contracts; coordinate temporary telephone connections with Departmental Representative.

## **Part 2 Products**

### **2.1 MATERIALS**

- .1 General Patching and Repair Materials: Refer to Section 02 41 19.16 - Selective Interior Demolition for listing of patching and repair materials incidental to removal or demolition of components associated with work of this Section.
- .2 Electrical Repair Materials: Use only new materials, CSA or ULC labelled as appropriate and matching components remaining after work associated with components identified for removal or demolition are completed.
- .3 Fire stopping Repair Materials: Use fire stopping materials compatible with existing fire stopping systems where removal or demolition work affects rated assemblies, restore to match existing fire rated performance.

## **Part 3 Execution**

### **3.1 PREPARATION**

- .1 Protection of Existing Systems to Remain: Protect systems and components indicated to remain in place during selective demolition operations and as follows:
  - .1 Prevent movement and install bracing to prevent settlement or damage of adjacent services and parts of existing buildings scheduled to remain.
  - .2 Notify Departmental Representative and cease operations where safety of buildings being demolished, adjacent structures or services appears to be endangered and await additional instructions before resuming demolition work specified in this Section.
  - .3 Prevent debris from blocking drainage inlets.
  - .4 Protect mechanical systems that will remain in operation.

### 3.2 EXECUTION

- .1 Demolition: Coordinate requirements of this Section with information contained in Section 02 41 19.16 - Selective Interior Demolition] and as follows:
  - .1 Disconnect electrical circuits and panel feeders; maintain electrical service and main distribution panel as is, ready for subsequent Work.
  - .2 Remove existing luminaires, electrical devices and equipment including associated conduits, boxes, wiring, and similar items unless specifically noted otherwise.
  - .3 Disconnect and remove communication systems including associated conduits, boxes, cabling, and similar items unless specifically noted otherwise.
  - .4 Disconnect and remove telephone outlets, associated conduit, cabling and sub terminal backboards and related accessories; maintain telephone service and main terminal backboard as is.
  - .5 Perform demolition work in a neat and workmanlike manner:
    - .1 Remove tools or equipment after completion of work, and leave site clean and ready for subsequent renovation work.
    - .2 Repair and restore damages caused as a result of work of this Section to match existing materials and finishes.
  - .6 Disconnect panel feeders back to main distribution panel and re label respective circuit breaker as "SPARE".
  - .7 Place weatherproof blank cover plates on exterior outlet boxes remaining after demolition and removal activities.
  - .8 Remove existing conduits, boxes, cabling and wiring associated with removed luminaires, electrical devices and equipment.
  - .9 Grind off conduits and make flush with surface of concrete where conduits are cast into concrete; seal open ends of conduit with silicone sealant and leave in place.
  - .10 Seal open ends of conduit with silicone sealant and leave in place where they are inaccessible or cannot be removed without damaging adjacent construction.

### 3.3 CLOSEOUT ACTIVITIES

- .1 Demolition Waste Disposal: Arrange for legal disposal and remove demolished materials to accredited provincial landfill site or alternative disposal site (recycle centre) except where explicitly noted otherwise for materials being salvaged for re use in new construction in accordance with Section 02 42 00 - Removal and Salvage of Construction Materials.
- .2 Hazardous Substances Disposal: Arrange for disposal of hazardous substances in accordance with requirements of Section 02 81 00- Hazardous Materials.

**END OF SECTION**

**Part 1        General**

**1.1           RELATED REQUIREMENTS**

- .1        Section Common Work Results for Electrical

**1.2           REFERENCE STANDARDS**

- .1        CSA Group (CSA)
  - .1        CAN/CSA-C22.2 No.18-98 (R2003), Outlet Boxes, Conduit Boxes and Fittings.
  - .2        CAN/CSA-C22.2 No.65-03 (R2008), Wire Connectors (Tri-National Standard with UL 486A-486B and NMX-J-543-ANCE-03).
- .2        Electrical and Electronic Manufacturers' Association of Canada (EEMAC)
  - .1        EEMAC 1Y-2-1961, Bushing Stud Connectors and Aluminum Adapters (1200 Ampere Maximum Rating).
- .3        National Electrical Manufacturers Association (NEMA)

**1.3           ACTION AND INFORMATIONAL SUBMITTALS**

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

**1.4           CLOSEOUT SUBMITTALS**

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

**1.5           DELIVERY, STORAGE AND HANDLING**

- .1        Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
- .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 off ground in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2        Store and protect wire and box connectors from nicks, scratches, and blemishes.
  - .3        Replace defective or damaged materials with new.

## **Part 2 Products**

### **2.1 MATERIALS**

- .1 Pressure type wire connectors to: CAN/CSA-C22.2 No.65, with current carrying parts of copper sized to fit copper conductors as required.
- .2 Fixture type splicing connectors to: CAN/CSA-C22.2 No.65, with current carrying parts of copper sized to fit [copper] conductors 10 AWG or less.
- .3 Bushing stud connectors: to NEMA to consist of:
  - .1 Connector body and stud clamp for copper conductors.
  - .2 Clamp for copper conductors.
  - .3 Stud clamp bolts.
  - .4 Bolts for copper conductors.
  - .5 Sized for conductors as indicated.
- .4 Clamps or connectors for flexible conduit, aluminum sheathed cable, mineral insulated cable, armoured cable, TECK cable as required to: CAN/CSA-C22.2 No.18.

## **Part 3 Execution**

### **3.1 EXAMINATION**

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

### **3.2 INSTALLATION**

- .1 Remove insulation carefully from ends of conductors [cables] and:
  - .1 Apply coat of zinc joint compound on aluminum conductors prior to installation of connectors.
  - .2 Install mechanical pressure type connectors and tighten screws [with appropriate compression tool recommended by manufacturer]. Installation shall meet secureness tests in accordance with CAN/CSA-C22.2 No.65.
  - .3 Install fixture type connectors and tighten to CAN/CSA-C22.2 No.65. Replace insulating cap.
  - .4 Install bushing stud connectors in accordance with NEMA.

**3.3 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - 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 00 - Cleaning.

**END OF SECTION**



**Part 1            General**

**1.1                RELATED REQUIREMENTS**

- .1    Section 26 05 00 - Common Work Results for Electrical
- .2    Section 26 05 20 - Wire and Box connectors (0-1000 V)
- .3    Section 26 05 34 - Conduits, Conduits Fastenings and Conduits Fittings
- .4    Section 26 05 36 - Cable Trays for Electrical Systems

**1.2                PRODUCT DATA**

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

**Part 2            Products**

**2.1                BUILDING WIRES**

- .1    Conductors: stranded for 10 AWG and larger. Minimum size: 12 AWG.
- .2    Copper conductors: size as indicated, with 600 V insulation of cross-linked thermosetting polyethylene material rated RW90 XLPE, Jacketted.
- .3    Copper conductors: size as indicated, with thermoplastic insulation type TW75 rated at 600 V.
- .4    Neutral supported cable: 3 phase insulated conductors of Copper and one neutral conductor of Copper steel reinforced, size as indicated, type RW90 (green) or TW75.

**2.2                TECK 90 CABLE**

- .1    Cable: in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2    Conductors:
  - .1    Grounding conductor: copper.
  - .2    Circuit conductors: copper, size as indicated.
- .3    Insulation:
  - .1    Cross-linked polyethylene XLPE.
  - .2    Rating:600 V.
- .4    Inner jacket: polyvinyl chloride material.
- .5    Armour: aluminum interlocking.
- .6    Overall covering: thermoplastic polyvinyl chloride, compliant to applicable Building Code classification for this project.

- .7 Fastenings:
  - .1 One hole steel straps to secure surface cables 50 mm and smaller. Two hole steel straps for cables larger than 50 mm.
  - .2 Threaded rods: 6 mm diameter to support suspended channels.
- .8 Connectors:
  - .1 Watertight approved for TECK cable.

### **2.3 ARMOURED CABLES**

- .1 Conductors: insulated, copper, size as indicated.
- .2 Type: AC90.
- .3 Armour: interlocking type fabricated from aluminum strip.
- .4 Connectors: anti short connectors.

### **2.4 CONTROL CABLES**

- .1 Type: LVT: 2 soft annealed copper conductors, sized as indicated:
  - .1 Insulation: thermoplastic.
  - .2 Sheath: thermoplastic jacket, and armour of closely wound aluminum wire.
- .2 Type: low energy 300 V control cable: solid annealed copper conductors sized as indicated
  - .1 Insulation: TW.
- .3 Type: 600 V 2 stranded annealed copper conductors, sizes as indicated:
  - .1 Insulation: TW polyethylene RW90 (x-link).

### **2.5 ACCEPTABLE PRODUCTS**

- .1 General Cable;
- .2 Nexans Canada inc.;
- .3 Prysmian.

## **Part 3 Execution**

### **3.1 FIELD QUALITY CONTROL**

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Perform tests using method appropriate to site conditions and to approval of Departmental Representative and local authority having jurisdiction over installation.
- .3 Perform tests before energizing electrical system.

### **3.2 GENERAL CABLE INSTALLATION**

- .1 Lay cable in cable trays in accordance with Section 26 05 36 - Cable Trays for Electrical Systems.
- .2 Terminate cables in accordance with Section 26 05 20 - Wire and Box Connectors - (0-1000 V).
- .3 Cable Colour Coding: to Section 26 05 00 - Common Work Results for Electrical.
- .4 Conductor length for parallel feeders to be identical.
- .5 Lace or clip groups of feeder cables at distribution centres, pull boxes, and termination points.
- .6 Wiring in walls: typically drop or loop vertically from above to better facilitate future renovations. Generally wiring from below and horizontal wiring in walls to be avoided unless indicated.
- .7 Branch circuit wiring for surge suppression receptacles and permanently wired computer and electronic equipment to be 2-wire circuits only, i.e. common neutrals not permitted.
- .8 Provide numbered wire collars for control wiring. Numbers to correspond to control shop drawing legend. Obtain wiring diagram for control wiring.

### **3.3 INSTALLATION OF BUILDING WIRES**

- .1 Install wiring as follows:
  - .1 In conduit systems in accordance with Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.
  - .2 In surface and lighting fixture raceways in accordance with Section 26.

### **3.4 INSTALLATION OF TECK90 CABLE (0 -1000 V)**

- .1 Group cables wherever possible on channels.
- .2 Install cable exposed, securely supported by hangers.

### **3.5 INSTALLATION OF ARMOURED CABLES**

- .1 Group cables wherever possible on channels.

### **3.6 INSTALLATION OF CONTROL CABLES**

- .1 Install control cables in conduit.
- .2 Ground control cable shield.

### **3.7 INSTALLATION OF NON-METALLIC SHEATHED CABLE**

- .1 Install cables.
- .2 Install straps and box connectors to cables as required.

**END OF SECTION**



**Part 1        General**

**1.1            RELATED REQUIREMENTS**

- .1        Section 26 05 00 - Common Work Results for Electrical
- .2        Section 26 05 33 - Raceway and Boxes for Electrical Systems

**1.2            REFERENCE STANDARDS**

- .1        CSA Group
  - .1        CSA C22.1-12, Canadian Electrical Code, Part 1 (22nd Edition), Safety Standard for Electrical Installations.
  - .2        CSA C22.2 No.41-13, Grounding and Bonding Equipment (Tri-National Standard, with NMX-J-590ANCE and UL 467).
  - .3        CSA C22.2 No.65-13, Wire connectors (Tri-National Standard, with UL 486A-486B NMX-J-543-ANCE).

