



Agence spatiale canadienne Canadian Space Agency

DAVID FLORIDA LABORATORY - BUILDING # 65  
3701 Carling Ave., P.O.Box 11490, Station H,  
Ottawa, Ontario, K2H 8S2



# **SPECIFICATIONS**

## **SUMP PUMP REPLACEMENT**

### **NON-CLEAN ROOMS**

#### **PROJECT**

##### **CSA15-M5A**

**Issued for Tender  
September, 2015**

SPECIFICATIONS:

<u>Section Number</u>	<u>Title</u>	<u>No. of Pages</u>
<b><u>DIVISION 1 GENERAL REQUIREMENTS</u></b>		
01 11 00	Summary of Work	3
01 14 00	Work Restrictions	3
01 31 19	Project Meetings	2
01 33 00	Submittal Procedures	4
01 35 29.06	Health and Safety Requirements	4
01 35 43	Environmental Procedures	3
01 41 00	Regulatory Requirements	1
01 45 00	Quality Control	2
01 51 00	Temporary Utilities	3
01 52 00	Construction Facilities	3
01 56 00	Temporary Barriers and Enclosures	2
01 61 00	Common Product Requirements	4
01 71 00	Examination and Preparation	2
01 73 00	Execution	2
01 74 11	Cleaning	2
01 74 21	Construction Demolition Waste Management and Disposal	5
01 77 00	Closeout Procedures	1
01 78 00	Closeout Submittals	7
01 79 00	Demonstration and Training	2
01 91 13	General Commissioning (CX) Requirements	9
01 91 31	Commissioning (CX) Plan	6
<b><u>DIVISION 21 FIRE SUPPRESSION</u></b>		
21 05 01	Common Work Results for Mechanical	4
21 13 13	Wet Pipe Sprinkler Systems	6
<b><u>DIVISION 22 PLUMBING</u></b>		
22 05 23	General Duty Valves for Plumbing Piping	7
22 05 29	Hangers and Supports for Plumbing Piping and Equipment	4
22 05 53	Identification for Plumbing Piping and Equipment	5
22 07 19	Plumbing Piping Insulation	5
22 10 10	Plumbing Pumps	7
22 13 17	Drainage Waste and Vent Piping - Cast Iron and Copper	2
22 13 18	Drainage Waste and Vent Piping - Plastic	2
22 14 13	Facility Drainage Piping	3
22 42 01	Plumbing Specialties and Accessories	13
<b><u>DIVISION 23 HEATING, VENTILATING AND AIR CONDITIONING (HVAC)</u></b>		
23 05 17	Pipe Welding	3
<b><u>DIVISION 25 INTEGRATED AUTOMATION</u></b>		

---

25 01 11	EMCS: Start-Up, Verification, and Commissioning	4
25 01 12	EMCS: Training	2
25 05 01	EMCS: General Requirements	3
25 05 02	EMCS: Submittals and Review Process	4
25 05 03	EMCS: Project Record Documents	2
25 05 54	EMCS: Identification	2
25 05 60	EMCS: Field Installation	6
25 08 20	EMCS: Warranty and Maintenance	2
25 10 01	EMCS: Local Area Network (LAN)	2
25 10 02	EMCS: Operator Work Station (OWS)	1
25 30 01	EMCS: Building Controllers	3
25 30 02	EMCS: Field Control Devices	3
25 90 01	EMCS: Site Requirements, Applications, and Systems Sequences of Operations	1

**DIVISION 26 ELECTRICAL**

26 05 00	Common Work Results for Electrical	5
26 05 20	Wire and Box Connectors (0-1000V)	2
26 05 21	Wires and Cables (0-1000V)	3
26 05 31	Splitters, Junction, Pull Boxes and Conduits	2
26 05 34	Conduits, Conduit Fastenings and Conduit Fittings	3
26 28 16.02	Moulded Case Circuit Breakers	2

END

---

## PART 1 - GENERAL

### 1.1 WORK COVERED BY CONTRACT DOCUMENTS

- .1 Work of this Contract comprises the replacement of existing sump pumps, as per the Contract Documents.

### 1.2 CONTRACT METHOD

- .1 Construct Work under a single stipulated price contract.

### 1.3 WORK BY OTHERS

- .1 Co-operate with other Contractors in carrying out their respective works and carry out instructions from Departmental Representative.
- .2 Co-ordinate work with that of other Contractors. If any part of work under this Contract depends for its proper execution or result upon work of another Contractor, report promptly to Departmental Representative, in writing, any defects which may interfere with proper execution of Work.

### 1.4 WORK SEQUENCE

- .1 Construct Work in stages to accommodate Owner's intermittent use of premises during construction.
- .2 Co-ordinate Progress Schedule and co-ordinate with Owner Occupancy during construction.
- .3 Maintain fire access/control.

### 1.5 CONTRACTOR USE OF PREMISES

- .1 Limit use of premises for Work, for storage, and for access, to allow:
    - .1 Owner occupancy.
    - .2 Partial owner occupancy.
    - .3 Work by other contractors.
    - .4 Public usage.
  - .2 Co-ordinate use of premises under direction of Departmental Representative.
  - .3 Obtain and pay for use of additional storage or work areas needed for operations under this Contract.
  - .4 Remove or alter existing work to prevent injury or damage to portions of existing work which remain.
  - .5 Repair or replace portions of existing work which have been altered during construction operations to match existing or adjoining work, as directed by Departmental Representative.
  - .6 At completion of operations condition of existing work: equal to or better than that which existed before new work started.
-

#### 1.6 OWNER OCCUPANCY

- .1 Owner will occupy premises during entire construction period for execution of normal operations.
- .2 Co-operate with Owner in scheduling operations to minimize conflict and to facilitate Owner usage.

#### 1.7 ALTERATIONS, ADDITIONS OR REPAIRS TO EXISTING BUILDING

- .1 Execute work with least possible interference or disturbance to building operations, its occupants, and normal use of premises. Arrange with Departmental Representative to facilitate execution of work.
- .2 Use only elevators, existing in building for moving workers and material.
  - .1 Protect walls of passenger elevators, to approval of Departmental Representative prior to use.
  - .2 Accept liability for damage, safety of equipment and overloading of existing equipment.

#### 1.8 EXISTING SERVICES

- .1 Notify Departmental Representative and utility companies of intended interruption of services and obtain required permission.
- .2 Where Work involves breaking into or connecting to existing services, give Departmental Representative 48 hours' notice for necessary interruption of mechanical or electrical service throughout course of work. Minimize duration of interruptions. Carry out work at times as directed by governing authorities with minimum disturbance to tenant operations.
- .3 Provide alternative routes for personnel traffic.
- .4 Establish location and extent of service lines in area of work before starting Work. Notify Departmental Representative of findings.
- .5 Submit schedule to and obtain approval from Departmental Representative for any shut-down or closure of active service or facility including power and communications services. Adhere to approved schedule and provide notice to affected parties.
- .6 Provide temporary services when directed by Departmental Representative to maintain critical building and tenant systems.
- .7 Where unknown services are encountered, immediately advise Departmental Representative and confirm findings in writing.
- .8 Protect, relocate or maintain existing active services. When inactive services are encountered, cap off in manner approved by authorities having jurisdiction.
- .9 Record locations of maintained, re-routed and abandoned service lines.
- .10 Construct barriers in accordance with Section 01 56 00 - Temporary Barriers and Enclosures.

#### 1.9 DOCUMENTS REQUIRED

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

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

## **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 ACCESS AND EGRESS

- .1 Design, construct and maintain temporary "access to" and "egress from" work areas, including stairs, runways, ramps or ladders and scaffolding, independent of finished surfaces and in accordance with relevant municipal, provincial and other regulations.

### 1.2 USE OF SITE AND FACILITIES

- .1 Execute work with least possible interference or disturbance to normal use of premises. Make arrangements with Engineer to facilitate work as stated.
- .2 Maintain existing services to building and provide for personnel and vehicle access.
- .3 Where security is reduced by work provide temporary means to maintain security.
- .4 Engineer will assign sanitary facilities for use by Contractor's personnel. Keep facilities clean.
- .5 Use only elevators, dumbwaiters, conveyors or escalators existing in building for moving workers and material.
- .6 Protect walls of passenger elevators, to approval of Engineer prior to use.
- .7 Accept liability for damage, safety of equipment and overloading of existing equipment.
- .8 Closures: protect work temporarily until permanent enclosures are completed.

### 1.3 ALTERATIONS, ADDITIONS OR REPAIRS TO EXISTING BUILDING

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

### 1.4 EXISTING SERVICES

- .1 Notify Engineer and utility companies of intended interruption of services and obtain required permission.
  - .2 Where Work involves breaking into or connecting to existing services, provide the Engineer forty-eight (48) hours of notice for necessary interruption of mechanical or electrical service throughout course of work. Keep duration of interruptions minimal. Carry out interruptions after normal working hours of occupants, preferably on weekends.
  - .3 Provide for personnel, pedestrian and vehicular traffic.
  - .4 Construct barriers in accordance with Section 01 56 00 - Temporary Barriers and Enclosures.
-

## 1.5 SPECIAL REQUIREMENTS

- .1 Paint public or occupied areas Monday to Friday from 18:00 to 07:00 hours only and on Saturdays, Sundays, and statutory holidays.
- .2 Carry out noise generating Work Monday to Friday from 18:00 to 07:00 hours and on Saturdays, Sundays, and statutory holidays.
- .3 Submit schedule in accordance with Section 01 32 16.06 - Construction Progress Schedule - Critical Path Method (CPM) .
- .4 Ensure Contractor's personnel employed on site become familiar with and obey regulations including safety, fire, traffic and security regulations.
- .5 Keep within limits of work and avenues of ingress and egress.
- .6 Ingress and egress of Contractor vehicles at site is limited to Parking Lot P-10 adjacent to Building 65.
- .7 Deliver materials outside of peak traffic hours 17:00 to 07:00 and 13:00 to 15:00 unless otherwise approved by Engineer.

## 1.6 SECURITY

- .1 Where security has been reduced by Work of Contract, provide temporary means to maintain security.
  - .2 Security clearances:
    - .1 Personnel employed on this project will be subject to security check. Obtain clearance, as instructed, for each individual who will require to enter premises.
    - .2 Obtain requisite clearance, as instructed, for each individual required to enter premises.
    - .3 Personnel will be checked daily at start of work shift and provided with pass which must be worn at all times. Pass must be returned at end of work shift and personnel checked out.
    - .4 Contractor's personnel will require satisfactory RCMP initiated security screening in order to complete Work in premises and on site.
  - .3 Security escort:
    - .1 Personnel employed on this project must be escorted when executing work in non-public areas during normal working hours. Personnel must be escorted in all areas after normal working hours.
    - .2 Submit an escort request to Engineer at least 14 days before service is needed. For requests submitted within time noted above, costs of security escort will be paid for by Owner. Cost incurred by late request will be Contractor's responsibility.
    - .3 Any escort request may be cancelled free of charge if notification of cancellation is given at least 4 hours before scheduled time of escort. Cost incurred by late request will be Contractor's responsibility.
    - .4 Calculation of costs will be based on average hourly rate of security officer for minimum of 8 hours per day for late service request and of 4 hours for late cancellations.
-



1.7 BUILDING SMOKING ENVIRONMENT

- .1 Smoking is not permitted in or in the vicinity of the building for a distance of 9 meters. Comply with smoking restrictions.

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 ADMINISTRATIVE

- .1 Schedule and administer project meetings.
- .2 Prepare agenda for meetings.
- .3 Distribute written notice of each meeting four (4) days in advance of meeting date to Consultant.
- .4 Provide physical space and make arrangements for meetings.
- .5 Preside at meetings.
- .6 Record the meeting minutes. Include significant proceedings and decisions. Identify actions by parties.
- .7 Reproduce and distribute copies of minutes within three days after meetings and transmit to meeting participants and, affected parties not in attendance Consultant.
- .8 Representative of Contractor, Subcontractor and suppliers attending meetings will be qualified and authorized to act on behalf of party each represents.

### 1.2 PRECONSTRUCTION MEETING

- .1 Within 10 days after award of Contract, request a meeting of parties in contract to discuss and resolve administrative procedures and responsibilities.
  - .2 Senior representatives of Consultant, Contractor, major Subcontractors, field inspectors and supervisors will be in attendance.
  - .3 Establish time and location of meeting and notify parties concerned minimum five (5) days before meeting.
  - .4 Incorporate mutually agreed variations to Contract Documents into Agreement, prior to signing.
  - .5 Agenda to include:
    - .1 Appointment of official representative of participants in the Work.
    - .2 Schedule of Work: in accordance with Section 01 32 16.06 - Construction Progress Schedule - Critical Path Method (CPM).
    - .3 Schedule of submission of shop drawings, samples, colour chips. Submit submittals in accordance with Section 01 33 00 - Submittal Procedures.
    - .4 Requirements for temporary facilities, site sign, offices, storage shed, utilities, fences in accordance with Section 01 52 00 - Construction Facilities.
    - .5 Site security in accordance with Section 01 56 00 - Temporary Barriers and Enclosures.
    - .6 Procedures for proposed changes, change orders, approvals required, mark-up percentages permitted, time extensions, overtime, administrative requirements.
    - .7 Record drawings in accordance with Section 01 33 00 - Submittal Procedures.
    - .8 Maintenance manuals in accordance with Section 01 78 00 - Closeout Submittals.
    - .9 Take-over procedures, acceptance, warranties in accordance with Section 01 78 00 - Closeout Submittals.
    - .10 Monthly progress claims, administrative procedures, photographs, hold backs.
    - .11 Appointment of inspection and testing agencies or firms.
-

- .12 Insurances, transcript of policies.
- .13 Indication of time and dates of equipment delivery.

### 1.3 PROGRESS MEETINGS

- .1 During course of Work and two (2) weeks prior to project completion, schedule progress meetings monthly.
- .2 Contractor, major Subcontractors involved in Work, Consultant and Owner are to be in attendance.
- .3 Notify parties minimum four (4) days prior to meetings.
- .4 Record minutes of meetings and circulate to attending parties and affected parties not in attendance within three (3) days after meeting.
- .5 Agenda to include the following:
  - .1 Review, approval of minutes of previous meeting.
  - .2 Review of Work progress since previous meeting.
  - .3 Field observations, problems, conflicts.
  - .4 Problems which impede construction schedule.
  - .5 Review of off-site fabrication delivery schedules.
  - .6 Corrective measures and procedures to regain projected schedule.
  - .7 Revision to construction schedule.
  - .8 Progress schedule, during succeeding work period.
  - .9 Review submittal schedules: expedite as required.
  - .10 Maintenance of quality standards.
  - .11 Review proposed changes for effect on construction schedule and on completion date.
  - .12 Other business.

## 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 ADMINISTRATIVE

- .1 Submit to Engineer submittals listed for review. Submit promptly and in orderly sequence to not cause delay in Work. Failure to submit in ample time is not considered sufficient reason for extension of Contract Time and no claim for extension by reason of such default will be allowed.
- .2 Do not proceed with Work affected by submittal until review is complete.
- .3 Present shop drawings, product data, samples and mock-ups in SI Metric units.
- .4 Where items or information is not produced in SI Metric units converted values are acceptable.
- .5 Review submittals prior to submission to Engineer. This review represents that necessary requirements have been determined and verified, or will be, and that each submittal has been checked and coordinated with requirements of Work and Contract Documents. Submittals not stamped, signed, dated and identified as to specific project will be returned without being examined and considered rejected.
- .6 Notify Engineer, in writing at time of submission, identifying deviations from requirements of Contract Documents stating reasons for deviations.
- .7 Verify that field measurements and affected adjacent Work are coordinated.
- .8 Contractor's responsibility for errors and omissions in submission is not relieved by Engineer's review of submittals.
- .9 Contractor's responsibility for deviations in submission from requirements of Contract Documents is not relieved by Engineer review.
- .10 Keep one reviewed copy of each submission on site.

### 1.2 SHOP DRAWINGS AND PRODUCT DATA

- .1 The term "shop drawings" means drawings, diagrams, illustrations, schedules, performance charts, brochures and other data which are to be provided by Contractor to illustrate details of a portion of Work.
  - .2 Submit drawings stamped and signed by professional engineer registered or licensed in Ontario, Canada.
  - .3 Indicate materials, methods of construction and attachment or anchorage, erection diagrams, connections, explanatory notes and other information necessary for completion of Work. Where articles or equipment attach or connect to other articles or equipment, indicate that such items have been coordinated, regardless of Section under which adjacent items will be supplied and installed. Indicate cross references to design drawings and specifications.
  - .4 Allow four (4) days for Engineer's review of each submission.
  - .5 Adjustments made on shop drawings by Engineer are not intended to change Contract Price. If
-

adjustments affect value of Work, state such in writing to Engineer prior to proceeding with Work.

- .6 Make changes in shop drawings as Engineer may require, consistent with Contract Documents. When resubmitting, notify Engineer in writing of revisions other than those requested.
- .7 Accompany submissions with transmittal letter, in duplicate, containing:
  - .1 Date.
  - .2 Project title and number.
  - .3 Contractor's name and address.
  - .4 Identification and quantity of each shop drawing, product data and sample.
  - .5 Other pertinent data.
- .8 Submissions include:
  - .1 Date and revision dates.
  - .2 Project title and number.
  - .3 Name and address of:
    - .1 Subcontractor.
    - .2 Supplier.
    - .3 Manufacturer.
  - .4 Contractor's stamp, signed by Contractor's authorized representative certifying approval of submissions, verification of field measurements and compliance with Contract Documents.
  - .5 Details of appropriate portions of Work as applicable:
    - .1 Fabrication.
    - .2 Layout, showing dimensions, including identified field dimensions, and clearances.
    - .3 Setting or erection details.
    - .4 Capacities.
    - .5 Performance characteristics.
    - .6 Standards.
    - .7 Operating weight.
    - .8 Wiring diagrams.
    - .9 Single line and schematic diagrams.
    - .10 Relationship to adjacent work.
- .9 After Engineer's review, distribute copies.
- .10 Submit electronic copy of shop drawings for each requirement requested in specification Sections and as Engineer may reasonably request.
- .11 Submit electronic copies of product data sheets or brochures for requirements requested in specification Sections and as requested by Engineer where shop drawings will not be prepared due to standardized manufacture of product.
- .12 Submit electronic copies of test reports for requirements requested in specification Sections and as requested by Engineer.
  - .1 Report signed by authorized official of testing laboratory that material, product or system identical to material, product or system to be provided has been tested in accordance with specified requirements.
  - .2 Testing must have been within 3 years of date of contract award for project.
- .13 Submit electronic copies of certificates for requirements requested in specification Sections and as requested by Engineer.
  - .1 Statements printed on manufacturer's letterhead and signed by responsible officials of manufacturer of product, system or material attesting that product, system or material meets specification requirements.

- .2 Certificates must be dated after award of project contract complete with project name.
- .14 Submit electronic copies of manufacturer's instructions for requirements requested in specification Sections and as requested by Engineer.
  - .1 Pre-printed material describing installation of product, system or material, including special notices and Material Safety Data Sheets concerning impedances, hazards and safety precautions.
- .15 Submit electronic copies of Manufacturer's Field Reports for requirements requested in specification Sections and as requested by Engineer.
- .16 Documentation of the testing and verification actions taken by manufacturer's representative to confirm compliance with manufacturer's standards or instructions.
- .17 Submit electronic copies of Operation and Maintenance Data for requirements requested in specification Sections and as requested by Engineer.
- .18 Delete information not applicable to project.
- .19 Supplement standard information to provide details applicable to project.
- .20 If upon review by Engineer, no errors or omissions are discovered or if only minor corrections are made, transparency copies will be returned and fabrication and installation of Work may proceed. If shop drawings are rejected, noted copy will be returned and resubmission of corrected shop drawings, through same procedure indicated above, must be performed before fabrication and installation of Work may proceed.
- .21 The review of shop drawings by Public Works and Government Services Canada (PWGSC) is for sole purpose of ascertaining conformance with general concept.
  - .1 This review shall not mean that PWGSC approves detail design inherent in shop drawings, responsibility for which shall remain with Contractor submitting same, and such review shall not relieve Contractor of responsibility for errors or omissions in shop drawings or of responsibility for meeting requirements of construction and Contract Documents.
  - .2 Without restricting generality of foregoing, Contractor is responsible for dimensions to be confirmed and correlated at job site, for information that pertains solely to fabrication processes or to techniques of construction and installation and for co-ordination of Work of sub-trades.

### 1.3 SAMPLES

- .1 Submit for review samples in duplicate or triplicate as requested in respective specification Sections. Label samples with origin and intended use.
  - .2 Deliver samples prepaid to site office.
  - .3 Notify Engineer in writing, at time of submission of deviations in samples from requirements of Contract Documents.
  - .4 Where colour, pattern or texture is criterion, submit full range of samples.
  - .5 Adjustments made on samples by Engineer are not intended to change Contract Price. If adjustments affect value of Work, state such in writing to Engineer prior to proceeding with Work.
  - .6 Make changes in samples which Engineer may require, consistent with Contract Documents.
-

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

#### 1.4 MOCK-UPS

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

#### 1.5 PHOTOGRAPHIC DOCUMENTATION

.1 Submit electronic copies of colour digital photography in JPG or TIFF format, standard resolution monthly with progress statement and as directed by Engineer.

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

.3 Number of viewpoints: six (6) locations.

.1 Viewpoints and their location as determined by Engineer.

.4 Frequency of photographic documentation: weekly and as directed by Engineer.

#### 1.6 CERTIFICATES AND TRANSCRIPTS

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

### PART 2 - PRODUCTS

#### 2.1 NOT USED

.1 Not Used.

### PART 3 - EXECUTION

#### 3.1 NOT USED

.1 Not Used.

### END OF SECTION

---

## PART 1- GENERAL

### 1.1 REFERENCES

- .1 Canadian General Standards Board (CGSB)

### 1.2 REFERENCES

- .1 Canada Labour Code, Part 2, Canada Occupational Safety and Health Regulations
- .2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (MSDS).
- .3 Province of Ontario
  - .1 Occupational Health and Safety Act, R.S.O. 1990 Updated 2005.

### 1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Make submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit site-specific Health and Safety Plan: Within seven (7) days after date of Notice to Proceed and prior to commencement of Work. Health and Safety Plan must include:
  - .1 Results of site specific safety hazard assessment.
  - .2 Results of safety and health risk or hazard analysis for site tasks and operation found in work plan.
- .3 Submit three (3) copies of Contractor's authorized representative's work site health and safety inspection reports to Engineer and Consultant weekly.
- .4 Submit copies of reports or directions issued by Federal, Provincial and Territorial health and safety inspectors.
- .5 Submit copies of incident and accident reports.
- .6 Submit WHMIS MSDS - Material Safety Data Sheets in accordance with Section 01 47 15 - Sustainable Requirements: Construction and Section 02 81 01 - Hazardous Materials.
- .7 Engineer will review Contractor's site-specific Health and Safety Plan and provide comments to Contractor within five (5) days after receipt of plan. Revise plan as appropriate and resubmit plan to Engineer and Consultant within five (5) days after receipt of comments from Engineer and Consultant.
- .8 Engineer's review of Contractor's final Health and Safety plan should not be construed as approval and does not reduce the Contractor's overall responsibility for construction Health and Safety.
- .9 Medical Surveillance: where prescribed by legislation, regulation or safety program, submit certification of medical surveillance for site personnel prior to commencement of Work, and submit additional certifications for any new site personnel to Engineer and Consultant.
- .10 On-site Contingency and Emergency Response Plan: address standard operating procedures to be implemented during emergency situations.
- .11 Contractor shall submit Health and Safety reports to Engineer for approval on a weekly basis.



- .12 Contractor shall submit copies of personnel training in confined spaces to Engineer for approval and prior to commencement of Work.