**1.3            ACTION AND INFORMATIONAL SUBMITTALS**

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

**1.4            CLOSEOUT SUBMITTALS**

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

**1.5            DELIVERY, STORAGE AND HANDLING**

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

**Part 2 Products**

**2.1 CONNECTORS AND TERMINATIONS**

- .1 Copper compression connectors to CSA C22.2 No.65 as required sized for conductors.
- .2 Contact aid for aluminum cables where applicable.
- .3 2 way joint boxes dry location type in accordance with Section 26 05 33 - Raceway and Boxes for Electrical Systems.

**Part 3 Execution**

**3.1 EXAMINATION**

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

**3.2 INSTALLATION**

- .1 Install stress cones, terminations, and splices in accordance with manufacturer's instructions.
- .2 Bond and ground as required to CSA C22.2No.41.

**3.3 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - 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 00 - Cleaning.

**END OF SECTION**

**Part 1        General**

**1.1            RELATED REQUIREMENTS**

- .1        Section 26 05 00 - Common Work Results for Electrical.

**1.2            REFERENCE STANDARDS**

- .1        American National Standards Institute/Institute of Electrical and Electronics Engineers (ANSI/IEEE)
  - .1        ANSI/IEEE 837-02, IEEE Standard for Qualifying Permanent Connections Used in Substation Grounding.
- .2        CSA Group (CSA)
  - .1        CSA Z32-09, Electrical Safety and Essential Electrical Systems in Health Care Facilities.

**1.3            ACTION AND INFORMATIONAL SUBMITTALS**

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

**1.4            CLOSEOUT SUBMITTALS**

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

**1.5            DELIVERY, STORAGE AND HANDLING**

- .1        Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
- .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 off ground in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2        Store and protect grounding equipment from nicks, scratches, and blemishes.
  - .3        Replace defective or damaged materials with new.

**Part 2 Products**

**2.1 EQUIPMENT**

- .1 Clamps for grounding of conductor: size as required to electrically conductive underground water pipe.
- .2 Rod electrodes: [9 copper clad steel mm diameter by minimum 3 m long.
- .3 Grounding conductors: bare stranded copper, soft annealed, size as indicated.
- .4 Insulated grounding conductors: green, copper conductors, size as indicated.
- .5 Ground bus: copper, size as indicated, 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.

**Part 3 Execution**

**3.1 EXAMINATION**

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

**3.2 INSTALLATION GENERAL**

- .1 Install complete permanent, continuous grounding system including, electrodes, conductors, connectors, accessories. Where EMT is used, run ground wire in conduit.
- .2 Install connectors in accordance with manufacturer's instructions.
- .3 Protect exposed grounding conductors from mechanical injury.
- .4 Make buried connections, and connections to conductive water main, electrodes, using copper welding by thermit process.

- .5 Use mechanical connectors for grounding connections to equipment provided with lugs.
- .6 Soldered joints not permitted.
- .7 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.
- .8 Install flexible ground straps for bus duct enclosure joints, where such bonding is not inherently provided with equipment.
- .9 Install separate ground conductor to outdoor lighting standards.
- .10 Connect building structural steel and metal siding to ground by welding copper to steel.
- .11 Make grounding connections in radial configuration only, with connections terminating at single grounding point. Avoid loop connections.
- .12 Bond single conductor, metallic armoured cables to cabinet at supply end, [and load end.
- .13 Ground secondary service pedestals.

### **3.3 MAINTENANCE HOLES**

- .1 Install conveniently located grounding stud, electrode, size [as indicated] stranded copper conductor in each maintenance hole.
- .2 Install ground rod in each maintenance hole so that top projects through bottom of maintenance hole. Provide with lug to which grounding connection can be made. Confirm ground resistance meets or exceeds Canadian Electrical Code minimum requirements.

### **3.4 ELECTRODES**

- .1 Make ground connections to continuously conductive underground water pipe on street side of water meter.
- .2 Install water metre shunt.
- .3 Install concrete encased electrodes in building foundation footings, with terminal connected to grounding network.
- .4 Install rod electrodes and make grounding connections as indicated.
- .5 Bond separate, multiple electrodes together.
- .6 Use size 2/0 AWG copper conductors for connections to electrodes.
- .7 Make special provision for installing electrodes that will give acceptable resistance to ground value where rock or sand terrain prevails. Ground as indicated.

### **3.5 EQUIPMENT GROUNDING**

- .1 Install grounding connections to typical equipment included in, but not necessarily limited to following list. Service equipment, transformers, switchgear, duct systems, frames of motors, motor control centres, starters, control panels, building steel work, generators, elevators and escalators, distribution panels, outdoor lighting, cable trays.

### **3.6 GROUNDING BUS**

- .1 Install copper grounding bus mounted on insulated supports on wall of electrical room and communication equipment room.
- .2 Ground items of electrical equipment in electrical room and IT equipment in communication equipment room to ground bus with individual bare stranded copper connections size 2/0AWG.

### **3.7 COMMUNICATION SYSTEMS**

- .1 Install grounding connections for telephone, sound, fire alarm, security systems, intercommunication systems as follows:
  - .1 Telephones: make telephone grounding system in accordance with telephone company's requirements.
  - .2 Sound, fire alarm, security systems, intercommunication systems as indicated.

### **3.8 FIELD QUALITY CONTROL**

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Perform ground continuity and resistance tests using method appropriate to site conditions and to approval of Departmental Representative and local authority having jurisdiction over installation.
- .3 Perform tests before energizing electrical system.
- .4 Disconnect ground fault indicator during tests.

### **3.9 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - 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 00 - Cleaning.

**END OF SECTION**

**Part 1 General**

**1.1 RELATED REQUIREMENTS**

- .1 Section 26 05 00 - Common Work Results for Electrical.

**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 hangers and supports and include product characteristics, performance criteria, physical size, finish and limitations.

**1.3 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials in dry location indoors off ground and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect hangers and supports from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.

**Part 2 Products**

**2.1 SUPPORT CHANNELS**

- .1 U shape, size 25.4 x 12.7 mm, 3.18 mm thick, suspended or surface mounted.

**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 hangers and supports 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 Secure equipment to solid masonry, tile and plaster surfaces with lead anchors.
- .2 Secure equipment to poured concrete with expandable inserts.
- .3 Secure equipment to hollow masonry walls or suspended ceilings with toggle bolts.
- .4 Secure surface mounted equipment with twist clip fasteners to inverted T bar ceilings. Ensure that T bars are adequately supported to carry weight of equipment specified before installation.
- .5 Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.
- .6 Suspended support systems.
  - .1 Support individual cable or conduit runs with 6 mm diameter threaded rods and spring clips.
  - .2 Support 2 or more cables or conduits on channels supported by 6 mm diameter threaded rod hangers where direct fastening to building construction is impractical.
- .7 For surface mounting of two or more conduits use channels.
- .8 Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.
- .9 Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.
- .10 Do not use wire lashing or perforated strap to support or secure raceways or cables.
- .11 Do not use supports or equipment installed for other trades for conduit or cable support except with permission of other trade and approval of Departmental Representative.
- .12 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer's installation recommendations.

### 3.3 **CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - 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 00 - Cleaning.

**END OF SECTION**

**Part 1            General**

**1.1                RELATED REQUIREMENTS**

- .1            Section 26 05 00 - Common Work Results for Electrical.

**1.2                REFERENCE STANDARDS**

- .1            CSA Group (CSA)
  - .1            CSA C22.1-06, Canadian Electrical Code, Part 1, 20th Edition.

**1.3                ACTION AND INFORMATIONAL SUBMITTALS**

- .1            Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2            Product Data:
  - .1            Provide manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
- .3            Provide shop drawings: in accordance with Section 01 33 00 - Submittal Procedures.

**Part 2            Products**

**2.1                SPLITTERS**

- .1            Construction: sheet metal enclosure, welded corners and formed hinged cover suitable for locking in closed position.
- .2            Terminations: main and branch lugs to match required size and number of incoming and outgoing conductors as indicated.
- .3            Spare Terminals: minimum three spare terminals or lugs on each connection or lug block sized less than 400 A.

**2.2                JUNCTION AND PULL BOXES**

- .1            Construction: welded steel enclosure.
- .2            Covers Flush Mounted: 25 mm minimum extension all around.
- .3            Covers Surface Mounted: screw-on flat covers.

**2.3                ACCEPTABLE PRODUCTS**

- .1            Thomas & Betts;
- .2            Roger Girard;
- .3            Bel;
- .4            Or equivalent.

**Part 3 Execution**

**3.1 SPLITTER INSTALLATION**

- .1 Mount plumb, true and square to building lines.
- .2 Extend splitters full length of equipment arrangement except where indicated otherwise.

**3.2 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 except where indicated otherwise.
- .3 Install terminal block as indicated in Type T cabinets.
- .4 Only main junction and pull boxes are indicated. Install additional pull boxes as required by CSA C22.1.

**3.3 IDENTIFICATION**

- .1 Equipment Identification: to Section 26 05 00 - Common Work Results for Electrical.
- .2 Identification Labels: size 2 indicating voltage and phase or as indicated.

**END OF SECTION**

**Part 1        General**

**1.1            RELATED REQUIREMENTS**

- .1        Section 26 05 00 - Common Work Results for Electrical.

**1.2            REFERENCE STANDARDS**

- .1        CSA Group (CSA)
  - .1        CSA C22.1-06, Canadian Electrical Code, Part 1, 20th Edition.

**1.3            ACTION AND INFORMATIONAL SUBMITTALS**

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

**1.4            DELIVERY, STORAGE AND HANDLING**

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

**Part 2        Products**

**2.1            OUTLET AND CONDUIT BOXES GENERAL**

- .1        Size boxes in accordance with CSA C22.1.
- .2        102 mm square or larger outlet boxes as required.
- .3        Gang boxes where wiring devices are grouped.
- .4        Blank cover plates for boxes without wiring devices.
- .5        347 V outlet boxes for 347 V switching devices.
- .6        Combination boxes with barriers where outlets for more than one system are grouped.

**2.2            GALVANIZED STEEL OUTLET BOXES**

- .1        One-piece electro-galvanized construction.
- .2        Single and 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.
- .3        Utility boxes for outlets connected to surface-mounted EMT conduit, minimum size 102 x 54 x 48 mm.
- .4        102 mm square or octagonal outlet boxes for lighting fixture outlets.
- .5        Extension and plaster rings for flush mounting devices in finished tile walls.

**2.3 MASONRY BOXES**

- .1 Electro-galvanized steel masonry and multi gang boxes for devices flush mounted in exposed block walls.

**2.4 CONDUIT BOXES**

- .1 Cast FS boxes with factory-threaded hubs and mounting feet for surface wiring of devices.

**2.5 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 35 mm and pull boxes for larger conduits.
- .4 Double locknuts and insulated bushings on sheet metal boxes.

**2.6 ACCEPTABLE PRODUCTS**

- .1 Thomas & Betts;
- .2 Roger Girard;
- .3 Bel;
- .4 Or equivalent.

**Part 3 Execution**

**3.1 INSTALLATION**

- .1 Support boxes independently of connecting conduits.
- .2 Fill boxes with paper, sponges or foam or similar approved material to prevent entry of debris during construction. Remove upon completion of work.
- .3 For flush installations mount outlets flush with finished wall using plaster rings to permit wall finish to come within 6 mm of opening.
- .4 Provide correct size of openings in boxes for conduit, mineral insulated and armoured cable connections. Do not install reducing washers.
- .5 Vacuum clean interior of outlet boxes before installation of wiring devices.
- .6 Identify systems for outlet boxes as required.

**END OF SECTION**

**Part 1        General**

**1.1            RELATED REQUIREMENTS**

- .1        Section 26 05 00 - Common Work Results for Electrical.

**1.2            REFERENCE STANDARDS**

- .1        CSA Group (CSA)
  - .1        CAN/CSA C22.2 No. 18-98 (R2003), Outlet Boxes, Conduit Boxes, Fittings and Associated Hardware, A National Standard of Canada.
  - .2        CSA C22.2 No. 45-M1981 (R2003), Rigid Metal Conduit.
  - .3        CSA C22.2 No. 56-04, Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.
  - .4        CSA C22.2 No. 83-M1985 (R2003), Electrical Metallic Tubing.
  - .5        CSA C22.2 No. 211.2-M1984 (R2003), Rigid PVC (Unplasticized) Conduit.
  - .6        CAN/CSA C22.2 No. 227.3-05, Nonmetallic Mechanical Protection Tubing (NMPT), A National Standard of Canada (February 2006).

**1.3            ACTION AND INFORMATIONAL SUBMITTALS**

- .1        Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2        Product data: submit manufacturer's printed product literature, specifications and datasheets.
  - .1        Submit cable manufacturing data.
- .3        Quality assurance submittals:
  - .1        Test reports: submit certified test reports.
  - .2        Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
  - .3        Instructions: submit manufacturer's installation instructions.

**Part 2        Products**

**2.1            CABLES AND REELS**

- .1        Provide cables on reels or coils.
  - .1        Mark or tag each cable and outside of each reel or coil, to indicate cable length, voltage rating, conductor size, and manufacturer's lot number and reel number.
- .2        Each coil or reel of cable to contain only one continuous cable without splices.
- .3        Identify cables for exclusively dc applications.
- .4        Reel and mark shielded cables rated 2,001 volts and above.

## **2.2 CONDUITS**

- .1 Rigid metal conduit: to CSA C22.2 No. 45, galvanized steel threaded.
- .2 Epoxy coated conduit: to CSA C22.2 No. 45, with zinc coating and corrosion resistant epoxy finish inside and outside.
- .3 Electrical metallic tubing (EMT): to CSA C22.2 No. 83, with couplings.
- .4 Rigid pvc conduit: to CSA C22.2 No. 211.2.
- .5 Flexible metal conduit: to CSA C22.2 No. 56,
- .6 Flexible pvc conduit: to CAN/CSA-C22.2 No. 227.3

## **2.3 CONDUIT FASTENINGS**

- .1 One hole steel straps to secure surface conduits 50 mm and smaller.
  - .1 Two hole steel straps for conduits larger than 50 mm.
- .2 Beam clamps to secure conduits to exposed steel work.
- .3 Channel type supports for two or more conduits.
- .4 Threaded rods, 6 mm diameter, to support suspended channels.

## **2.4 CONDUIT FITTINGS**

- .1 Fittings: to CAN/CSA C22.2 No. 18, manufactured for use with conduit specified.  
Coating: same as conduit.
- .2 Ensure factory "L"; where 90 degrees bends for 25 mm and larger conduits.
- .3 Watertight connectors and couplings for EMT.
  - .1 Set-screws are not acceptable.

## **2.5 EXPANSION FITTINGS FOR RIGID CONDUIT**

- .1 Weatherproof expansion fittings with internal bonding assembly suitable for 200 mm linear expansion.
- .2 Watertight expansion fittings with integral bonding jumper suitable for linear expansion and 19 mm deflection.
- .3 Weatherproof expansion fittings for linear expansion at entry to panel.

## **2.6 FISH CORD**

- .1 Polypropylene.

## **2.7 ACCEPTABLE PRODUCTS**

- .1 Columbia (TEM, Rigide);
- .2 IPEX (CPV), Thomas & Betts (série Carlon CPV);
- .3 Prysmian Group (TEM);
- .4 Or equivalent.

**Part 3 Execution**

**3.1 MANUFACTURER'S INSTRUCTIONS**

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

**3.2 INSTALLATION**

- .1 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.
- .2 Conceal conduits except in unfinished areas and in mechanical and electrical service rooms.
- .3 Use rigid galvanized steel threaded conduit except where specified otherwise.
- .4 Use electrical metallic tubing (EMT).
- .5 Use rigid pvc conduit in corrosive areas.
- .6 Use flexible metal conduit for connection to motors in dry areas.
- .7 Use liquid tight flexible metal conduit for connection to motors or vibrating equipment in damp, wet or corrosive locations.
- .8 Install conduit sealing fittings in hazardous areas.
  - .1 Fill with compound.
- .9 Minimum conduit size for lighting and power circuits: 19 mm.
- .10 Bend conduit cold:
  - .1 Replace conduit if kinked or flattened more than 1/10th of its original diameter.
- .11 Mechanically bend steel conduit over 19 mm diameter.
- .12 Field threads on rigid conduit must be of sufficient length to draw conduits up tight.
- .13 Install fish cord in empty conduits.
- .14 Run 2-25 mm spare conduits up to ceiling space and 2-25 mm spare conduits down to ceiling space from each flush panel.
  - .1 Terminate these conduits in 152 x 152 x 102 mm junction boxes in ceiling space or in case of an exposed concrete slab, terminate each conduit in surface type box.
- .15 Remove and replace blocked conduit sections.
  - .1 Do not use liquids to clean out conduits.
- .16 Dry conduits out before installing wire.

**3.3 SURFACE CONDUITS**

- .1 Run parallel or perpendicular to building lines.
- .2 Locate conduits behind infrared or gas fired heaters with 1.5 m clearance.
- .3 Run conduits in flanged portion of structural steel.
- .4 Group conduits wherever possible on suspended 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.

**3.4 CONCEALED CONDUITS**

- .1 Run parallel or perpendicular to building lines.
- .2 Do not install horizontal runs in masonry walls.
- .3 Do not install conduits in terrazzo or concrete toppings.

**3.5 CLEANING**

- .1 Proceed in accordance with Section 01 74 00 - Cleaning.
- .2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

**END OF SECTION**

**Part 1        General**

**1.1            RELATED REQUIREMENTS**

- .1        Section 26 05 00 - Common Work results for Electrical.

**1.2            REFERENCE STANDARDS**

- .1        CSA Group (CSA)
  - .1        CAN/CSA C22.1 No.126.1-02, Metal Cable Tray Systems.
  - .2        CAN/CSA C22.1 No.126.2-02, Non Metallic Cable Tray Systems.
- .2        National Electrical Manufacturers Association (NEMA)
  - .1        NEMA FG 1-1993, Fibreglass and Cable Tray Systems.
  - .2        NEMA VE 1-2002, Metal Cable Tray Systems.
  - .3        NEMA VE 2-2001, Cable Tray Installation Guidelines.

**1.3            ACTION AND INFORMATIONAL SUBMITTALS**

- .1        Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2        Product Data: submit manufacturer's product data sheets for cable tray indicating dimensions, materials, and finishes, including classifications and certifications.
- .3        Shop Drawings: submit shop drawings showing materials, finish, dimensions, accessories, layout, and installation details.
- .4        Identify types of cabletroughs used.
- .5        Show actual cabletrough installation details and suspension system.

**Part 2        Products**

**2.1            CABLETROUGH**

- .1        Ladder type, Class C1 to CAN/CSA C22.2 No.126.1.
- .2        Trays: extruded aluminum, dimensions as indicated.
- .3        Fittings: horizontal elbows, end plates, drop outs, vertical risers and drops, tees, wyes, expansion joints and reducers where required, manufactured accessories for cabletrough supplied.
- .4        Solid covers for complete cabletrough system including fittings.
- .5        Barriers where different voltage systems are in same cabletrough.
- .6        Ground cable trays with #2 AWG bare copper conductor attached to each tray section in accordance with CEC requirements.
- .7        Fire stop system at penetrations of fire separations in accordance with Section 07 84 00 - Fire Stopping.

**2.2 SUPPORTS**

- .1 Provide splices, supports for a continuously grounded system as required.

**Part 3 Execution**

**3.1 INSTALLATION**

- .1 Install complete cabletrough system in accordance with NEMA VE 2.
- .2 Support cabletrough on both sides.
- .3 Remove sharp burrs or projections to prevent damage to cables or injury to personnel.

**3.2 CABLES IN CABLETROUGH**

- .1 Install cables individually.
- .2 Lay cables into cabletrough. Use rollers when necessary to pull cables.
- .3 Secure cables in cabletrough at 6 m centres, with nylon ties.
- .4 Identify cables every 30 m with size 2 nameplates.

**END OF SECTION**

**Part 1            General**

**1.1            RELATED REQUIREMENTS**

- .1        Section Section 20 05 00 – "General Requirements Concerning Common Work Results" applies

**1.2            REFERENCE STANDARDS**

- .1        CSA Group (CSA)
  - .1        CAN/CSA-C22.2 No.47 Air-Cooled Transformers (Dry Type).
  - .2        CSA C9 Dry-Type Transformers.
  - .3        CAN/CSA-C802.2, Minimum Efficiency Values for Dry Type Transformers.
- .2        National Electrical Manufacturers Association (NEMA)

**1.3            ACTION AND INFORMATIONAL SUBMITTALS**

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

**1.4            CLOSEOUT SUBMITTALS**

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

**1.5            DELIVERY, STORAGE AND HANDLING**

- .1        Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements
- .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 off ground in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2        Store and protect dry type transformers from nicks, scratches, and blemishes.
  - .3        Replace defective or damaged materials with new.

**Part 2 Products**

**2.1 DESIGN DESCRIPTION**

- .1 Design 1.
  - .1 Type:ANN.
  - .2 Single phase, 15 kVA,600 V input, 120/240 V output, 60 Hz.
  - .3 Vacuum impregnation
  - .4 Voltage taps: standard, 4 x 2.5% (FCAN-FCBN).
  - .5 Insulation: Class 150 degrees C temperature rise.
  - .6 Basic Impulse Level (BIL): standard.
  - .7 Hipot: standard.
  - .8 Average sound level: standard
  - .9 Impedance standard
  - .10 Enclosure: NEMA 2, removable metal front panel.
  - .11 Mounting: floor.
  - .12 Finish: in accordance with Section 26 05 00 - Common Work Results for Electrical.
  - .13 Copper windings.
  - .14 Winding configuration to be as noted on drawings.
- .2 Design 2.
  - .1 Type: ANN.
  - .2 3 phase, 15 kVA,600 V input, 120/208 V output, 60 Hz.
  - .3 Vacuum impregnation
  - .4 Voltage taps: standard, 4 x 2.5% (FCAN-FCBN).
  - .5 Insulation: Class 150 degrees C temperature rise.
  - .6 Basic Impulse Level (BIL): standard.
  - .7 Hipot: standard.
  - .8 Average sound level: standard
  - .9 Impedance standard
  - .10 Enclosure: NEMA 2, removable metal front panel.
  - .11 Mounting: floor.
  - .12 Finish: in accordance with Section 26 05 00 - Common Work Results for Electrical.
  - .13 Copper windings.
  - .14 Winding configuration to be as noted on drawings.