#### 1.4 FILING OF NOTICE

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

#### 1.5 SAFETY ASSESSMENT

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

#### 1.6 MEETINGS

- .1 Schedule and administer Health and Safety meeting with Engineer and Consultant prior to commencement of Work.

#### 1.7 REGULATORY REQUIREMENTS

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

#### 1.8 GENERAL REQUIREMENTS

- .1 Develop written site-specific Health and Safety Plan based on hazard assessment prior to beginning site Work and continue to implement, maintain, and enforce plan until final demobilization from site. Health and Safety Plan must address project specifications.
- .2 Engineer and/or Consultant may respond in writing, where deficiencies or concerns are noted and may request re-submission with correction of deficiencies or concerns.

#### 1.9 RESPONSIBILITY

- .1 Be responsible for health and safety of persons on site, safety of property on site and for protection of persons adjacent to site and environment to extent that they may be affected by conduct of Work.
- .2 Comply with and enforce compliance by employees with safety requirements of Contract Documents, applicable federal, provincial, territorial and local statutes, regulations, and ordinances, and with site-specific Health and Safety Plan.

#### 1.10 COMPLIANCE REQUIREMENTS

- .1 Comply with Ontario Health and Safety Act, R.S.O.

#### 1.11 UNFORSEEN HAZARDS

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

#### 1.12 HEALTH AND SAFETY CO-ORDINATOR

- .1 Employ and assign to Work, competent and authorized representative as Health and Safety Coordinator. Health and Safety Coordinator must:
  - .1 Have site-related working experience specific to activities associated with working with heights.
  - .2 Have working knowledge of occupational safety and health regulations.
  - .3 Be responsible for completing Contractor's Health and Safety Training Sessions and ensuring that personnel not successfully completing required training are not permitted to enter site to perform Work.
  - .4 Be responsible for implementing, enforcing daily and monitoring site-specific Contractor's Health and Safety Plan.
  - .5 Be on site during execution of Work and report directly to and be under direction of site supervisor.

#### 1.13 POSTING OF DOCUMENTS

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

#### 1.14 CORRECTION OF NON-COMPLIANCE

- .1 Immediately address health and safety non-compliance issues identified by authority having jurisdiction or by Engineer.
- .2 Provide Engineer with written report of action taken to correct non-compliance of health and safety issues identified.
- .3 Engineer may stop Work if non-compliance of health and safety regulations is not corrected.

#### 1.15 BLASTING

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

#### 1.16 POWDER ACTUATED DEVICES

- .1 Use powder actuated devices only after receipt of written permission from Engineer.

#### 1.17 WORK STOPPAGE

- .1 Give precedence to safety and health of public and site personnel and protection of environment over cost and schedule considerations for Work.

**PART 2 - PRODUCTS**

2.1 NOT USED

.1 Not used.

**PART 3 - EXECUTION**

3.1 NOT USED

.1 Not used.

**END OF SECTION**

## PART 1- GENERAL

### 1.1 REFERENCES

- .1 Definitions:
  - .1 Environmental Pollution and Damage: presence of chemical, physical, biological elements or agents which adversely affect human health and welfare; unfavourably alter ecological balances of importance to human life; affect other species of importance to humankind; or degrade environment aesthetically, culturally and/or historically.
  - .2 Environmental Protection: prevention/control of pollution and habitat or environment disruption during construction. Control of environmental pollution and damage requires consideration of land, water, and air; biological and cultural resources; and includes management of visual aesthetics; noise; solid, chemical, gaseous, and liquid waste; radiant energy and radioactive material as well as other pollutants.
- .2 Reference Standards:
  - .1 Canada Green Building Council (CaGBC)
  - .2 Canadian Construction Documents Committee (CCDC)
    - .1 CCDC 2-2008 Stipulated Price Contract.
  - .3 U.S. Environmental Protection Agency (EPA)/Office of Water
    - .1 EPA 832/R-92-005-92, Storm Water Management for Construction Activities, Chapter 3.

### 1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
  - .2 Prior to commencing construction activities or delivery of materials to site, provide Environmental Protection Plan for review and approval by Engineer.
  - .3 Ensure Environmental Protection Plan includes comprehensive overview of known or potential environmental issues to be addressed during construction.
  - .4 Address topics at level of detail commensurate with environmental issue and required construction tasks.
  - .5 Include in Environmental Protection Plan:
    - .1 Names of persons responsible for ensuring adherence to Environmental Protection Plan.
    - .2 Names and qualifications of persons responsible for manifesting hazardous waste to be removed from site.
    - .3 Names and qualifications of persons responsible for training site personnel.
    - .4 Descriptions of environmental protection personnel training program.
    - .5 Erosion and sediment control plan identifying type and location of erosion and sediment controls to be provided including monitoring and reporting requirements to assure that control measures are in compliance with erosion and sediment control plan, Federal, Provincial, and Municipal laws and regulations, EPA 832/R-92-005, Chapter 3 requirements.
    - .6 Drawings showing locations of proposed material storage areas, structures, sanitary facilities, and stockpiles of excess or spoil materials including methods to control runoff and to contain materials on site.
    - .7 Traffic Control Plans including measures to reduce erosion of temporary roadbeds by construction traffic, especially during wet weather. Ensure plans include measures to minimize amount of mud transported onto paved public roads by vehicles or runoff.
-

- .8 Work area plan showing proposed activity in each portion of area and identifying areas of limited use or non-use. Ensure plan includes measures for marking limits of use areas and methods for protection of features to be preserved within authorized work areas.
- .9 Spill Control Plan including procedures, instructions, and reports to be used in event of unforeseen spill of regulated substance.
- .10 Non-Hazardous solid waste disposal plan identifying methods and locations for solid waste disposal including clearing debris.
- .11 Air pollution control plan detailing provisions to assure that dust, debris, materials, and trash, are contained on project site.
- .12 Contaminant Prevention Plan identifying potentially hazardous substances to be used on job site; intended actions to prevent introduction of such materials into air, water, or ground; and detailing provisions for compliance with Federal, Provincial, and Municipal laws and regulations for storage and handling of these materials.
- .13 Waste Water Management Plan identifying methods and procedures for management and/or discharge of waste waters which are directly derived from construction activities, such as concrete curing water, clean-up water, dewatering of ground water, disinfection water, hydrostatic test water, and water used in flushing of lines.
- .14 Pesticide treatment plan to be included and updated, as required.

### 1.3 FIRES

- .1 Fires and burning of rubbish on site are not permitted.

### 1.4 DRAINAGE

- .1 Provide Erosion and Sediment Control Plan identifying type and location of erosion and sediment controls provided. Ensure plan includes monitoring and reporting requirements to assure that control measures are in compliance with erosion and sediment control plan, Federal, Provincial, and Municipal laws and regulations, EPA 832/R-92-005, Chapter 3 requirements.
- .2 Storm Water Pollution Prevention Plan (SWPPP) to be substituted for erosion and sediment control plan.
- .3 Provide temporary drainage and pumping required to keep excavations and site free from water.
- .4 Ensure pumped water into waterways, sewer or drainage systems is free of suspended materials.
- .5 Control disposal or runoff of water containing suspended materials or other harmful substances in accordance with local authority requirements.

### 1.5 SITE CLEARING AND PLANT PROTECTION

- .1 Protect trees and plants on site and adjacent properties as indicated.
- .2 Wrap in burlap, trees and shrubs adjacent to construction work, storage areas and trucking lanes, and encase with protective wood framework from grade level to height of 2 m minimum.
- .3 Protect roots of designated trees to dripline during excavation and site grading to prevent disturbance or damage. Avoid unnecessary traffic, dumping and storage of materials over root zones.
- .4 Minimize stripping of topsoil and vegetation.
- .5 Restrict tree removal to areas indicated or designated by Engineer.

## 1.6 POLLUTION CONTROL

- .1 Maintain temporary erosion and pollution control features installed under this Contract.
- .2 Control emissions from equipment and plant to local authorities' emission requirements.
- .3 Prevent sandblasting and other extraneous materials from contaminating air and waterways beyond application area.
  - .1 Provide temporary enclosures where indicated directed by Engineer.
- .4 Cover or wet down dry materials and rubbish to prevent blowing dust and debris. Provide dust control for temporary roads.

## 1.7 NOTIFICATION

- .1 Engineer will notify Contractor in writing of observed noncompliance with Federal, Provincial or Municipal environmental laws or regulations, permits, and other elements of Contractor's Environmental Protection plan.
- .2 Contractor: after receipt of such notice, inform Engineer of proposed corrective action and take such action for approval by Engineer.
  - .1 Do not take action until after receipt of written approval by Engineer.
- .3 Engineer will issue stop order of work until satisfactory corrective action has been taken.
- .4 No time extensions granted or equitable adjustments allowed to Contractor for such suspensions.

## PART 2 - PRODUCTS

### 2.1 NOT USED

- .1 Not Used.

## PART 3 - EXECUTION

### 3.1 CLEANING

- .1 Clean in accordance with Section 01 74 11 - Cleaning.
- .2 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .3 Bury rubbish and waste materials on site after receipt of written approval from Engineer.
- .4 Ensure public waterways, storm and sanitary sewers remain free of waste and volatile materials disposal.

END OF SECTION

---

## PART 1 - GENERAL

### 1.1 REFERENCES AND CODES

- .1 Perform Work in accordance with National Building Code of Canada (NBC) including amendments up to tender closing date and other codes of provincial or local application provided that in case of conflict or discrepancy, more stringent requirements apply.
- .2 Meet or exceed requirements of:
  - .1 Contract documents.
  - .2 Specified standards, codes and referenced documents.

### 1.2 HAZARDOUS MATERIAL DISCOVERY

- .1 Asbestos: demolition of spray or trowel-applied asbestos is hazardous to health. Stop work immediately when material resembling spray or trowel-applied asbestos is encountered during demolition work. Notify Engineer.
- .2 Mould: stop work immediately when material resembling mould is encountered during demolition work. Notify Engineer.

### 1.3 BUILDING SMOKING ENVIRONMENT

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

## 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 INSPECTION

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

### 1.2 ACCESS TO WORK

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

### 1.3 PROCEDURES

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

### 1.4 REJECTED WORK

- .1 Remove defective Work, whether result of poor workmanship, use of defective products or damage and whether incorporated in Work or not, which has been rejected by Engineer as failing to conform to Contract Documents. Replace or re-execute in accordance with Contract Documents.
  - .2 Make good other Contractor's work damaged by such removals or replacements promptly.
  - .3 If in opinion of Engineer it is not expedient to correct defective Work or Work not performed in accordance with Contract Documents, Owner will deduct from Contract Price difference in value between Work performed and that called for by Contract Documents, amount of which will be determined by Engineer.
-



### 1.5 REPORTS

- .1 Submit four (4) copies of inspection and test reports to Engineers and Departmental Representative for their review and approval.
- .2 Provide copies to subcontractor of work being inspected or tested manufacturer or fabricator of material being inspected or tested.

### 1.6 TESTS AND MIX DESIGNS

- .1 Furnish test results and mix designs as requested.
- .2 Cost of tests and mix designs beyond those called for in Contract Documents or beyond those required by law of Place of Work will be appraised by Engineer and may be authorized as recoverable.

### 1.7 MOCK-UPS

- .1 Prepare mock-ups for Work specifically requested in specifications. Include for Work of Sections required to provide mock-ups.
- .2 Construct in locations acceptable to Engineer as specified in specific Section.
- .3 Prepare mock-ups for Engineer's review with reasonable promptness and in orderly sequence, to not cause delays in Work.
- .4 Failure to prepare mock-ups in ample time is not considered sufficient reason for extension of Contract Time and no claim for extension by reason of such default will be allowed.
- .5 If requested, Engineer will assist in preparing schedule fixing dates for preparation.
- .6 Mock-ups may remain as part of Work.

### 1.8 MILL TESTS

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

## PART 2 - PRODUCTS

### 2.1 NOT USED

- .1 Not Used.

## PART 3 - EXECUTION

### 3.1 NOT USED

- .1 Not Used.

END OF SECTION

---

## PART 1 - GENERAL

### 1.1 REFERENCES

- .1 U.S. Environmental Protection Agency (EPA) / Office of Water
  - .1 EPA 832R92005, Storm Water Management for Construction Activities: Developing Pollution Prevention Plans and Best Management Practices.