**2.2 EQUIPMENT IDENTIFICATION**

- .1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Label size: 7.
- .3 Nameplate wording: as indicated.

### **2.3 ACCEPTABLE PRODUCTS**

- .1 Delta;
- .2 Hammond;
- .3 Rex.

\*The transformers shall be "Industrial/Standard" series. The "Commercial/Residential" series are not accepted.

## **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 dry type transformers 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 Mount dry type transformers up to 75 kVA as indicated.
- .2 Mount dry type transformers above 75 kVA on floor.
- .3 Ensure adequate clearance around transformer for ventilation.
- .4 Install transformers in level upright position.
- .5 Remove shipping supports only after transformer is installed and just before putting into service.
- .6 Loosen isolation pad bolts until no compression is visible.
- .7 Make primary and secondary connections in accordance with wiring diagram.
- .8 Energize transformers after installation is complete.
- .9 Make conduit entry into bottom 1/3 of transformer enclosure.

### **3.3 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - 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 00 - Cleaning.

**3.4 PROTECTION**

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

**END OF SECTION**

**Part 1        General**

**1.1            RELATED REQUIREMENTS**

- .1        Section 26 05 00 - Common Work Results for Electrical

**1.2            REFERENCE STANDARDS**

- .1        CSA Group
  - .1        CSA C22.2 No.3118, Switchgear Assemblies.

**1.3            ACTION AND INFORMATIONAL SUBMITTALS**

- .1        Submit in accordance with Section 01 33 00- Submittal Procedures.
- .2        Product Data:
  - .1        Submit manufacturer's instructions, printed product literature and data sheets for service entrance board 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, Canada.
  - .2        Indicate on drawings:
    - .1        Floor anchoring method and foundation template.
    - .2        Dimensioned cable entry and exit locations.
    - .3        Dimensioned position and size of bus.
    - .4        Overall length, height and depth.
    - .5        Dimensioned layout of internal and front panel mounted components.
  - .3        Include time-current characteristic curves for circuit breakers and fuses.

**1.4            MAINTENANCE MATERIAL SUBMITTALS**

- .1        Extra Materials:
  - .1        Submit maintenance materials in accordance with Section 01 78 00- Closeout Submittals.

**1.5            CLOSEOUT SUBMITTALS**

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

**1.6            DELIVERY, STORAGE AND HANDLING**

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

- .3 Storage and Handling Requirements:
  - .1 Store materials indoors, in dry location, off ground and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect service entrance board from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.

## **Part 2 Products**

### **2.1 SERVICE ENTRANCE BOARD**

- .1 Service Entrance Board: to CSA C22.2 No.31.
- .2 Rating: 347/600V, 600A, 3-phase, 4 wire.
- .3 Cubicles: free standing, dead front, size as indicated.
- .4 Barrier metering section from adjoining Sections.
- .5 Provision for installation of power supply authority metering in barriered Section.
- .6 Owners metering.
- .7 Distribution section.
- .8 Hinged access panels with captive knurled thumb screws.
- .9 Bus bars and main connections: 99.3 % copper.
- .10 Bus from load terminals of main breaker via metering section to main lugs of distribution section.
- .11 Cable from load terminals of main breaker to metering section and bus from metering section to lugs of distribution section.
- .12 Identify phases with colour coding.

### **2.2 MOULDED CASE CIRCUIT BREAKERS**

- .1 Moulded case circuit breaker in accordance with Section 26 28 16.02 – Moulded Case Circuit Breakers.
- .2 The capacity of the main breaker must be indicated on drawings with RMSLSI electronic release. The breaking capacity must be at least 22 kA /600 V.
- .3 The main breaker compartment must include lockout devices and sealing screws on the frontal cover. The grounding must include removable flange to ensure the ground cable's grounding.

### **2.3 GROUNDING**

- .1 Copper ground bus extending full width of cubicles and located at bottom.
- .2 Lugs at each end for size 6 AWG

## **2.4 POWER SUPPLY AUTHORITY METERING**

- .1 Public service metering transformer compartment must be exclusively reserved and conceived according to Hydro-Quebec requirement.
- .2 It must be provided with bus and holes suited for bus type standard current transformer. The compartment must include devices to seal the frontal cover which must be provided with hinged door to allow easy access.
- .3 The installation of the metering transformer supplied by Hydro-Québec falls under the contractor's tasks.

## **2.5 FINISHES**

- .1 Apply finishes in accordance with Section 26 05 00- Common Work Results for Electrical.
  - .1 Service entrance board exterior: gray.

## **2.6 EQUIPMENT IDENTIFICATION**

- .1 Provide equipment identification in accordance with Section 26 05 00- Common Work Results for Electrical.
- .2 Nameplates:
  - .1 White plate, black letters, size 7.
  - .2 Complete board labelled: "600 V."
  - .3 Main disconnect labelled: "Main Breaker ".
  - .4 Branch disconnects labelled: "Feeder "as indicated.

## **2.7 SOURCE QUALITY CONTROL**

- .1 Departmental Representative to witness final factory tests.
- .2 Notify Departmental Representative in writing 5days in advance that service entrance board is ready for testing.

## **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 service entrance board 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     Locate service entrance board.
- .2     Connect main secondary service to line terminals of main breaker.
- .3     Connect load terminals of distribution breakers to feeders.
- .4     Check factory made connections for mechanical security and electrical continuity.
- .5     Run one grounding conductor 6 AWG bare copper in 16 mm conduit from ground bus to building ground.
- .6     Check trip unit settings against co-ordination study to ensure proper working and protection of components.

**3.3           CLEANING**

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

**END OF SECTION**

**Part 1        General**

**1.1            RELATED REQUIREMENTS**

- .1        Section 26 05 00 – Common work results for electrical.
- .2        Section 26 28 16.02 – Moulded case circuit breakers.

**1.2            REFERENCE STANDARDS**

- .1        CSA Group (CSA)
  - .1        CSA C22.2 No.29-, Panelboards and Enclosed Panelboards.

**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 panelboards and include product characteristics, performance criteria, physical size, finish and limitations.
- .3        Shop Drawings:
  - .1        Include on drawings:
    - .1        Electrical detail of panel, branch breaker type, quantity, ampacity and enclosure dimension.

**1.4            CLOSEOUT SUBMITTALS**

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

**1.5            DELIVERY, STORAGE AND HANDLING**

- .1        Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements
- .2        Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3        Storage and Handling Requirements:
  - .1        Store materials off ground in dry location indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2        Store and protect panelboards from nicks, scratches, and blemishes.
  - .3        Replace defective or damaged materials with new.

## **Part 2        Products**

### **2.1            PANELBOARDS**

- .1 Panelboards: to CSA C22.2 No.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.
- .2 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.
- .3 Panelboards: mains, number of circuits, and number and size of branch circuit breakers as indicated.
- .4 Minimum of 2 flush locks for each panel board.
- .5 Two keys for each panelboard and key panelboards alike.
- .6 Copper bus with neutral of same ampere rating of mains.
- .7 Mains: suitable for bolt-on breakers.
- .8 Trim with concealed front bolts and hinges.
- .9 Trim and door finish: baked enamel.
- .10 Isolated ground bus.
- .11 Include grounding busbar with 3 of terminals for bonding conductor equal to breaker capacity of the panel board.

### **2.2            BREAKERS**

- .1 Breakers: to Section 26 28 16.02 - Moulded Case Circuit Breakers.
- .2 Breakers with thermal and magnetic tripping in panelboards except as indicated otherwise.
- .3 Main breaker: separately mounted on top or bottom of panel to suit cable entry. When mounted vertically, down position should open breaker.
- .4 Lock-on devices for 10 % of 15 to 30 A breakers installed as indicated. Turn over unused lock-on devices to Departmental Representative.
- .5 Lock-on devices for, fire alarm, emergency, door supervisory, stairway, and exit circuits.

### **2.3            EQUIPMENT IDENTIFICATION**

- .1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Nameplate for each panelboard size 4 engraved as indicated.
- .3 Nameplate for each circuit in distribution panelboards size 2 engraved as indicated.

- .4 Complete circuit directory with typewritten legend showing location and load of each circuit, mounted in plastic envelope at inside of panel door.
- .5 Circuits supplying Patient Care Areas must be entered in circuit directory with Bold Font.

## **2.4 ACCEPTABLE PRODUCTS**

- .1 Eaton;
- .2 Schneider;
- .3 Siemens.

## **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 panelboards 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 Locate panelboards as indicated and mount securely, plumb, true and square, to adjoining surfaces.
- .2 Install surface mounted panelboards on plywood backboards in accordance with Section 06 10 10 - Rough Carpentry. Where practical, group panelboards on common backboard.
- .3 Mount panelboards to height specified in Section 26 05 00 - Common Work Results for Electrical or as indicated.
- .4 Connect loads to circuits.
- .5 Connect neutral conductors to common neutral bus with respective neutral identified.
- .6 Where panels of different systems (i.e. Standard and Vital Power) supply a common patient care area, ground busses in panels to be interconnect with a minimum #6 AWG ground conductor.

### **3.3 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - 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 00 - Cleaning.

**3.4 PROTECTION**

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

**END OF SECTION**

**Part 1            General**

**1.1                RELATED REQUIREMENTS**

- .1        Section 20 05 00 – "General Requirements Concerning Common Work Results" applies.

**1.2                REFERENCE STANDARDS**

- .1        CSA Group (CSA)
  - .1        CSA C22.2 No.42 General Use Receptacles, Attachment Plugs and Similar Devices.
  - .2        CAN/CSA C22.2 No.42.1 Cover Plates for Flush-Mounted Wiring Devices (Bi-national standard, with UL 514D).
  - .3        CSA C22.2 No.55 Special Use Switches.
  - .4        CSA C22.2 No.111 General-Use Snap Switches (Bi-national standard, with UL 20).

**1.3                ACTION AND INFORMATIONAL SUBMITTALS**

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

**1.4                CLOSEOUT SUBMITTALS**

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

**1.5                DELIVERY, STORAGE AND HANDLING**

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

**Part 2        Products**

**2.1            SWITCHES**

- .1    20 A, 120 V single pole, three-way, switches to: CSA C22.2 No.55 and CSA C22.2 No.111.
- .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 moulding for parts subject to carbon tracking.
  - .4    Suitable for back and side wiring.
  - .5    Ivorytoggle.
- .3    Toggle operated] fully rated for tungsten filament and fluorescent lamps, and up to 80 % of rated capacity of motor loads heating loads.
- .4    Switches of one manufacturer throughout project.

**2.2            RECEPTACLES**

- .1    Duplex receptacles, CSA type 5-15 R, 125 V, 15 A, U ground, to: CSA C22.2 No.42 with following features:
  - .1    Ivoryurea moulded housing.
  - .2    Suitable for No. 10 AWG for back and side wiring.
  - .3    Break-off links for use as split receptacles.
  - .4    Eight back wired entrances, four side wiring screws.
  - .5    Triple wipe contacts and rivetted grounding contacts.
- .2    Single receptacles CSA type 5-15 R, 125 V, 15 A, U ground with following features:
  - .1    Ivory urea moulded housing.
  - .2    Suitable for No. 10 AWG for back and side wiring.
  - .3    Four back wired entrances, 2 side wiring screws.
- .3    Other receptacles with ampacity and voltage as indicated.
- .4    Receptacles of one manufacturer throughout project.

**2.3            COVER PLATES**

- .1    Cover plates for wiring devices to: CSA C22.2 No.42.1.
- .2    Sheet steel utility box cover for wiring devices installed in surface-mounted utility boxes.
- .3    Stainless steel, vertically brushed, 1 mm thick cover plates for wiring devices mounted in flush-mounted outlet box.
- .4    Sheet metal cover plates for wiring devices mounted in surface-mounted FS or FD type conduit boxes.

- .5 Weatherproof double lift spring-loaded cast aluminum cover plates, complete with gaskets for duplex receptacles as indicated.
- .6 Weatherproof spring-loaded cast aluminum cover plates complete with gaskets for single receptacles or switches.

## **2.4 SOURCE QUALITY CONTROL**

- .1 Cover plates from one manufacturer throughout project.

## **2.5 ACCEPTABLE PRODUCTS**

- .1 Hubbell;
- .2 Leviton;
- .3 Bryant;
- .4 Pass & Seymour;
- .5 Arrow Hart.

## **Part 3 Execution**

### **3.1 EXAMINATION**

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

### **3.2 INSTALLATION**

- .1 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 Mount toggle switches at height [as indicated]
- .2 Receptacles:
  - .1 Install receptacles in gang type outlet box when more than one receptacle is required in one location.
  - .2 Mount receptacles at height [as indicated].
  - .3 Where split receptacle has one portion switched, mount vertically and switch upper portion.
  - .4 Install GFI type receptacles as indicated.

- .3 Cover plates:
  - .1 Install suitable common cover plates where wiring devices are grouped.
  - .2 Do not use cover plates meant for flush outlet boxes on surface-mounted boxes.

### **3.3 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - 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 00 - Cleaning.

### **3.4 PROTECTION**

- .1 Protect installed products and components from damage during construction.
- .2 Protect stainless steel cover plate finish with paper or plastic film until painting and other work is finished.
- .3 Repair damage to adjacent materials caused by wiring device installation.

**END OF SECTION**

**Part 1        General**

**1.1            RELATED REQUIREMENTS**

- .1        Section 20 05 00 – "General Requirements Concerning Common Work Results" applies

**1.2            REFERENCE STANDARDS**

- .1        Fuses standards\_CSA C22.2 no 106 et CAN/CSA C22.2 no 248.
- .2        High rupturing capacity (HRC) fuses 200kA RMS symmetrical and current limiting fuses.

**1.3            ACTION AND INFORMATIONAL SUBMITTALS**

- .1        Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2        Product Data:
  - .1        Provide fuse performance data characteristics for each fuse type. Performance data to include: average melting time-current characteristics.
- .3        Shop Drawings:
  - .1        Provide shop drawings in accordance with Section 01 33 00 - Submittal Procedures.

**1.4            DELIVERY, STORAGE AND HANDLING**

- .1        Ship fuses in original containers.
- .2        Do not ship fuses installed in switchboard.
- .3        Store fuses in original containers in storage cabinet moisture free location.

**1.5            EXTRA MATERIALS**

- .1        Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.
- .2        Six spare fuses of each type and size installed up to and including 600 A.

**Part 2        Products**

**2.1            FUSES - GENERAL**

- .1        Fuse type references L1, L2, J1, R1, etc. have been adopted for use in this specification.
- .2        Fuses: product of one manufacturer.

## 2.2 FUSE TYPES

- .1 Class L fuses.
  - .1 Type L1, time delay, capable of carrying 500 % of its rated current for 10 s minimum.
  - .2 Type L2, fast acting.
- .2 Class J fuses.
  - .1 Type J1, time delay, capable of carrying 500 % of its rated current for 10 s minimum.
  - .2 Type J2, fast acting.
- .3 Class R -R fuses.
  - .1 Type R1, (UL Class RK1), time delay, capable of carrying 500 % of its rated current for 10 s minimum, to meet UL Class RK1 maximum let-through limits.
  - .2 Type R2, time delay, capable of carrying 500 % of its rated current for 10 s minimum.
  - .3 Type R3, (UL Class RK1), fast acting Class R, to meet UL Class RK1 maximum let-through limits.
- .4 Class C fuses.

## Part 3 Execution

### 3.1 INSTALLATION

- .1 Install fuses in mounting devices immediately before energizing circuit.
- .2 Ensure correct fuses fitted to physically matched mounting devices.
  - .1 Install rejection clips for Class R fuses.
- .3 Ensure correct fuses fitted to assigned electrical circuit.
- .4 Where UL Class RK1 fuses are specified, install warning label "Use only UL Class RK1 fuses for replacement" on equipment.
- .5 Install spare fuses in fuse storage cabinet.

**END OF SECTION**

**Part 1            General**

**1.1                RELATED REQUIREMENTS**

- .1        Section 20 05 00 – "General Requirements Concerning Common Work Results" applies.

**1.2                REFERENCE STANDARDS**

- .1        CSA Group (CSA)
  - .1        CSA C22.2 No. 5 Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures (Tri-national standard with UL 489, and NMX-J-266-ANCE-2010).

**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 circuit breakers and include product characteristics, performance criteria, physical size, finish and limitations.
- .3        Certificates:
  - .1        Prior to installation of circuit breakers in either new or existing installation, Contractor must submit 3 copies of a production certificate of origin from the manufacturer. Production certificate of origin must be duly signed by factory and local manufacturer's representative certifying that circuit breakers come from this manufacturer and are new and meet standards and regulations.
    - .1        Production certificate of origin must be submitted Departmental Representative for approval.
  - .2        Delay in submitting production of certificate of origin will not justify any extension of contract and additional compensation.
  - .3        Any work of manufacturing, assembly or installation to begin only after acceptance of production certificate of origin by Departmental Representative Unless complying with this requirement, Departmental Representative reserves the right to mandate manufacturer listed on circuit breakers to authenticate new circuit breakers under the contract, and to Contractor's expense.
  - .4        Production certificate of origin must contain:
    - .1        Manufacturer's name and address and person responsible for authentication. Person responsible must sign and date certificate.
    - .2        Licensed dealer's name and address and person of distributor responsible for Contractor's account.
    - .3        Contractor's name and address and person responsible for project.

- .4 Local manufacturer's representative name and address. Local manufacturer's representative must sign and date certificate.
- .5 Name and address of building where circuit breakers will be installed:
  - .1 Project title:
  - .2 End user's reference number:
  - .3 List of circuit breakers:

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

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store circuit breakers indoors off ground and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect circuit breakers from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.

### **Part 2 Products**

#### **2.1 BREAKERS GENERAL**

- .1 Moulded-case circuit breakers, fused circuit breakers, Circuit breakers, ground-fault circuit-interrupters: to CSA C22.2 No. 5
- .2 Bolt-on moulded case circuit breaker: quick- make, quick-break type, for manual and automatic operation
- .3 Plug-in moulded case circuit breakers: quick- make, quick-break type, for manual and automatic operation
- .4 Magnetic instantaneous trip elements in circuit breakers to operate only when value of current reaches setting.
  - .1 Trip settings on breakers with adjustable trips to range from 3-8 times current rating.
- .5 Circuit breakers with interchangeable trips as indicated.

#### **2.2 THERMAL MAGNETIC BREAKERS DESIGN A**

- .1 Moulded case circuit breaker to operate automatically by means of thermal and magnetic tripping devices to provide inverse time current tripping and instantaneous tripping for short circuit protection.

**2.3 MAGNETIC BREAKERS (DESIGN B)**

- .1 Moulded case circuit breaker to operate automatically by means of magnetic tripping devices to provide instantaneous tripping for short circuit protection.

**2.4 CURRENT LIMITING AND SERIES RATED THERMAL MAGNETIC BREAKERS (DESIGN C)**

- .1 Thermal magnetic breakers with current limiters.
  - .1 Time current limiting characteristics of fuses limiters coordinated with time current tripping characteristics of circuit breaker.
  - .2 Co-ordination to result in interruption by breaker of fault-level currents up to interrupting capacity of breaker.
- .2 Series rated breakers to be manufacturer tested and listed. Breakers to be applied following manufacturer's guidelines and accepted best practice.
  - .1 Breakers applied following manufacturer's guidelines and accepted best practice.

**2.5 OPTIONAL FEATURES**

- .1 Include:
  - .1 Shunt trip.
  - .2 Auxiliary switch.
  - .3 Motor-operated mechanism c/w time delay unit.
  - .4 Under-voltage release.
  - .5 On-off locking device.
  - .6 Handle mechanism.

**Part 3 Execution**

**3.1 EXAMINATION**

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

**3.2 INSTALLATION**

- .1 Install circuit breakers as indicated.

**3.3 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - 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 00 - Cleaning.

**END OF SECTION**

## **Part 1        General**

### **1.1            RELATED REQUIREMENTS**

- .1        Section 20 05 00 – "General Requirements Concerning Common Work Results" applies.
- .2        Section 26 28 13.01 – - Fuses - Low Voltage

### **1.2            REFERENCE STANDARDS**

- .1        CSA Group
  - .1        CAN/CSA-C22.2 No.4-Enclosed and Dead-Front Switches (Tri-National Standard, with ANCE NMX-J-162-2004 and UL 98).
  - .2        CSA C22.2 No.39Fuseholder Assemblies.

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

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

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

- .1        Deliver, store and handle materials in accordance with Section [01 61 00 - Common Product Requirements] [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 off ground and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2        Store and protect disconnect switches - fused and non-fused from nicks, scratches, and blemishes.
  - .3        Replace defective or damaged materials with new.

## **Part 2        Products**

### **2.1            DISCONNECT SWITCHES**

- .1        Fusible, disconnect switch in CSA enclosure [\_type 2 \_\_\_\_], to CAN/CSA-C22.2 No.4 size as indicated.
- .2        Provision for padlocking in on switch position by 3 locks.
- .3        Mechanically interlocked door to prevent opening when handle in ON position.

- .4 Fuses: size as indicated, in accordance with Section 26 28 13.01 - Fuses - Low Voltage.
- .5 Fuseholders: relocatable to CSA C22.2 No.39 suitable without adaptors, for type and size of fuse indicated.
- .6 Quick-make, quick-break action.
- .7 ON-OFF switch position indication on switch enclosure cover.

## **2.2 EQUIPMENT IDENTIFICATION**

- .1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Indicate name of load controlled on size 4 nameplate.

## **2.3 ACCEPTABLE PRODUCTS**

- .1 Eaton;
- .2 Schneider;
- .3 Siemens.

## **Part 3 Execution**

### **3.1 EXAMINATION**

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

### **3.2 INSTALLATION**

- .1 Install disconnect switches complete with fuses if applicable.