### 1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

### 1.3 INSTALLATION AND REMOVAL

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

### 1.4 WATER SUPPLY

- .1 Provide continuous supply of potable water for construction use.
- .2 Arrange for connection with appropriate utility company and pay costs for installation, maintenance and removal.
- .3 Pay for utility charges at prevailing rates.

### 1.5 TEMPORARY HEATING AND VENTILATION

---

- .1 Provide temporary heating required during construction period, including attendance, maintenance and fuel.
- .2 Provide temporary heat and ventilation in enclosed areas as required to:
  - .1 Facilitate progress of Work.
  - .2 Protect Work and products against dampness and cold.
  - .3 Prevent moisture condensation on surfaces.
  - .4 Provide ambient temperatures and humidity levels for storage, installation and curing of materials.
  - .5 Provide adequate ventilation to meet health regulations for safe working environment.
- .3 Maintain temperatures of minimum 10 degrees C in areas where construction is in progress.
- .4 Ventilating:
  - .1 Prevent accumulations of dust, fumes, mists, vapours or gases in areas occupied during construction.
  - .2 Provide local exhaust ventilation to prevent harmful accumulation of hazardous substances into atmosphere of occupied areas.
  - .3 Dispose of exhaust materials in manner that will not result in harmful exposure to persons.
  - .4 Ventilate storage spaces containing hazardous or volatile materials.
  - .5 Ventilate temporary sanitary facilities.
  - .6 Continue operation of ventilation and exhaust system for time after cessation of work process to assure removal of harmful contaminants.
- .5 Maintain strict supervision of operation of temporary heating and ventilating equipment to:
  - .1 Conform with applicable codes and standards.
  - .2 Enforce safe practices.
  - .3 Prevent abuse of services.
  - .4 Prevent damage to finishes.
  - .5 Vent direct-fired combustion units to outside.
- .6 Be responsible for damage to Work due to failure in providing adequate heat and protection during construction.

#### 1.6 TEMPORARY POWER AND LIGHT

- .1 Provide and pay for temporary power during construction for temporary lighting, sump pumps and operating of power tools, to a maximum supply of 600 volts, 225 amps.
  - .2 Arrange for connection with appropriate utility company. Pay costs for installation, maintenance and removal.
  - .3 Provide and maintain temporary lighting throughout project. Ensure level of illumination on all floors and stairs is not less than 162 lx.
  - .4 Power supply is available. Contractor shall submit their power supply requirements after the contract award if required.
  - .5 Electrical power and lighting systems installed under this Contract may be used for construction requirements only with prior approval of provided that guarantees are not affected. Make good damage to electrical system caused by use under this Contract. Replace lamps which have been used for more than 3 months.
-

### 1.7 TEMPORARY COMMUNICATION FACILITIES

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

### 1.8 FIRE PROTECTION

- .1 Provide and maintain temporary fire protection equipment during performance of Work required by insurance companies having jurisdiction and governing codes, regulations and bylaws.
- .2 Burning rubbish and construction waste materials is not permitted on site.

### 1.9 TEMPORARY SUMP PUMPS

- .1 Contractor to provide and pay for rental of temporary sump pumps during construction demolition of existing equipment to prevent flooding risk to adjacent areas.
- .2 Contractor to provide temporary connections to existing building services including mechanical, electrical and controls.
- .3 Contractor shall confirm locations of temporary equipment on site prior to commencing demolition and new works.

## PART 2 - PRODUCTS

### 2.1 NOT USED

- .1 Not Used.

## PART 3 - EXECUTION

### 3.1 SHUTDOWNS

- .1 Contractor to provide 72 hours' notice to CSA in order to arrange for any shutdowns of building services.

END OF SECTION

---

## PART 1 - GENERAL

### 1.1 REFERENCES

- .1 Canadian General Standards Board (CGSB)
  - .1 CAN/CGSB 1.189-00, Exterior Alkyd Primer for Wood.
  - .2 CGSB 1.59-97, Alkyd Exterior Gloss Enamel.
- .2 Canadian Standards Association (CSA International)
  - .1 CSA-A23.1/A23.2-04, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.
  - .2 CSA-0121-M1978 (R2003), Douglas Fir Plywood.
  - .3 CAN/CSA-S269.2-M1987 (R2003), Access Scaffolding for Construction Purposes.
  - .4 CAN/CSA-Z321-96(R2001), Signs and Symbols for the Occupational Environment.
- .3 Public Works Government Services Canada (PWGSC) Standard Acquisition Clauses and Conditions (SACC)-ID: R0202D, Title: General Conditions 'C', In Effect as of: May 14, 2004.
- .4 U.S. Environmental Protection Agency (EPA) / Office of Water
  - .1 EPA 832R92005, Storm Water Management for Construction Activities: Developing Pollution Prevention Plans and Best Management Practices.

### 1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

### 1.3 INSTALLATION AND REMOVAL

- .1 Provide construction facilities in order to execute work expeditiously.
- .2 Remove from site all such work after use.

### 1.4 SCAFFOLDING

- .1 Scaffolding in accordance with CAN/CSA-S269.2.
- .2 Provide and maintain scaffolding ramps ladders swing staging platforms and temporary stairs.

### 1.5 HOISTING

- .1 Provide, operate and maintain hoists cranes required for moving of workers, materials and equipment. Make financial arrangements with Subcontractors for their use of hoists.
  - .2 Hoists cranes to be operated by qualified operator.
-

#### 1.6 ELEVATORS

- .1 Permanent elevators may be used by construction personnel and transporting of materials. Obtain direction from Engineer.

#### 1.7 SITE STORAGE/LOADING

- .1 Confine work and operations of employees by Contract Documents. Do not unreasonably encumber premises with products.
- .2 Do not load or permit to load any part of Work with weight or force that will endanger Work.

#### 1.8 CONSTRUCTION PARKING

- .1 Parking will be permitted on site in areas designated by Engineer.
- .2 Provide and maintain adequate access to project site.
- .3 Clean runways and taxi areas where used by Contractor's equipment.

#### 1.9 SECURITY

- .1 Provide and pay for responsible security personnel to guard site and contents of site after working hours and during holidays.

#### 1.10 EQUIPMENT, TOOL AND MATERIALS STORAGE

- .1 Provide and maintain, in clean and orderly condition, lockable weatherproof sheds for storage of tools, equipment and materials.
- .2 Locate materials not required to be stored in weatherproof sheds on site in manner to cause least interference with work activities.

#### 1.11 SANITARY FACILITIES

- .1 Existing sanitary facilities for work force in accordance with governing regulations and ordinances. Co-ordinate use with Engineer.
- .2 Post notices and take precautions as required by local health authorities. Keep area and premises in sanitary condition.

#### 1.12 PROTECTION AND MAINTENANCE OF TRAFFIC

- .1 Protect travelling public from damage to person and property.
  - .2 Contractor's traffic on roads selected for hauling material to and from site to interfere as little as possible with public traffic.
-

1.13 CLEAN-UP

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

**PART 2 - PRODUCTS**

2.1 NOT USED

- .1 Not Used.

**PART 3 - EXECUTION**

- .1 NOT USED
- .2 Not used.

**END OF SECTION**

---

## PART 1- GENERAL

### 1.1 REFERENCES

- .1 Canadian General Standards Board (CGSB)
  - .1 CGSB 1.59-97, Alkyd Exterior Gloss Enamel.
  - .2 CAN/CGSB 1.189-00, Exterior Alkyd Primer for Wood.
- .2 Canadian Standards Association (CSA International)
  - .1 CSA-O121-M1978 (R2003), Douglas Fir Plywood.
- .3 Public Works Government Services Canada (PWGSC) Standard Acquisition Clauses and Conditions (SACC)-ID: R0202D, Title: General Conditions 'C', In Effect as Of: May 14, 2004.

### 1.2 INSTALLATION AND REMOVAL

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

### 1.3 DUST TIGHT SCREENS

- .1 Provide dust tight screens or insulated partitions to localize dust generating activities, and for protection of workers, finished areas of Work and public.
- .2 Maintain and relocate protection until such work is complete.

### 1.4 ACCESS TO SITE

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

### 1.5 FIRE ROUTES

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

### 1.6 PROTECTION FOR OFF-SITE AND PUBLIC PROPERTY

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

### 1.7 PROTECTION OF BUILDING FINISHES

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



- .2 Provide necessary screens, covers, and hoardings.
- .3 Confirm with Engineer locations and installation schedule three (3) days prior to installation.
- .4 Be responsible for damage incurred due to lack of or improper protection.

#### 1.8 WASTE MANAGEMENT AND DISPOSAL

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

#### PART 2 - PRODUCTS

##### 2.1 NOT USED

- .1 Not Used.

#### PART 3 - EXECUTION

##### 3.1 NOT USED

- .1 Not Used.

END OF SECTION

---

## PART 1 - GENERAL

### 1.1 REFERENCES

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

### 1.2 QUALITY

- .1 Products, materials, equipment and articles incorporated in Work shall be new, not damaged or defective, and of best quality for purpose intended. If requested, furnish evidence as to type, source and quality of products provided.
- .2 Procurement policy is to acquire, in cost effective manner, items containing highest percentage of recycled and recovered materials practicable consistent with maintaining satisfactory levels of competition. Make reasonable efforts to use recycled and recovered materials and in otherwise utilizing recycled and recovered materials in execution of work.
- .3 Defective products, whenever identified prior to completion of Work, will be rejected, regardless of previous inspections. Inspection does not relieve responsibility, but is precaution against oversight or error. Remove and replace defective products at own expense and be responsible for delays and expenses caused by rejection.
- .4 Should disputes arise as to quality or fitness of products, decision rests strictly with Engineer based upon requirements of Contract Documents.
- .5 Unless otherwise indicated in specifications, maintain uniformity of manufacture for any particular or like item throughout building.
- .6 Permanent labels, trademarks and nameplates on products are not acceptable in prominent locations, except where required for operating instructions, or when located in mechanical or electrical rooms.

### 1.3 AVAILABILITY

- .1 In event of failure to notify Engineer at commencement of Work and should it subsequently appear that Work may be delayed for such reason, Engineer reserves right to substitute more readily available products of similar character, at no increase in Contract Price or Contract Time.

### 1.4 STORAGE, HANDLING AND PROTECTION

- .1 Handle and store products in manner to prevent damage, adulteration, deterioration and soiling and in accordance with manufacturer's instructions when applicable.
-

- .2 Store packaged or bundled products in original and undamaged condition with manufacturer's seal and labels intact. Do not remove from packaging or bundling until required in Work.
- .3 Store products subject to damage from weather in weatherproof enclosures.
- .4 Store cementitious products clear of earth or concrete floors, and away from walls.
- .5 Keep sand, when used for grout or mortar materials, clean and dry. Store sand on wooden platforms and cover with waterproof tarpaulins during inclement weather.
- .6 Store sheet materials, lumber and other materials that require such on flat, solid supports and keep clear of ground. Slope to shed moisture.
- .7 Store and mix paints in heated and ventilated room. Remove oily rags and other combustible debris from site daily. Take every precaution necessary to prevent spontaneous combustion.
- .8 Remove and replace damaged products at own expense and to satisfaction of Engineer.
- .9 Touch-up damaged factory finished surfaces to Engineer's satisfaction. Use touch-up materials to match original. Do not paint over name plates.

#### 1.5 TRANSPORTATION

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

#### 1.6 MANUFACTURER'S INSTRUCTIONS

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

#### 1.7 QUALITY OF WORK

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

#### 1.8 CO-ORDINATION

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

#### 1.9 CONCEALMENT

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

#### 1.10 REMEDIAL WORK

- .1 Perform remedial work required to repair or replace parts or portions of Work identified as defective or unacceptable. Co-ordinate adjacent affected Work as required.
- .2 Perform remedial work by specialists familiar with materials affected. Perform in a manner to neither damage nor put at risk any portion of Work.