### **3.3 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - 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 00 - Cleaning.

**END OF SECTION**

**Part 1            General**

**1.1                RELATED REQUIREMENTS**

- .1        Section 20 05 00 – "General Requirements Concerning Common Work Results" applies.
- .2        Section 26 29 03- Control Devices

**1.2                REFERENCE STANDARDS**

- .1        CSA Group (CSA)
  - .1        CSA C22.2 No.14, Industrial Control Equipment.
- .2        National Electrical Manufacturers Association (NEMA)
  - .1        NEMA ICS 2 Controllers, Contactors and Overload Relays Rated 600 V.

**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 contactors and include product characteristics, performance criteria, physical size, finish and limitations.

**1.4                CLOSEOUT SUBMITTALS**

- .1        Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2        Operation and Maintenance Data: submit operation and maintenance data for contactors for incorporation into manual.
- .3        Include operating information required for start-up, synchronizing and shut-down of generating units.

**1.5                DELIVERY, STORAGE AND HANDLING**

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

**Part 2 Products**

**2.1 CONTACTORS**

- .1 Contactors: to CSA C22.2 No.14.
- .2 Electrically held controlled by pilot devices as indicated and rated for type of load controlled. Half size contactors not accepted.
- .3 [Fused switch] combination contactor as indicated.
- .4 Complete with 2 normally open and 2 normally closed auxiliary contacts unless indicated otherwise.
- .5 Mount in [CSA] NEMA Enclosure type 2 unless otherwise indicated.
- .6 Include following options in cover:
  - .1 Red indicating lamp.
  - .2 On-Off selector switch.
- .7 Control transformer: in accordance with Section 26 29 03 - Control Devices, factory wired and installed in contactor enclosure.

**2.2 EQUIPMENT IDENTIFICATION**

- .1 Identify equipment in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Size 4 nameplate indicating name of load controlled.

**Part 3 Execution**

**3.1 INSTALLATION**

- .1 Install contactors and connect power wires and auxiliary control devices.
- .2 Identify contactors with nameplates or labels indicating panel and circuit number.
- .3 Test contactors in accordance with 26 05 00 - Common Work Results for Electrical.

**3.2 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - 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 00 - Cleaning.

**3.3 PROTECTION**

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

**END OF SECTION**



**Part 1            General**

**1.1                RELATED REQUIREMENTS**

- .1        Section 20 05 00 – "General Requirements Concerning Common Work Results" applies.

**1.2                REFERENCE STANDARDS**

- .1        International Electromechanical Commission (IEC)
  - .1        IEC 947-4-1, Part 4: Electromechanical contactors and motor-starters.

**1.3                ACTION AND INFORMATIONAL SUBMITTALS**

- .1        Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2        Product Data:
  - .1        Provide manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
- .3        Shop Drawings:
  - .1        Provide shop drawings: in accordance with Section 01 33 00 - Submittal Procedures.
    - .1        Provide shop drawings for each type of starter to indicate:
      - .1        Mounting method and dimensions.
      - .2        Starter size and type.
      - .3        Layout and components.
      - .4        Enclosure types.
      - .5        Wiring diagram.
      - .6        Interconnection diagrams.

**1.4                CLOSEOUT SUBMITTALS**

- .1        Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.
- .2        Submit operation and maintenance data for each type and style of motorstarter for incorporation into maintenance manual.
- .3        Extra Materials:
  - .1        Provide listed spare parts for each different size and type of starter.
    - .1        [3] contacts, stationary.
    - .2        [3] contacts, movable.
    - .3        [1] contacts, auxiliary.
    - .4        [1] control transformer[s].
    - .5        [1] operating coil.

- .6 [2] fuses.
- .7 [10] % indicating lamp bulbs used.

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

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

## **Part 2 Products**

### **2.1 MATERIALS**

- .1 Starters: to IEC 947-4 with AC4 utilization category.

### **2.2 MANUAL MOTOR STARTERS**

- .1 Single phase manual motor starters of size, type, rating, and enclosure type as indicated, with components as follows:
  - .1 Switching mechanism, quick make and break.
  - .2 One overload heater, manual reset, trip indicating handle.
- .2 Accessories:
  - .1 Heavy duty labelled as indicated.
  - .2 Indicating light heavy duty type and colour as indicated.
  - .3 Locking tab to permit padlocking in "ON" or "OFF" position.

### **2.3 FULL VOLTAGE MAGNETIC STARTERS**

- .1 Combination magnetic starters of size, type, rating and enclosure type as indicated with components as follows:
  - .1 Contactor solenoid operated, rapid action type.
  - .2 Motor overload protective device in each phase, manually reset from outside enclosure.
  - .3 Wiring and schematic diagram inside starter enclosure in visible location.
  - .4 Identify each wire and terminal for external connections, within starter, with permanent number marking identical to diagram.
- .2 Combination type starters to include circuit breaker motor circuit interrupter fused disconnect switch with operating lever on outside of enclosure to control disconnect [motor circuit interrupter] [circuit breaker], and provision for:
  - .1 Locking in "OFF" position with up to 3 padlocks.
  - .2 Independent locking of enclosure door.
  - .3 Provision for preventing switching to "ON" position while enclosure door open.

- .3 Accessories:
  - .1 Selector switches: [heavy duty] labelled as indicated.
  - .2 Indicating lights: heavy duty type and Colour as indicated.
  - .3 1-N/O and 1-N/C spare auxiliary contacts unless otherwise indicated.

## **2.4 CONTROL TRANSFORMER**

- .1 Single phase, dry type, control transformer with primary voltage as indicated and 120 V secondary, complete with secondary fuse, installed in with starter as indicated.
- .2 Size control transformer for control circuit load plus 20 % spare capacity.

## **2.5 ACCESSORIES**

- .1 Pushbutton: heavy duty, oil tight as required.
- .2 Selector switches: heavy duty, oil tight as required.
- .3 Indicating lights: heavy duty, oil tight, type and colour as indicated.

## **2.6 FINISHES**

- .1 Apply finishes to enclosure in accordance with Section 26 05 00 - Common Work Results for Electrical.

## **2.7 EQUIPMENT IDENTIFICATION**

- .1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Manual starter designation label, white plate, black letters, size 1, engraved as indicated.
- .3 Magnetic starter designation label, white plate, black letters, size 1 engraved as indicated.

## **2.8 ACCEPTABLE PRODUCTS**

- .1 Eaton;
- .2 Allen Bradley;
- .3 Schneider;
- .4 Siemens.

## **Part 3 Execution**

### **3.1 INSTALLATION**

- .1 Install starters and control devices in accordance with manufacturer's instructions.
- .2 Install and wire, starters and controls as indicated.
- .3 Ensure correct fuses installed.

- .4 Confirm motor nameplate and adjust overload device to suit.

### **3.2 FIELD QUALITY CONTROL**

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical and manufacturer's instructions.
- .2 Operate switches and contactors to verify correct functioning.
- .3 Perform starting and stopping sequences of contactors and relays.
- .4 Check that sequence controls, interlocking with other separate related starters, equipment, control devices, operate as indicated.

### **3.3 CLEANING**

- .1 Clean in accordance with Section 01 74 00 - Cleaning.
  - .1 Remove surplus materials, excess materials, rubbish, tools and equipment.

**END OF SECTION**

**Part 1            General**

**1.1                RELATED REQUIREMENTS**

- .1            Section 26 05 00"General Requirements Concerning Common Work Results".

**1.2                REFERENCE STANDARDS**

- .1            Underwriters' Laboratories of Canada (ULC)
- .2            Reference Standards
  - .1            IES LM-79 Approved Method: Electrical and Photometric Measurements of Solid-State Lighting Products.
  - .2            IES LM-80 Approved Method: Measuring Lumen Maintenance of LED Light Sources.
  - .3            IES TM-21 Projecting Long Term Lumen Maintenance of LED Light Sources.
  - .4            UL 8750 Light Emitting Diode Equipment for Use in Lighting Products.
- .3            Reference Standards- Power Units
  - .1            UL 1310 Class 2 *Power Units or equivalent* ou équivalent CSA.
  - .2            ANSI C62.41 Catégorie A IEEE Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits.
  - .3            FCC Title 47 CFR Part 18 Electronic Code of Federal Regulations – Telecommunication – Industrial, Scientific, and Medical Equipment.

**1.3                ACTION AND INFORMATIONAL SUBMITTALS**

- .1            Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2            Product Data:
  - .1            Provide manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
  - .2            Provide complete photometric data prepared by independent testing laboratory for luminaires where specified, for approval review by Departmental Representative
  - .3            Photometric data to include: spacing criterion VCP Table where applicable.
- .3            Quality assurance submittals: provide following in accordance with Section 01 45 00 - Quality Control.
  - .1            Manufacturer's instructions: provide manufacturer's written installation instructions and special handling criteria, installation sequence, cleaning procedures.

**1.4 QUALITY ASSURANCE**

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

**1.5 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .3 Divert unused metal materials from landfill to metal recycling facility.
- .4 Disposal and recycling of fluorescent lamps as per local regulations.

**Part 2 Products**

**2.1 LIGHT EMITTING DIODE DEVICES (LED)**

- .1 All LED devices and their components must, at minimal meet all reference standards listed above.
- .2 Each fixture must be equipped with a compatible factory installed driver. Everything must be approved for plenum use.
- .3 Supply units shall be equipped with colour connectors determined in accordance with the standard requirements ANSI C82.11.
- .4 Driver technical data:
  - .1 120 V  $\pm$ 5 %,
  - .2 Power factor: 90 % minimum.
  - .3 Total harmonic distortion: 20 % maximum.
  - .4 Class A nominal sound volume.
  - .5 Operation ambient temperature: 10 to 40 °C, 90 % R.H.
  - .6 The housing temperature: 0 at 62 °C, 90 % R.H.
  - .7 Must tolerate without damage a condition of open circuit or short circuit without use of fuses or other external protection devices.
  - .8 Must not contain any PCB.
- .5 Drivers for low voltage dimming shall be compatible with a 0-10 Vdc controller. For dimming to line voltage applications, the contractor must ensure compatibility between drivers and dimmers.
- .6 Minimum 5 years warranty, parts and labor, for the device. This includes, without limitation, diodes, connectors, driver and all other components necessary for the proper functioning of the device.

**2.2 FINISHES**

- .1 Light fixture finish and construction to meet ULC listing[s] and CSA certification[s] related to intended installation.

**Part 3 Execution**

**3.1 INSTALLATION**

- .1 Locate and install luminaires as indicated.
- .2 Provide adequate support to suit ceiling system.

**3.2 WIRING**

- .1 Connect luminaires to lighting circuits:
  - .1 Install flexible or rigid conduit for luminaires as indicated.

**3.3 LUMINAIRE SUPPORTS**

- .1 For suspended ceiling installations support luminaires independently of ceiling.

**3.4 LUMINAIRE ALIGNMENT**

- .1 Align luminaires mounted in continuous rows to form straight uninterrupted line.
- .2 Align luminaires mounted individually parallel or perpendicular to building grid lines.

**3.5 CLEANING**

- .1 Clean in accordance with Section 01 74 00 - Cleaning.
  - .1 Remove surplus materials, excess materials, rubbish, tools and equipment.