#### 1.11 LOCATION OF FIXTURES

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

#### 1.12 FASTENINGS

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

#### 1.13 FASTENINGS - EQUIPMENT

- .1 Use fastenings of standard commercial sizes and patterns with material and finish suitable for service.
  - .2 Use heavy hexagon heads, semi-finished unless otherwise specified. Use No. 304 stainless steel for exterior areas.
-

- .3 Bolts may not project more than one diameter beyond nuts.
- .4 Use plain type washers on equipment, sheet metal and soft gasket lock type washers where vibrations occur. Use resilient washers with stainless steel.

#### 1.14 PROTECTION OF WORK IN PROGRESS

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

#### 1.15 EXISTING UTILITIES

- .1 When breaking into or connecting to existing services or utilities, execute Work at times directed by local governing authorities, with minimum of disturbance to Work, and/or building occupants and pedestrian and vehicular traffic.
- .2 Protect, relocate or maintain existing active services. When services are encountered, cap off in manner approved by authority having jurisdiction. Stake and record location of capped service.

#### 1.16 HAZARDOUS MATERIALS

- .1 Use of hazardous material is prohibited at federal facilities as per current regulations based on PWGSC guidelines.

### PART 2 - PRODUCTS

#### 2.1 NOT USED

- .1 Not Used.
- .2

### PART 3 - EXECUTION

#### 3.1 NOT USED

- .1 Not Used.

END OF SECTION

---

## PART 1 - GENERAL

### 1.1 SURVEY REFERENCE POINTS

- .1 Existing base horizontal and vertical control points are designated on drawings.
- .2 Locate, confirm and protect control points prior to starting site work. Preserve permanent reference points during construction.
- .3 Make no changes or relocations without prior written notice to Consultant.
- .4 Report to Consultant when reference point is lost or destroyed, or requires relocation because of necessary changes in locations.
- .5 Require surveyor to replace control points in accordance with original survey control.

### 1.2 SURVEY REQUIREMENTS

- .1 Establish lines and levels, locate and lay out, by instrumentation.
- .2 Establish lines and levels for mechanical and electrical work.

### 1.3 EXISTING SERVICES

- .1 Before commencing work, establish location and extent of service lines in area of Work and notify Consultant of findings.

### 1.4 LOCATION OF EQUIPMENT AND FIXTURES

- .1 Location of equipment, fixtures and outlets indicated or specified are to be considered as approximate.
- .2 Locate equipment, fixtures and distribution systems to provide minimum interference and maximum usable space and in accordance with manufacturer's recommendations for safety, access and maintenance.
- .3 Inform Consultant of impending installation and obtain approval for actual location.
- .4 Submit field drawings to indicate relative position of various services and equipment when required by Consultant.

### 1.5 RECORDS

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

### 1.6 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit name and address of Surveyor to Consultant.
  - .2 On request of Consultant, submit documentation to verify accuracy of field engineering work.
-

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

**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 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit written request in advance of cutting or alteration which affects:
  - .1 Structural integrity of elements of project.
  - .2 Integrity of weather-exposed or moisture-resistant elements.
  - .3 Efficiency, maintenance, or safety of operational elements.
  - .4 Visual qualities of sight-exposed elements.
  - .5 Work of Owner or separate contractor.
- .3 Include in request:
  - .1 Identification of project.
  - .2 Location and description of affected Work.
  - .3 Statement on necessity for cutting or alteration.
  - .4 Description of proposed Work, and products to be used.
  - .5 Alternatives to cutting and patching.
  - .6 Effect on Work of Owner or separate contractor.
  - .7 Written permission of affected separate contractor.
  - .8 Date and time work will be executed.

### 1.2 MATERIALS

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

### 1.3 PREPARATION

- .1 Inspect existing conditions, including elements subject to damage or movement during cutting and patching.
  - .2 After uncovering, inspect conditions affecting performance of Work.
  - .3 Beginning of cutting or patching means acceptance of existing conditions.
  - .4 Provide supports to assure structural integrity of surroundings; provide devices and methods to protect other portions of project from damage.
  - .5 Provide protection from elements for areas which are to be exposed by uncovering work; maintain excavations free of water.
  - .6 For all hot work, including work which generates sparks, smoke or excessive dust, obtain a site hot work permit from Engineer minimum 2 days prior to work.
-



#### 1.4 EXECUTION

- .1 Execute cutting, fitting, and patching including excavation and fill, to complete Work.
- .2 Fit several parts together, to integrate with other Work.
- .3 Uncover Work to install ill-timed Work.
- .4 Remove and replace defective and non-conforming Work.
- .5 Remove samples of installed Work for testing.
- .6 Provide openings in non-structural elements of Work for penetrations of mechanical and electrical Work.
- .7 Execute Work by methods to avoid damage to other Work, and which will provide proper surfaces to receive patching and finishing.
- .8 Employ original installer to perform cutting and patching for weather-exposed and moisture-resistant elements, and sight-exposed surfaces.
- .9 Cut rigid materials using masonry saw or core drill. Pneumatic or impact tools not allowed on masonry work without prior approval.
- .10 Restore work with new products in accordance with requirements of Contract Documents.
- .11 Fit Work airtight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.
- .12 At penetration of fire rated wall, ceiling, or floor construction, completely seal voids with firestopping material in accordance with Section 07 84 00 - Firestopping, full thickness of the construction element.
- .13 Refinish surfaces to match adjacent finishes: Refinish continuous surfaces to nearest intersection. Refinish assemblies by refinishing entire unit.
- .14 Conceal pipes, ducts and wiring in floor, wall and ceiling construction of finished areas except where indicated otherwise.

#### 1.5 WASTE MANAGEMENT AND DISPOSAL

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

END OF SECTION

---

## PART 1 - GENERAL

### 1.1 PROJECT CLEANLINESS

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

### 1.2 FINAL CLEANING

- .1 When Work is Substantially Performed remove surplus products, tools, construction machinery and equipment not required for performance of remaining Work.
  - .2 Remove waste products and debris other than that caused by others, and leave Work clean and suitable for occupancy.
  - .3 Prior to final review remove surplus products, tools, construction machinery and equipment.
  - .4 Remove waste products and debris.
  - .5 Remove waste materials from site at regularly scheduled times or dispose of as directed by Engineer. Do not burn waste materials on site.
  - .6 Make arrangements with and obtain permits from authorities having jurisdiction for disposal of waste
-

and debris.

- .7 Clean and polish glass, mirrors, hardware, wall tile, stainless steel, chrome, porcelain enamel, baked enamel, plastic laminate, and mechanical and electrical fixtures. Replace broken, scratched or disfigured glass.
- .8 Remove stains, spots, marks and dirt from decorative work, electrical and mechanical fixtures, furniture fitments, walls, and grounds surrounding building.
- .9 Clean lighting reflectors, lenses, and other lighting surfaces.
- .10 Clean equipment and fixtures to sanitary condition; clean or replace filters of mechanical equipment.
- .11 Remove debris and surplus materials from crawl areas and other accessible concealed spaces.

### 1.3 WASTE MANAGEMENT AND DISPOSAL

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

## 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 WASTE MANAGEMENT GOALS

- .1 Prior to start of Work conduct meeting with Engineer to review and discuss PWGSC's Waste Management Plan and Goals.
- .2 PWGSC's Waste Management Goal 75 percent of total Project Waste to be diverted from landfill sites. Provide Engineer documentation certifying that waste management, recycling, reuse of recyclable and reusable materials have been extensively practiced.
- .3 Accomplish maximum control of solid construction waste.
- .4 Preserve environment and prevent pollution and environment damage.

### 1.2 DEFINITIONS

- .1 Class III: non-hazardous waste - construction renovation and demolition waste.
- .2 Inert Fill: inert waste - exclusively asphalt and concrete.
- .3 Materials Source Separation Program (MSSP): consists of series of ongoing activities to separate reusable and recyclable waste material into material categories from other types of waste at point of generation.
- .4 Recyclable: ability of product or material to be recovered at end of its life cycle and re-manufactured into new product for reuse.
- .5 Recycle: process by which waste and recyclable materials are transformed or collected for purpose of being transferred into new products.
- .6 Recycling: process of sorting, cleansing, treating and reconstituting solid waste and other discarded materials for purpose of using in altered form. Recycling does not include burning, incinerating, or thermally destroying waste.
- .7 Reuse: repeated use of product in same form but not necessarily for same purpose. Reuse includes:
  - .1 Salvaging reusable materials from re-modelling projects, before demolition stage, for resale, reuse on current project or for storage for use on future projects.
  - .2 Returning reusable items including pallets or unused products to vendors.
- .8 Salvage: removal of structural and non-structural materials from deconstruction/disassembly projects for purpose of reuse or recycling.
- .9 Separate Condition: refers to waste sorted into individual types.
- .10 Source Separation: acts of keeping different types of waste materials separate beginning from first time they became waste.
- .11 Waste Reduction Workplan (WRW): written report which addresses opportunities for reduction, reuse, or recycling of materials. Refer to Schedule B. WRW is based on information acquired from WA (Schedule A).

1.3 DOCUMENTS

- .1 Maintain at job site, one copy of following documents:
  - .1 Waste Audit.
  - .2 Waste Reduction Workplan.
  - .3 Material Source Separation Plan.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Prepare and submit following prior to project start-up:
  - .1 Submit 2 copies of completed Waste Reduction Workplan (WRW).
- .3 Submit before final payment summary of waste materials salvaged for reuse, recycling or disposal by project using deconstruction/disassembly material audit form.
  - .1 Failure to submit could result in hold back of final payment.
  - .2 Provide receipts, scale tickets, waybills, and show quantities and types of materials reused, recycled, co-mingled and separated off-site or disposed of.
  - .3 For each material reused, sold or recycled from project, include amount quantities by number, type and size of items and the destination.
  - .4 For each material land filled or incinerated from project, include amount of material and identity of landfill, incinerator or transfer station.

1.5 WASTE REDUCTION WORKPLAN (WRW)

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

- .8 Monitor and report on waste reduction by documenting total volume and cost of actual waste removed from project.

#### 1.6 MATERIALS SOURCE SEPARATION PROGRAM (MSSP)

- .1 Prepare MSSP and have ready for use prior to project start-up.
- .2 Implement MSSP for waste generated on project in compliance with approved methods and as reviewed by Engineer.
- .3 Provide on-site facilities for collection, handling, and storage of anticipated quantities of reusable and recyclable materials.
- .4 Provide containers to deposit reusable and recyclable materials.
- .5 Locate containers in locations, to facilitate deposit of materials without hindering daily operations.
- .6 Locate separated materials in areas which minimize material damage.
- .7 Collect, handle, store on-site, and transport off-site, salvaged materials in separate condition.
  - .1 Transport to approved and authorized recycling facility to users of material for recycling.
- .8 Collect, handle, store on-site, and transport off-site, salvaged materials in combined condition.
  - .1 Ship materials to site operating under Certificate of Approval premises of Owner.
  - .2 Materials must be immediately separated into required categories for reuse or recycling.

#### 1.7 STORAGE, HANDLING AND PROTECTION

- .1 Store, materials to be reused, recycled and salvaged in locations as directed by Engineer.
- .2 Unless specified otherwise, materials for removal do not become Contractor's property.
- .3 Separate non-salvageable materials from salvaged items. Transport and deliver non-salvageable items to licensed disposal facility.
- .4 Protect structural components not removed for demolition from movement or damage.
- .5 Support affected structures. If safety of building is endangered, cease operations and immediately notify Engineer.
- .6 Protect surface drainage, mechanical and electrical from damage and blockage.
- .7 Separate and store materials produced during dismantling of structures in designated areas.
- .8 Prevent contamination of materials to be salvaged and recycled and handle materials in accordance with requirements for acceptance by designated facilities.
  - .1 On-site source separation is recommended.
  - .2 Remove co-mingled materials to off-site processing facility for separation.
  - .3 Provide waybills for separated materials.

1.8 DISPOSAL OF WASTES

- .1 Do not bury rubbish or waste materials.
- .2 Do not dispose of waste, volatile materials, mineral spirits ,oil or paint thinner into waterways, storm, or sanitary sewers.
- .3 Keep records of construction waste including:
  - .1 Number and size of bins.
  - .2 Waste type of each bin.
  - .3 Total tonnage generated.
  - .4 Tonnage reused or recycled.
  - .5 Reused or recycled waste destination.
- .4 Remove materials from deconstruction as deconstruction/disassembly Work progresses.
- .5 Prepare project summary to verify destination and quantities on a material-by-material basis as identified in pre-demolition material audit.

1.9 USE OF SITE AND FACILITIES

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

1.10 SCHEDULING

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

PART 2 - PRODUCTS

2.1 NOT USED

- .1 Not Used.

PART 3 - EXECUTION

3.1 APPLICATION

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

3.2 CLEANING

---

- .1 Remove tools and waste materials on completion of Work, and leave work area in clean and orderly condition.
- .2 Clean-up work area as work progresses.
- .3 Source separate materials to be reused/recycled into specified sort areas.

### 3.3 DIVERSION OF MATERIALS

- .1 From following list, separate materials from general waste stream and stockpile in separate piles or containers, as reviewed by Engineer, and consistent with applicable fire regulations.
  - .1 Mark containers or stockpile areas.
  - .2 Provide instruction on disposal practices.
- .2 On-site sale of salvaged, recovered, reusable, recyclable materials is not permitted.
- .3 Demolition Waste:

Material Type	% Recommended Diversion	Actual Diversion %
Electrical Equipment	80	
Mechanical Equipment	100	
Metals	100	
Wood (uncontaminated)	100	

- .4 Construction Waste:

Material Type	%Recommended Diversion	Actual Diversion %
Cardboard	100	
Plastic Packaging	100	
Rubble	100	
Steel	100	
Wood (uncontaminated)	100	

### 3.4 CANADIAN GOVERNMENTAL DEPARTMENTS CHIEF RESPONSIBILITY FOR THE ENVIRONMENT

- .1 Ontario Ministry of the Environment and Energy
- .2 <http://www.energy.gov.on.ca/en/renewable-energy-facilitation-office/resources-and-acts-2/>

END



## PART 1 - GENERAL

### 1.1 ADMINISTRATIVE REQUIREMENTS

- .1 Acceptance of Work Procedures:
  - .1 Contractor's Inspection: Contractor: conduct inspection of Work, identify deficiencies and defects, and repair as required to conform to Contract Documents.
    - .1 Notify Engineer in writing of satisfactory completion of Contractor's inspection and submit verification that corrections have been made.
    - .2 Request Engineer's inspection.
  - .2 Engineer's Inspection:
    - .1 Engineer and Contractor to inspect Work and identify defects and deficiencies.
    - .2 Contractor to correct Work as directed.
  - .3 Completion Tasks: submit written certificates in English that tasks have been performed as follows:
    - .1 Work: completed and inspected for compliance with Contract Documents.
    - .2 Defects: corrected and deficiencies completed.
    - .3 Equipment and systems: tested, adjusted and balanced and fully operational.
    - .4 Certificates required by Fire Commissioner Utility companies: submitted.
    - .5 Operation and Maintenance manuals for Engineer's review and approval in accordance with 01 78 00 - Closeout Submittals: submitted.
    - .6 Operation of systems: demonstrated to Owner's personnel.
    - .7 Commissioning of mechanical systems: completed in accordance with 01 91 13 - General Commissioning (Cx) Requirements and copies of final Commissioning Report submitted to Engineer.
    - .8 Work: complete and ready for final inspection.
  - .4 Final Inspection:
    - .1 When completion tasks are done, request final inspection of Work by Engineer, and Contractor.
    - .2 When Work incomplete according to Owner and Engineer, complete outstanding items and request re-inspection.

### 1.2 FINAL CLEANING

- .1 Clean in accordance with Section 01 74 11 - Cleaning.
  - .1 Remove surplus materials, excess materials, rubbish, tools and equipment.
- .2 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

END OF SECTION

---

## PART 1 - GENERAL

### 1.1 ADMINISTRATIVE REQUIREMENTS

- .1 Pre-warranty Meeting:
  - .1 Convene meeting one week prior to contract completion with contractor's representative and Engineer, in accordance with Section 01 31 19 - Project Meetings to:
    - .1 Verify Project requirements.
    - .2 Review manufacturer's installation instructions and warranty requirements.
  - .2 Engineer to establish communication procedures for:
    - .1 Notifying construction warranty defects.
    - .2 Determine priorities for type of defects.
    - .3 Determine reasonable response time.
    - .3 Contact information for bonded and licensed company for warranty work action: provide name, telephone number and address of company authorized for construction warranty work action.
    - .4 Ensure contact is located within local service area of warranted construction, is continuously available, and is responsive to inquiries for warranty work action.

### 1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Two weeks prior to Substantial Performance of the Work, submit to the Engineer, four final copies of operating and maintenance manuals in English and French.
- .3 Provide spare parts, maintenance materials and special tools of same quality and manufacture as products provided in Work.
- .4 Provide evidence, if requested, for type, source and quality of products supplied.

### 1.3 FORMAT

- .1 Organize data as instructional manual.
  - .2 Binders: vinyl, hard covered, 3 'D' ring, loose leaf 219 x 279 mm with spine and face pockets.
  - .3 When multiple binders are used correlate data into related consistent groupings.
    - .1 Identify contents of each binder on spine.
  - .4 Cover: identify each binder with type or printed title 'Project Record Documents'; list title of project and identify subject matter of contents.
  - .5 Arrange content by systems, under Section numbers and sequence of Table of Contents.
  - .6 Provide tabbed fly leaf for each separate product and system, with typed description of product and major component parts of equipment.
  - .7 Text: manufacturer's printed data, or typewritten data.
  - .8 Drawings: provide with reinforced punched binder tab.
    - .1 Bind in with text; fold larger drawings to size of text pages.
-

- .9 Provide 1:1 scaled CAD files in dwg format on CD.

#### 1.4 CONTENTS - PROJECT RECORD DOCUMENTS

- .1 Table of Contents for Each Volume: provide title of project;
  - .1 Date of submission; names.
  - .2 Addresses and telephone numbers of Engineer and Contractor with name of responsible parties.
  - .3 Schedule of products and systems, indexed to content of volume.
- .2 For each product or system:
  - .1 List names, addresses and telephone numbers of subcontractors and suppliers, including local source of supplies and replacement parts.
  - .2 Warranty letters
  - .3 Provide recommended spare parts and list of all maintenance materials.
  - .4 Provide maintenance Schedule for all equipment, guidelines of maintenance services and troubleshooting procedures in table format.
  - .5 Provide applicable MSDS and WHMIS information, as required.
  - .6 In the case of multiple models of similar equipment, indicate the type of equipment installed.
  - .7 Include mechanical & electrical as-built drawings. All changes to be marked in red.
- .3 Product Data: mark each sheet to identify specific products and component parts, and data applicable to installation; delete inapplicable information.
- .4 Drawings: supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams.
- .5 Typewritten Text: as required to supplement product data.
  - .1 Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions specified in Section 01 45 00 - Quality Control.
- .6 Training: refer to Section 01 79 00 - Demonstration and Training.

#### 1.5 RECORD DOCUMENTS AND SAMPLES

- .1 Maintain, in addition to requirements in General Conditions, at site for Engineer and Owner one record copy of:
    - .1 Contract Drawings.
    - .2 Specifications.
    - .3 Addenda.
    - .4 Change Orders and other modifications to Contract.
    - .5 Reviewed shop drawings, product data, and samples.
    - .6 Field test records.
    - .7 Inspection certificates.
    - .8 Manufacturer's certificates.
  - .2 Store record documents and samples in field office apart from documents used for construction.
    - .1 Provide files, racks, and secure storage.
-

- .3 Label record documents and file in accordance with Section number listings in List of Contents of this Project Manual.
  - .1 Label each document "PROJECT RECORD" in neat, large, printed letters.
- .4 Maintain record documents in clean, dry and legible condition.
  - .1 Do not use record documents for construction purposes.
- .5 Keep record documents and samples available for inspection by Engineer.

#### 1.6 RECORDING INFORMATION ON PROJECT RECORD DOCUMENTS

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

#### 1.7 EQUIPMENT AND SYSTEMS

- .1 For each item of equipment and each system include description of unit or system, and component parts.
    - .1 Give function, normal operation characteristics and limiting conditions.
    - .2 Include performance curves, with engineering data and tests, and complete nomenclature and commercial number of replaceable parts.
  - .2 Panel board circuit directories: provide electrical service characteristics, controls, and communications.
  - .3 Include installed colour coded wiring diagrams.
-

- .4 Operating Procedures: include start-up, break-in, and routine normal operating instructions and sequences.
  - .1 Include regulation, control, stopping, shut-down, and emergency instructions.
  - .2 Include summer, winter, and any special operating instructions.
- .5 Maintenance Requirements: include routine procedures and guide for trouble-shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.
- .6 Provide servicing and lubrication schedule, and list of lubricants required.
- .7 Include manufacturer's printed operation and maintenance instructions.
- .8 Include sequence of operation by controls manufacturer.
- .9 Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.
- .10 Provide installed control diagrams by controls manufacturer.
- .11 Provide Contractor's co-ordination drawings, with installed colour coded piping diagrams.
- .12 Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.
- .13 Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.
- .14 Include test and balancing reports as specified in Section 01 45 00 - Quality Control and 01 91 13 - General Commissioning (Cx) Requirements.
- .15 Additional requirements: as specified in individual specification sections.

#### 1.8 MATERIALS AND FINISHES

- .1 Building products, applied materials, and finishes: include product data, with catalogue number, size, composition, and colour and texture designations.
  - .1 Provide information for re-ordering custom manufactured products.
- .2 Instructions for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.
- .3 Moisture-protection and weather-exposed products: include manufacturer's recommendations for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.
- .4 Additional requirements: as specified in individual specifications sections.

#### 1.9 MAINTENANCE MATERIALS

- .1 Spare Parts:
    - .1 Provide spare parts, in quantities specified in individual specification sections.
    - .2 Provide items of same manufacture and quality as items in Work.
-

- .3 Deliver to site in location as directed; place and store.
  - .4 Receive and catalogue items.
  - .1 Submit inventory listing to Engineer.
  - .2 Include approved listings in Maintenance Manual.
  - .5 Obtain receipt for delivered products and submit prior to final payment.
- 
- .2 Extra Stock Materials:
    - .1 Provide maintenance and extra materials, in quantities specified in individual specification sections.
    - .2 Provide items of same manufacture and quality as items in Work.
    - .3 Deliver to site in location as directed; place and store.
    - .4 Receive and catalogue items.
  - .1 Submit inventory listing to Engineer.
  - .2 Include approved listings in Maintenance Manual.
  - .5 Obtain receipt for delivered products and submit prior to final payment.
- 
- .3 Special Tools:
    - .1 Provide special tools, in quantities specified in individual specification section.
    - .2 Provide items with tags identifying their associated function and equipment.
    - .3 Deliver to site in location as directed; place and store.
    - .4 Receive and catalogue items.
  - .1 Submit inventory listing to Engineer.
  - .2 Include approved listings in Maintenance Manual.

#### 1.10 DELIVERY, STORAGE AND HANDLING

- .1 Store spare parts, maintenance materials, and special tools in manner to prevent damage or deterioration.
- .2 Store in original and undamaged condition with manufacturer's seal and labels intact.
- .3 Store components subject to damage from weather in weatherproof enclosures.
- .4 Store paints and freezable materials in a heated and ventilated room.
- .5 Remove and replace damaged products at own expense and for review by Engineer.