**END OF SECTION**



**Part 1            General**

**1.1                RELATED REQUIREMENTS**

- .1        Section 26 05 00 – Electricity - "General Requirements Concerning Common Work Results.
- .2        26 05 34- Conduits, Conduit Fastenings and Conduit Fittings
- .3        26 05 21-- Wires and Cables (0-1000 V)

**1.2                REFERENCE STANDARDS**

- .1        CSA Group (CSA)
  - .1        CSA C22.2 NO. 141, Emergency Lighting Equipment

**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 emergency lighting and include product characteristics, performance criteria, physical size, finish and limitations.

**1.4                CLOSEOUT SUBMITTALS**

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

**1.5                DELIVERY, STORAGE AND HANDLING**

- .1        Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
- .2        Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3        Storage and Handling Requirements:
  - .1        Store materials off ground indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2        Store and protect emergency lighting from nicks, scratches, and blemishes.
  - .3        Replace defective or damaged materials with new.

**Part 2 Products**

**2.1 EQUIPMENT**

- .1 Emergency lighting equipment: to CSA C22.2 No.141.
- .2 Supply voltage: 120 V, AC.
- .3 Output voltage: 24 V DC.
- .4 Operating time 30 minutes.
- .5 Battery: sealed, maintenance free.
- .6 Charger: solid state, multi-rate, voltage/current regulated, inverse temperature compensated, short circuit protected with regulated output of plus or minus 0.01 V for plus or minus 10 % input variations.
- .7 Solid state transfer circuit.
- .8 Low voltage disconnect: solid state, modular, operates at 80 % battery output voltage.
- .9 Signal lights: solid state, for 'AC Power ON' and High Charge'
- .10 Lamp heads: remote, 345 degrees horizontal and 180 degrees vertical adjustment. Lamp type: LED,4 W, minimum.
- .11 Cabinet: suitable for direct or shelf mounting to wall and c/w knockouts for conduit. Removable or hinged front panel for easy access to batteries.
- .12 Auxiliary equipment:
  - .1 Ammeter.
  - .2 Voltmeter.
  - .3 Test switch.
  - .4 Time delay relay.
  - .5 Battery disconnect device.
  - .6 AC input and DC output terminal blocks inside cabinet.
  - .7 Cord and single twist-lock plug connection for AC.
  - .8 RFI suppressors.

**2.2 WIRING OF REMOTE HEADS**

- .1 Conduit: accordance with Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.
- .2 Conductors 26 05 21 - Wires and Cables (0-1000 V), sized as indicated

**Part 3 Execution**

**3.1 EXAMINATION**

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for emergency lighting installation in accordance with manufacturer's written instructions.

- .1 Visually inspect substrate in presence of Departmental Representative.
- .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
- .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative

### **3.2 INSTALLATION**

- .1 Install unit equipment and remote mounted fixtures.
- .2 Direct heads.
- .3 Connect exit lights to unit equipment.

### **3.3 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - 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 00 - Cleaning.

### **3.4 PROTECTION**

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

**END OF SECTION**



**Part 1            General**

**1.1                RELATED REQUIREMENTS**

- .1            Section 20 05 00 – "General Requirements Concerning Common Work Results" applies.

**1.2                REFERENCE STANDARDS**

- .1            CSA Group
  - .1            CSA C22.2 No.141, Emergency Lighting Equipment.
  - .2            CSA C860-11, Performance of Internally-Lighted Exit Signs.
- .2            National Fire Protection Association (NFPA)
  - .1            NFPA 101, Life Safety Code.
- .3            International Organization for Standardization (ISO)
  - .1            ISO 3864-1, Graphical symbols - Safety colours and safety signs - Part 1: Design principles for safety signs and safety markings.
  - .2            ISO 7010, Safety colours and safety signs - Registered safety signs.

**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.

**Part 2            Products**

**2.1                STANDARD UNITS**

- .1            Exit lights: to CSA C22.2 No.141 and CSA C860.
- .2            Graphics: [Green] pictogram and [white] graphical symbol and directional arrows to ISO 3864-1. Dimensions to ISO 7010.
- .3            Face plate to remain captive for relamping.

**2.2                SELF-POWERED UNITS**

- .1            Exit lights: to CSA C22.2 No.141 and CSA C860.
- .2            Housing: cold rolled steel minimum 1.0 mm thick, satin aluminum enamel finish
- .3            Face plates: Lexan Lamps LED-4W, lifetime 5 years
- .4            Face plate to remain captive for relamping.
- .5            Supply voltage: 120 V, ac.

- .6 Output voltage: 24V dc.
- .7 Operating time: 30 minimum.
- .8 Recharge time: 12 hours
- .9 Battery: sealed, maintenance free.
- .10 Charger: solid state, voltage/current regulated, inverse temperature compensated, short circuit protected, with regulated output of plus or minus 0.01 V for plus or minus 10% V input variation.
- .11 Solid state transfer circuit.
- .12 Signal lights: solid state, for AC Power ON' condition.
- .13 Lamp heads: integral on unit, 345 degrees horizontal and 180 degrees vertical adjustment.
  - .1 Lamp type: LED, [\_\_4\_\_] W,
- .14 Mounting: suitable for universal mounting directly on junction box and c/w knockouts for conduit.
  - .1 Removable or hinged front panel for easy access to batteries.
- .15 Cabinet: finish: white.
- .16 Auxiliary equipment:
  - .1 Ammeter.
  - .2 Voltmeter.
  - .3 Lamp disconnect switch.
  - .4 Test switch.
  - .5 AC/DC output terminal blocks inside cabinet.
  - .6 RFI suppressor.
  - .7 Cord and single twist-lock plug connection for AC power supply.

### **Part 3 Execution**

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

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

#### **3.2 INSTALLATION**

- .1 Install exit lights to manufacturer's recommendations, listing requirements, NFPA standard and local regulatory requirements.
- .2 Connect fixtures to exit light circuits.
- .3 Connect emergency lamp sockets to emergency circuits.
- .4 Lock exit light circuit breaker in on position.

**3.3 CLEANING**

- .1 Proceed in accordance with Section 01 74 00 - Cleaning.
- .2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

**END OF SECTION**



**Part 1            General**

**1.1                RELATED REQUIREMENTS**

- .1            Section 26 05 00 - Common Work Results for Electrical.

**1.2                REFERENCE STANDARDS**

- .1            National Research Council Canada (NRC)
  - .1            National Building Code of Canada 2015 (NBC).
- .2            Treasury Board of Canada (TBS), Occupational Safety and Health (OSH)
  - .1            Fire Protection Standard.
- .3            Underwriter's Laboratories of Canada (ULC)
  - .1            CAN/ULC-S524, Standard for the Installation of Fire Alarm Systems.
  - .2            CAN/ULC-S526, Visible Signal Devices for Fire Alarm Systems, Including Accessories.
  - .3            CAN/ULC-S527, Standard for Control Units for Fire Alarm Systems.
  - .4            CAN/ULC-S528, Manual Stations for Fire Alarm Systems, Including Accessories.
  - .5            CAN/ULC-S529, Smoke Detectors for Fire Alarm Systems.
  - .6            CAN/ULC-S530, Heat Actuated Fire Detectors for Fire Alarm Systems.
  - .7            CAN/ULC-S531 Standard for Smoke Alarms.
  - .8            CAN/ULC-S537, Standard for the Verification of Fire Alarm Systems.
  - .9            CAN/ULC-S561, Installation and service of fire station systems: ULC-S561.

**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 multiplex fire alarm system 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, Canada.
  - .2            Indicate on shop drawings:
    - .1            Detail assembly and internal wiring diagrams for control unit.
    - .2            Overall system riser wiring diagram identifying signaling circuits, initiating zones, control equipment; identifying terminations, terminal numbers, conductors and raceways.
  - .3            Details for devices.

- .4 Details and performance specifications for control, annunciation and peripherals with item by item cross reference to specification for compliance.
- .5 Step-by-step operating sequence, cross referenced to logic flow diagram.

**1.4 CLOSEOUT SUBMITTALS**

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for fire alarm system for incorporation into manual.
- .3 Include:
  - .1 Instructions for complete fire alarm system to permit effective operation and maintenance.
  - .2 Technical data - illustrated parts lists with parts catalogue numbers.
  - .3 Copy of approved shop drawings with corrections completed and marks removed except review stamps.
  - .4 List of recommended spare parts for system.

**1.5 MAINTENANCE MATERIAL SUBMITTALS**

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

**1.6 DELIVERY, STORAGE AND HANDLING**

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

**Part 2 Products**

**2.1 DESCRIPTION**

- .1 Fully supervised, microprocessor-based, fire alarm system, utilizing digital techniques for data control and digital, and multiplexing techniques for data transmission.
- .2 System to carry out fire alarm and protection functions; including receiving alarm signals; initiating general alarm; supervising components and wiring; actuating annunciators and auxiliary functions; initiating trouble signals and signalling to fire department.

- .3 Zoned, single stage coded.
- .4 Modular in design to allow for future expansion.
- .5 Operation of system shall not require personnel with special computer skills.
- .6 System to include:
  - .1 Central Control Unit in separate enclosure with power supply, stand-by batteries, central processor with microprocessor and logic interface, main system memory, input-output interfaces for alarm receiving, annunciation/display, and program control/signalling.
  - .2 Power supplies.
  - .3 Initiating/input circuits.
  - .4 Output circuits.
  - .5 Auxiliary circuits.
  - .6 Wiring.
  - .7 Manual and automatic initiating devices.
  - .8 Audible and visual signalling devices.
  - .9 End-of-line resistors.
  - .10 Local displays.
  - .11 Historic event recorder.
  - .12 Y2K compliancy.
- .7 Equipment and devices: ULC listed and labelled and supplied by single manufacturer.
- .8 Power supply: to CAN/ULC-S524.
- .9 Audible signal devices: to CAN/ULC-S524.
- .10 Visual signal devices: to CAN/ULC-S526.
- .11 Control unit: to CAN/ULC-S527.
- .12 Manual pull stations: to CAN/ULC-S528.
- .13 Thermal detectors: to CAN/ULC-S530.
- .14 Smoke detectors: to CAN/ULC-S529.

## 2.2 **SYSTEM OPERATION: SINGLE STAGE - SIGNALS ONLY**

- .1 Actuation of any alarm initiating device to:
  - .1 Cause electronic latch to lock-in alarm state at central control unit and data gathering panel/transponder.
  - .2 Indicate zone of alarm at central control unit.
  - .3 Cause audible signalling devices to sound continuously throughout building and at central control unit.
  - .4 Transmit signal to fire department via master fire alarm box.
  - .5 Cause air conditioning and ventilation fans to shut down or to function to provide required control of smoke movement.