#### 1.11 WARRANTIES AND BONDS

- .1 Develop warranty management plan to contain information relevant to Warranties.
  - .2 Submit warranty management plan, 30 days before planned pre-warranty conference, to Engineer approval.
  - .3 Warranty management plan to include required actions and documents to assure that Engineer receives warranties to which it is entitled.
  - .4 Provide plan in narrative form and contain sufficient detail to make it suitable for use by future maintenance and repair personnel.
  - .5 Submit, warranty information made available during construction phase, to Engineer for approval prior to each monthly pay estimate.
-

- .6 Warranty period shall start following the completion of all deficiencies, the review of the Operation & Maintenance Manuals by the Engineer and the personnel training has taken place; all in accordance with section 01 79 00 - Demonstration & Training.
- .7 Assemble approved information in binder, submit upon acceptance of work and organize binder as follows:
  - .1 Separate each warranty or bond with index tab sheets keyed to Table of Contents listing.
  - .2 List subcontractor, supplier, and manufacturer, with name, address, and telephone number of responsible principal.
  - .3 Obtain warranties and bonds, executed in duplicate by subcontractors, suppliers, and manufacturers, within ten days after completion of applicable item of work.
  - .4 Verify that documents are in proper form, contain full information, and are notarized.
  - .5 Co-execute submittals when required.
  - .6 Retain warranties and bonds until time specified for submittal.
- .8 Except for items put into use with Owner's permission, leave date of beginning of time of warranty until Date of Substantial Performance is determined.
- .9 Conduct joint 4 month and 9 month warranty inspection, measured from time of acceptance, by Engineer.
- .10 Include information contained in warranty management plan as follows:
  - .1 Roles and responsibilities of personnel associated with warranty process, including points of contact and telephone numbers within the organizations of Contractors, subcontractors, manufacturers or suppliers involved.
  - .2 Listing and status of delivery of Certificates of Warranty for extended warranty items, to include commissioned systems such as fire protection, alarm systems, sprinkler systems, lightning protection systems,.
  - .3 Provide list for each warranted equipment, item, feature of construction or system indicating:
    - .1 Name of item.
    - .2 Model and serial numbers.
    - .3 Location where installed.
    - .4 Name and phone numbers of manufacturers or suppliers.
    - .5 Names, addresses and telephone numbers of sources of spare parts.
    - .6 Warranties and terms of warranty: include one-year overall warranty of construction. Indicate items that have extended warranties and show separate warranty expiration dates.
    - .7 Cross-reference to warranty certificates as applicable.
    - .8 Starting point and duration of warranty period.
    - .9 Summary of maintenance procedures required to continue warranty in force.
    - .10 Cross-Reference to specific pertinent Operation and Maintenance manuals.
    - .11 Organization, names and phone numbers of persons to call for warranty service.
    - .12 Typical response time and repair time expected for various warranted equipment.
  - .4 Contractor's plans for attendance at 4 and 9 month post-construction warranty inspections.
  - .5 Procedure and status of tagging of equipment covered by extended warranties.
  - .6 Post copies of instructions near selected pieces of equipment where operation is critical for warranty and/or safety reasons.
- .11 Respond in timely manner to oral or written notification of required construction warranty repair work.

- .12 Written verification to follow oral instructions.
  - .1 Failure to respond will be cause for the Engineer to proceed with action against Contractor.

#### 1.12 WARRANTY TAGS

- .1 Tag, at time of installation, each warranted item. Provide durable, oil and water resistant tag approved by Engineer.
- .2 Attach tags with copper wire and spray with waterproof silicone coating.
- .3 Leave date of acceptance until project is accepted for occupancy.
- .4 Indicate following information on tag:
  - .1 Type of product/material.
  - .2 Model number.
  - .3 Serial number.
  - .4 Contract number.
  - .5 Warranty period.
  - .6 Inspector's signature.
  - .7 Construction Contractor.

#### PART 2 - PRODUCTS

##### 2.1 NOT USED

- .1 Not Used.

#### PART 3 - EXECUTION

##### 3.1 NOT USED

- .1 Not Used.

END OF SECTION

---



## PART 1 - GENERAL

### 1.1 ADMINISTRATIVE REQUIREMENTS

- .1 Demonstrate scheduled operation and maintenance of equipment and systems to Owner's personnel two weeks prior to date of interim completion.
- .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 individual Sections.
  - .4 Ensure testing, adjusting, and balancing have been performed in accordance with 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 at scheduled agreed upon times, at the equipment location.
  - .2 Instruct personnel in phases of operation and maintenance using operation and maintenance manuals as basis of instruction.
  - .3 Review contents of manual in detail to explain aspects of operation and maintenance.
  - .4 Prepare and insert additional data in operations and maintenance manuals when needed during instructions.

### 1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

### 1.3 QUALITY ASSURANCE

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

**PART 2 - PRODUCTS**

2.1 NOT USED

.1 Not Used.

**PART 3 - EXECUTION**

3.1 NOT USED

.1 Not Used.

END OF SECTION

---

## PART 1 - GENERAL

### 1.1 SUMMARY

- .1 Section Includes:
  - .1 General requirements relating to commissioning of project's components and systems, specifying general requirements to PV of components, equipment, sub-systems, systems, and integrated systems.
- .2 Related Requirements
  - .1 Section 01 77 00 Closeout Procedures.
  - .2 Section 01 79 00 Demonstration and Training.
- .3 Acronyms:
  - .1 AFD - Alternate Forms of Delivery, service provider.
  - .2 BMM - Building Management Manual.
  - .3 Cx - Commissioning.
  - .4 EMCS - Energy Monitoring and Control Systems.
  - .5 O&M - Operation and Maintenance.
  - .6 PI - Product Information.
  - .7 PV - Performance Verification.
  - .8 TAB - Testing, Adjusting and Balancing.

### 1.2 GENERAL

- .1 Cx is a planned program of tests, procedures and checks carried out systematically on systems and integrated systems of the finished Project. Cx is performed after systems and integrated systems are completely installed, functional and Contractor's Performance Verification responsibilities have been completed and approved. Objectives:
  - .1 Verify installed equipment, systems and integrated systems operate in accordance with contract documents and design criteria and intent.
  - .2 Ensure appropriate documentation is compiled into the BMM.
  - .3 Effectively train O&M staff.
- .2 Contractor assists in Cx process, operating equipment and systems, troubleshooting and making adjustments as required.
  - .1 Systems to be operated at full capacity under various modes to determine if they function correctly and consistently at peak efficiency. Systems to be interactive 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.
- .4 AFD managed projects the term Engineer in Cx specifications to be interpreted as AFD Service Provider.

### 1.3 COMMISSIONING OVERVIEW

- .1 Section 01 91 31 - Commissioning (Cx) Plan.

- .2 For Cx responsibilities refer to Section 01 91 31 - Commissioning (Cx) Plan.
- .3 Cx to be a line item of Contractor's cost breakdown.
- .4 Cx activities supplement field quality and testing procedures described in relevant technical sections.
- .5 Cx is conducted in concert with activities performed during stage of project delivery. Cx identifies issues in Planning and Design stages which are addressed during Construction and Cx stages to ensure the built [facility] is constructed and proven to operate satisfactorily under weather, environmental and occupancy conditions to meet functional and operational requirements. Cx activities include transfer of critical knowledge to facility operational personnel.
- .6 Engineer and/or Consultant will issue Interim Acceptance Certificate when:
  - .1 Completed Cx documentation has been received, reviewed for suitability and approved by Engineer and/or Consultant.
  - .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 Engineer and Consultant, 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 Engineer and Consultant.
    - .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 Engineer and Consultant.
  - .7 Have Cx schedules up-to-date.
  - .8 Ensure systems have been cleaned thoroughly.
  - .9 Complete TAB procedures on systems, submit TAB reports to Engineer and Consultant for review and approval.
  - .10 Ensure "As-Built" system schematics are available.
- .4 Inform Engineer and Consultant in writing of discrepancies and deficiencies on finished works.

## 1.6 CONFLICTS

- .1 Report conflicts between requirements of this section and other sections to Engineer and Consultant 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 Engineer and Consultant for changes to submittals and obtain written approval at least 8 weeks prior to start of Cx.
  - .3 Submit proposed Cx procedures to Engineer where not specified and obtain written approval at least 8 weeks prior to start of Cx.
  - .4 Provide additional documentation relating to Cx process required by Engineer and Consultant.

## 1.8 COMMISSIONING DOCUMENTATION

- .1 Refer to Section [01 91 33 - Commissioning (Cx) Forms: Installation Check Lists and Product Information (PI) / Performance Verification (PV) Forms for requirements and instructions for use].
- .2 Engineer and Consultant to review and approve Cx documentation.
- .3 Provide completed and approved Cx documentation to Engineer.

## 1.9 COMMISSIONING SCHEDULE

- .1 Provide detailed Cx schedule as part of construction schedule.
- .2 Provide adequate time for Cx activities prescribed in technical sections and commissioning sections including:
  - .1 Approval of Cx reports.
  - .2 Verification of reported results.
  - .3 Repairs, retesting, re-commissioning, re-verification.
  - .4 Training.

## 1.10 COMMISSIONING MEETINGS

- .1 Convene Cx meetings following project meetings: as specified herein.

- .2 Purpose: to resolve issues, monitor progress, identify deficiencies, relating to Cx.
- .3 Continue Cx meetings on regular basis until commissioning deliverables have been addressed.
- .4 At 60% construction completion stage. Engineer 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 Engineer, 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 Engineer 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 Engineer.
  - .3 Arrange for Engineer to witness tests.
  - .4 Obtain written approval of test results and documentation from Engineer before delivery to site.
- .2 Obtain manufacturer's installation, start-up and operations instructions prior to start-up of components, equipment and systems and review with Engineer
  - .1 Compare completed installation with manufacturer's published data, record discrepancies, and review with manufacturer.
  - .2 Modify procedures detrimental to equipment performance and review same with manufacturer before start-up.
- .3 Integrity of warranties:
  - .1 Use manufacturer's trained start-up personnel where specified elsewhere in other divisions or required to maintain integrity of warranty.

- .2 Verify with manufacturer that testing as specified will not void warranties.
  - .4 Qualifications of manufacturer's personnel:
    - .1 Experienced in design, installation and operation of equipment and systems.
    - .2 Ability to interpret test results accurately.
    - .3 To report results in clear, concise, logical manner.
- 1.14 PROCEDURES
- .1 Verify that equipment and systems are complete, clean, and operating in normal and safe manner prior to conducting start-up, testing and Cx.
  - .2 Conduct start-up and testing in following distinct phases:
    - .1 Included in delivery and installation:
      - .1 Verification of conformity to specification, approved shop drawings and completion of PI report forms.
      - .2 Visual inspection of quality of installation.
    - .2 Start-up: follow accepted start-up procedures.
    - .3 Operational testing: document equipment performance.
    - .4 System PV: include repetition of tests after correcting deficiencies.
    - .5 Post-substantial performance verification: to include fine-tuning.
  - .3 Correct deficiencies and obtain approval from Engineer after distinct phases have been completed and before commencing next phase.
  - .4 Document required 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 Engineer. 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 Engineer.
    - .2 Major equipment/systems: if evaluation report concludes that damage is minor, implement corrective measures approved by Engineer.
    - .3 If evaluation report concludes that major damage has occurred, Engineer 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 Engineer 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 Engineer 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 to Engineer 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 Engineer 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 Engineer 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 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 Engineer 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 Engineer within 5 days of test and with Cx report.

#### 1.23 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 Engineer in accordance with equipment manufacturer's instructions, using manufacturer's data, with manufacturer's assistance and using approved formulae.

#### 1.24 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 Engineer.
- .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 Engineer.

#### 1.25 REPEAT VERIFICATIONS

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

#### 1.26 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.

#### 1.27 DEFICIENCIES, FAULTS, DEFECTS

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

#### 1.28 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 Engineer Consultant.

#### 1.29 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.

#### 1.30 TRAINING

- .1 In accordance with Section 01 79 00 - Demonstration and Training.

#### 1.31 MAINTENANCE MATERIALS, SPARE PARTS, SPECIAL TOOLS

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

#### 1.32 OCCUPANCY

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

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

#### 1.34 PERFORMANCE VERIFICATION TOLERANCES

- .1 Application tolerances:
- .2 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.