- .6 Cause fire doors and smoke control doors, if normally held open, to close automatically.
- .7 Cause elevators to return to floor of egress, or to alternate floor, as required.
- .2 Acknowledging alarm: indicated at central control unit.
- .3 Ensure that it is possible to silence signals by « alarm silence »; switch at control unit, after 60 seconds period of operation.
- .4 Subsequent alarm, received after previous alarm has been silenced, to re-activate signals.
- .5 Actuation of supervisory devices to:
  - .1 Cause electronic latch to lock-in supervisory state at central control unit.
  - .2 Indicate respective supervisory zone at central control unit display.
  - .3 Cause audible signal at central control unit to sound.
  - .4 Activate common supervisory sequence.
- .6 Resetting alarm device not to return system indications/functions back to normal until control unit has been reset.
- .7 Trouble on system to:
  - .1 Indicate circuit in trouble at central control unit.
  - .2 Activate « system trouble » indication, buzzer and common trouble sequence. Acknowledging trouble condition to silence audible indication; whereas visual indication to remain until trouble is cleared and system is back to normal.
- .8 Trouble on system: suppressed during course of alarm.
- .9 Trouble condition on any circuit in system not to initiate alarm conditions.

### **2.3 CONTROL PANEL**

- .1 The control panel must include communicator module to the Fire station central according to CAN/ULC-S561.
- .2 Central control unit (CCU).
  - .1 Suitable for DCLB communication style: to CAN/ULC-S524.
  - .2 Features specified are minimum requirements for microprocessor-based system with digital data control and digital multiplexing techniques for data transmission.
  - .3 Minimum capacity of 500 addressable monitoring and 500 addressable control/signal points. Points may be divided between 2 communication channels in distributed system, each channel operating independently of other. Faults on one communication channel not to affect operation of other channel.
  - .4 System to provide for priority reporting levels, with fire alarm points assigned highest priority, supervisory and monitoring lower priority, and third priority for troubles. Possible to assign control priorities to control

points in system to guarantee operation or allow emergency override as required.

- .5 Integral power supply, battery charger and standby batteries.
- .6 Basic life safety software: retained in non volatile Erasable Programmable Read-Only-Memory (EPROM). Extra memory chips: easily field-installed. Random-Access-Memory (RAM) chips in panel to facilitate password-protected field editing of simple software functions (i.e. zone labels, priorities) and changing of system operation software.
- .7 Circuitry to continuously monitor communications and data processing cycles of microprocessor. Upon failure, audible and visual trouble indication to activate.
- .8 Communication between CCU and remote DGP's/TPR's to be supervised, DCLB. Should communications fail between CCU and remote units, audible and visual trouble to be indicated at CCU. Data communication to be binary DC, baseband, time-division multiplex, half-duplex. Each data channel: capable of communicating up to distance of 3,000 m.
- .9 Support up to 2 RS-232-C I/O ports. CCU output: parallel ASCII with adjustable baud rates to allow interface of any commercially available printer, terminal or PC.
- .10 Equipped with software routines to provide Event-Initiated-Programs (EIP); change is status of one or more monitor points, may be programmed to operate any or all of system's control points.
- .11 Software and hardware to maintain time of day, day of week, day of month, month and year.
- .12 Software to operate variable sensitivity addressable smoke detectors and annunciate their status and sensitivity settings at control panel.

#### **2.4 POWER SUPPLIES**

- .1 120 V, 60 Hz as primary source of power for system.
- .2 Voltage regulated, current limited distributed system power.
- .3 Primary power failure or power loss (less than 102 V) will activate common trouble sequence.
- .4 Interface with battery charger and battery to provide uninterruptible transfer of power to standby source during primary power failure or loss.
- .5 During normal operating conditions fault in battery charging circuit, short or open in battery leads to activate common trouble sequence and standby power trouble indicator.
- .6 Standby batteries: sealed, maintenance free.
- .7 Continuous supervision of wiring for external initiating and alarm circuits to be maintained during power failure.

## **2.5 INITIATING/INPUT CIRCUITS**

- .1 Receiving circuits for alarm initiating devices such as manual pull stations, smoke detectors, heat detectors and water flow switches, wired in DCLB configuration to central control unit.
- .2 Alarm receiving circuits (active and spare): compatible with smoke detectors and open contact devices.
- .3 Actuation of alarm initiating device: cause system to operate as specified in « System Operation ».
- .4 Receiving circuits for supervisory, N/O devices. Devices: wired in DCLB configuration to central control unit.
- .5 Actuation of supervisory initiating device: cause system to operate as specified in « System Operation ».

## **2.6 ALARM OUTPUT CIRCUITS**

- .1 Alarm output circuit: connected to signals, wired in class B configuration to central control unit.
  - .1 Signal circuits' operation to follow system programming; capable of sounding horns 24 VDC; fuse-protected from overloading/overcurrent.
  - .2 Manual alarm silence, automatic alarm silence and alarm silence inhibit to be provided by system's common control.

## **2.7 AUXILIARY CIRCUITS**

- .1 Auxiliary contacts for control functions.
- .2 Actual status indication (positive feedback) from controlled device.
- .3 Alarm trouble on system to cause operation of programmed auxiliary output circuits.
- .4 2 sets of separate contacts for elevator capture to main floor of egress and to alternate floor of egress.
- .5 Upon resetting system, auxiliary contacts to return to normal or to operate as pre-programmed.
- .6 Fans: stagger-started upon system reset; timing circuit to separate starting of each fan or set of fans connected to auxiliary contact on system.
  - .1 Timing circuit: controlled by CCU.
- .7 Auxiliary circuits: rated at 2 A, 24 Vdc or 120 Vac, fuse-protected.

## **2.8 WIRING**

- .1 Twisted copper conductors: rated 120 V.
- .2 To initiating circuits: 18 AWG minimum, and in accordance with manufacturer's requirements.
- .3 To signal circuits: 16 AWG minimum, and in accordance with manufacturer's requirements.

- .4 To control circuits: 14 AWG minimum, and in accordance with manufacturer's requirements.
- .5 Cable type FAS105:
  - .1 In suspended ceilings, drywalls and dry areas.
  - .2 For the connection of fire alarm detection and signaling devices.
  - .3 Allowed usage from a pull box for a maximum distance of 3 m (10').
  - .4 Size gage equal to the conductors.

## **2.9 MANUAL ALARM STATIONS**

- .1 Addressable manual pull station.
  - .1 Pull lever, break glass rod, semi-flush surface wall mounted type, single action, single stage, electronics to communicate station's status to addressable module/transponder over 2 wires and to supply power to station. Station address to be set on station in field.

## **2.10 AUTOMATIC ALARM INITIATING DEVICES**

- .1 Addressable thermal fire detectors, combination fixed temperature and rate of rise, non-restorable fixed temperature element, self-restoring rate of rise, fixed temperature 88 degrees C, rate of rise 8.3 degrees C per minute.
  - .1 Electronics to communicate detector's status to addressable module/transponder.
  - .2 Detector address to be set on detector head in field.
- .2 Smoke detector: photo-electric type air duct type with sampling tubes with protective housing.
  - .1 Twistlock Plug-in type with fixed base.
  - .2 Wire-in base assembly with integral red alarm LED, and terminals for remote relay.
- .3 Addressable smoke detector.
  - .1 Photo-electric type.
  - .2 Electronics to communicate detector's status to addressable module/transponder.
  - .3 Detector address to be set on detector head in field.

## **2.11 AUDIBLE SIGNAL DEVICES**

- .1 Horns: for surface or flush mounting, 24 V dc.
- .2 Mini-horns: for surface or flush mounting, red colour, 24 V dc.

## **2.12 VISUAL ALARM SIGNAL DEVICES**

- .1 Strobe type: flashing, red, 24 V dc.
- .2 Designed for surface mounting on as indicated.

**2.13 END-OF-LINE DEVICES**

- .1 End-of-line devices to control supervisory current in signalling circuits, sized to ensure correct supervisory current for each circuit. Open, short or ground fault in any circuit will alter supervisory current in that circuit, producing audible and visible alarm at main control panel and remotely as indicated.

**2.14 AS-BUILT RISER DIAGRAM**

- .1 Fire alarm system riser diagram: in glazed frame minimum size 600 x 600 mm.

**2.15 ANCILLARY DEVICES**

- .1 Remote relay unit to initiate fan shutdown.

**2.16 ACCEPTABLE PRODUCTS**

- .1 Chubb-Edwards;
- .2 Mircom;
- .3 Notifier;
- .4 Siemens;
- .5 Tyco (Simplex).

**Part 3 Execution**

**3.1 EXAMINATION**

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

**3.2 INSTALLATION**

- .1 Install systems in accordance with CAN/ULC-S524.
- .2 Installation and service of fire station systems: ULC-S561.
- .3 Install central control unit and connect to ac power supply, vdc standby power.
- .4 Install manual alarm stations and connect to alarm circuit wiring.
- .5 Locate and install detectors and connect to alarm circuit wiring. Mount detectors more than 1.5 m from air outlets. Maintain at least 600 mm radius clear space on ceiling, below and around detectors. Locate duct type detectors in straight portions of ducts.
- .6 Connect alarm circuits to main control panel.

- .7 Install horns and connect to signalling circuits.
- .8 Connect signalling circuits to main control panel.
- .9 Install end-of-line devices at end signalling circuits.
- .10 Install remote annunciator panels and connect to annunciator circuit wiring.
- .11 Install door releasing devices.
- .12 Install remote relay units to control fan shut down.
- .13 Splices are not permitted.
- .14 Provide necessary raceways, cable and wiring to make interconnections to terminal boxes, annunciator equipment and CCU, as required by equipment manufacturer.
- .15 Ensure that wiring is free of opens, shorts or grounds, before system testing and handing over.
- .16 Identify circuits and other related wiring at central control unit, annunciators, and terminal boxes.
- .17 Connect the limitation box to the fire alarm control panel via a 53 mm conduit.
- .18 Connect the limitation box to the telecom room via a 41 mm conduit.
- .19 The metal sheath of BX cables shall be cut with the appropriate tool (hacksaws not allowed) and cable extremities to be fitted with insulating bushings.

### 3.3 **FIELD QUALITY CONTROL**

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical and CAN/ULC-S537.
- .2 Fire alarm system:
  - .1 Test such device and alarm circuit to ensure manual stations, smoke detectors and thermal detectors transmit alarm to control panel and actuate general alarm.
  - .2 Check annunciator panels to ensure zones are shown correctly.
  - .3 Simulate grounds and breaks on alarm and signalling circuits to ensure proper operation of systems.
  - .4 Addressable circuits system style DCLB:
    - .1 Test each conductor on all DCLB addressable links for capability of providing 3 or more subsequent alarm signals on line side of single open-circuit fault condition imposed near electrically most remote device on each link. Operate Acknowledge/Silence switch after reception of each of the 3 signals. Correct imposed fault after completion of each series of tests.
    - .2 Test each conductor on all DCLB addressable links for capability of providing 3 or more subsequent alarm signals during ground-fault condition imposed near electrically most remote device on each link. Operate Acknowledge/Silence switch after reception of each of the 3 signals. Correct imposed fault after completion of each series of tests.

- .3 Provide final PROM program re-burn for system Departmental Representative incorporating program changes made during construction.

### **3.4 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - 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 00 - Cleaning.

### **3.5 PROTECTION**

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

### **3.6 CLOSEOUT ACTIVITIES**

- .1 Provide on-site lectures and demonstration by fire alarm equipment manufacturer to train operational personnel in use and maintenance of fire alarm system.

### **3.7 MAINTENANCE**

- .1 Provide individual price on tender form for subsequent PROM re-burns. Price: good for 3 years from date of project completion.

**END OF SECTION**