#### 1.35 OWNER'S PERFORMANCE TESTING

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

END OF SECTION

**Part 1 General**

**1.1 GENERAL**

- .1 Provide a fully functional system:
  - .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 design requirements.
  - .5 Produces a complete functional system prior to issuance of Certificate of Completion.
  - .6 Management tool that sets out scope, standards, roles and responsibilities, expectations, deliverables, and provides:
    - .1 Overview of Cx.
    - .2 General description of elements that make up Cx Plan.
    - .3 Process and methodology for successful Cx.
- .4 Acronyms:
  - .1 Cx - Commissioning.
  - .2 BMM - Building Management Manual.
  - .3 EMCS - Energy Monitoring and Control Systems.
  - .4 MSDS - Material Safety Data Sheets.
  - .5 PI - Product Information.
  - .6 PV - Performance Verification.
  - .7 TAB - Testing, Adjusting and Balancing.
  - .8 WHMIS - Workplace Hazardous Materials Information System.
- .5 Commissioning terms used in this Section:
  - .1 Bumping: short term start-up to prove ability to start and prove correct rotation.
  - .2 Deferred Cx - Cx activities delayed for reasons beyond Contractor's control due to lack of occupancy, weather conditions, need for heating/cooling loads.

**1.2 DEVELOPMENT OF 100% CX PLAN**

- .1 Cx Plan to be 100% completed by contractor within 8 weeks of award of contract to take into account:

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

### 1.3 REFINEMENT OF CX PLAN

- .1 During construction phase, revise, refine and update Cx Plan to include:
- .1 Changes resulting from Client program modifications.
  - .2 Approved design and construction changes.
- .2 Revise, refine and update every 6 weeks during construction phase. At each revision, indicate revision number and date.
- .3 Submit each revised Cx Plan to Engineer for review and obtain written approval.
- .4 Include testing parameters at full range of operating conditions and check responses of equipment and systems.

### 1.4 COMPOSITION, ROLES AND RESPONSIBILITIES OF CX TEAM

- .1 Engineer 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 Engineer is responsible for:
    - .1 Witnessing, certifying accuracy of reported results.
    - .2 Witnessing and certifying TAB and other tests.
    - .3 Ensuring implementation of final Cx Plan.
    - .4 Performing verification of performance of installed systems and equipment.
  - .2 Construction Team: contractor, sub-contractors, suppliers and support disciplines, is responsible for construction/installation in accordance with contract documents, including:
    - .1 Organizing Cx.
    - .2 Monitoring operations Cx activities.
    - .3 Testing.
    - .4 TAB.
    - .5 Performance of Cx activities.
    - .6 Delivery of training and Cx documentation.
    - .7 Assigning one person as point of contact with Consultant and Engineer for administrative and coordination purposes.
    - .8 Implementation of Training Plan.
  - .3 Contractor's Cx agent implements specified Cx activities including:
    - .1 Demonstrations.
    - .2 Training.
    - .3 Testing.
    - .4 Preparation, submission of test reports.

## 1.5 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 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 Changes to EMCS control strategies beyond level of training provided to O M personnel.
  - .6 Provide names of participants to Engineer and details of instruments and procedures to be followed for Cx 2 months prior to starting date of Cx for review and approval.

## 1.6 EXTENT OF CX

- .1 Plumbing systems:
  - .1 Sump pumps, complete with sump pits and controls.

## 1.7 DELIVERABLES RELATING TO O M PERSPECTIVES

- .1 General requirements:
  - .1 Compile English and 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 MSDS data sheets.
  - .7 Electrical Panel inventory containing detailed inventory of electrical circuitry for each panel board. Duplicate of inventory inside each panel.

## 1.8 DELIVERABLES RELATING TO THE CX PROCESS

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

## 1.9 PRE-CX ACTIVITIES AND RELATED DOCUMENTATION

- .1 Items listed in this Cx Plan include the following:
  - .1 Pre-Start-Up inspections: by Engineer prior to permission to start up and rectification of deficiencies to Engineer's satisfaction.
  - .2 Include completed documentation with Cx report.
  - .3 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 Engineer and does not form part of Cx specifications.
  - .4 Include completed documentation in Cx report.
- .2 Pre-Cx activities - MECHANICAL:
  - .1 Plumbing systems:
    - .1 "Bump" each item of equipment in its "stand-alone" mode.
    - .2 Complete pre-start-up checks and complete relevant documentation.
    - .3 After equipment has been started, test related systems in conjunction with control systems on a system-by-system basis.
  - .2 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 Engineer prior to start of Final Acceptance Test period.

#### 1.10 START-UP

- .1 Start-up components, equipment and systems.
- .2 Rectify start-up deficiencies to satisfaction of Engineer.
- .3 Performance Verification (PV):
  - .1 Approved Cx Agent provided by Contractor to perform.
    - .1 Repeat when necessary until results are acceptable to Engineer.
    - .2 Use procedures modified generic procedures to suit project requirements.
    - .3 Engineer to witness and certify reported results using approved PI and PV forms.
    - .4 Engineer to approve completed PV reports produced by Contractor.
    - .5 Engineer 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 start-up and testing.

#### 1.11 CX ACTIVITIES AND RELATED DOCUMENTATION

- .1 Perform Cx by specified Cx agency using procedures and PV forms developed by Contractor and approved by Engineer.
- .2 Upon satisfactory completion, Cx agency performing tests to prepare Cx Report using approved PV forms.
- .3 Engineer reserves right to verify a percentage of reported results at no cost to contract.

#### 1.12 INSTALLATION CHECK LISTS (ICL)

- .1 Installation Checklists to be prepared by Contractor and provided to Engineer for review and approval.

#### 1.13 PRODUCT INFORMATION (PI) REPORT FORMS

- .1 Product Information forms to be prepared by Contractor and provided to Engineer for review and approval.

#### 1.14 PERFORMANCE VERIFICATION (PV) REPORT

- .1 Performance Verification forms to be prepared by Contractor and provided to Engineer for review and approval.

#### 1.15 CX SCHEDULES

- .1 Prepare detailed critical path Cx Schedule and submit to Engineer for review and approval same time as project Construction Schedule. Include:
  - .1 Milestones, testing, documentation, training and Cx activities of components, equipment, subsystems, systems and integrated systems, including:
    - .1 Design criteria, design intents.
    - .2 Pre-TAB review: 28 days after contract award, and before construction starts.
    - .3 Cx agents' credentials: 30 days before start of Cx.
    - .4 Cx procedures: 2 months after award of contract.



- .5 Cx Report format: 1 month after contract award.
- .6 Submission of list of instrumentation with relevant certificates: 21 days before start of Cx.
- .7 Notification of intention to start Cx: 14 days before start of Cx.
- .8 Identification of deferred Cx.
- .9 Implementation of training plans.
- .10 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.
- .2 After approval, incorporate Cx Schedule into Construction Schedule.
- .3 Engineer, Contractor, Contractor's Cx agent, and Engineer will monitor progress of Cx against this schedule.
- 1.16 CX REPORTS**
  - .1 Submit reports of tests, witnessed and certified by Engineer 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 Engineer.
- 1.17 FINAL SETTINGS**
  - .1 Upon completion of Cx to satisfaction of Engineer lock control devices in their final positions, indelibly mark settings marked and include in Cx Reports.
- Part 2 Products**
- 2.1 NOT USED**
  - .1 Not Used.
- Part 3 Execution**
- 3.1 NOT USED**
  - .1 Not Used.

END OF SECTION

## PART 1 - GENERAL

### 1.1 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 new work and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop drawings:
  - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
  - .2 Drawings to show:
    - .1 Mounting arrangements.
    - .2 Operating and maintenance clearances.
  - .3 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 new work for incorporation into manual.
  - .1 Operation and maintenance manual approved by Consultants and Departmental Representative, 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.
  - .5 Approvals:
    - .1 Submit 2 copies of draft Operation and Maintenance Manual to Consultants and 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 white prints as required for each phase of work. Mark changes as work progresses and as changes occur. Include changes to existing mechanical systems, control systems and low voltage control wiring.
  - .2 Transfer information weekly to reproducibles, revising reproducibles to show work as actually installed.
  - .3 Use different colour waterproof ink for each service.
  - .4 Make available for reference purposes and inspection.
- .8 As-Built drawings:
  - .1 Prior to start of Testing, Adjusting and Balancing for HVAC, finalize production of as-built drawings.
  - .2 Identify each drawing in lower right hand corner in letters at least 12 mm high as follows: "AS BUILT DRAWINGS: THIS DRAWING HAS BEEN REVISED TO SHOW MECHANICAL SYSTEMS AS INSTALLED" (Signature of Contractor) (Date).
  - .3 Submit to Departmental Representative for approval and make corrections as directed.
  - .4 Perform testing, adjusting and balancing for HVAC using as-built drawings.
  - .5 Submit completed reproducible as-built drawings with Operating and Maintenance Manuals.
- .9 Submit copies of as-built drawings for inclusion in final TAB report.

### 1.3 MAINTENANCE MATERIAL SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Furnish spare parts as follows:
  - .1 One set of packing for each pump.
  - .2 One casing joint gasket for each size pump.
  - .3 One glass for each gauge glass.
- .3 Provide one set of special tools required to service equipment as recommended by manufacturers.
  - .1 Furnish one commercial quality grease gun, grease and adapters to suit different types of grease and grease fittings.

### 1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements 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 materials from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.
- .4 Develop Construction Waste Management Plan related to Work of this Section.
- .5 Packaging Waste Management: remove for reuse by manufacturer of pallets, crates, padding, and

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

## PART 2 - PRODUCTS

### 2.1 NOT USED

- .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 new work 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 PAINTING REPAIRS AND RESTORATION

- .1 Prime and touch up marred finished paintwork to match original.
- .2 Restore to new condition, finishes which have been damaged.

### 3.3 SYSTEM CLEANING

- .1 Clean interior and exterior of all systems including strainers.

### 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.
  - .1 Sump Pump flow and controls tests.
- .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 DEMONSTRATION

- .1 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.
- .2 Use operation and maintenance manual, as-built drawings, and audio visual aids as part of instruction materials.

- .3 Instruction duration time requirements as specified in appropriate sections.
- .4 Departmental Representative will record these demonstrations on video tape for future reference.

### 3.6 CLEANING

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

### 3.7 PROTECTION

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

**END OF SECTION**

## PART 1 - GENERAL

### 1.1 REFERENCES

- .1 National Fire Prevention Association (NFPA)
  - .1 NFPA 13-2013, Standard for the Installation of Sprinkler Systems.
  - .2 NFPA 25-2014, Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems.

### 1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Provide manufacturer's printed product literature and data sheets, and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
  - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
    - .1 Indicate:
      - .1 Materials.
      - .2 Finishes.
      - .3 Method of anchorage
      - .4 Number of anchors.
      - .5 Supports.
      - .6 Reinforcement.
      - .7 Assembly details.
      - .8 Accessories.
    - .2 Test reports:
      - .1 Submit certified test reports for wet pipe fire protection sprinkler systems from approved independent testing laboratories, indicating compliance with specifications for specified performance characteristics and physical properties.
    - .3 Certificates:
      - .1 Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
    - .4 Manufacturers' Instructions:
      - .1 Provide manufacturer's installation instructions.
    - .5 Field Quality Control Submittals:
      - .1 Manufacturer's Field Reports: manufacturer's field reports specified.

### 1.3 CLOSEOUT SUBMITTALS

- .1 Provide operation, maintenance and engineering data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.
  - .1 Manufacturer's Catalog Data, including specific model, type, and size for:
    - .1 Pipe and fittings.
    - .2 Valves, including gate, check, and globe.
    - .3 Pipe hangers and supports.
    - .4 Pressure or flow switch.
    - .5 Mechanical couplings.
  - .2 Field Test Reports:
    - .1 Preliminary tests on piping system.

- .3 Records:
  - .1 As-built drawings of each system.
    - .1 After completion, but before final acceptance, submit complete set of as-built drawings of each system for record purposes.
    - .2 Submit 760 mm by 1050 mm drawings on reproducible Mylar film with title block similar to full size contract drawings.
  - .4 Operation and Maintenance Manuals:
    - .1 Provide Contractor's Material and Test Certificate for aboveground piping and other documentation for incorporation into manual in accordance with NFPA 13.

#### 1.4 QUALITY ASSURANCE

- .1 Qualifications:
  - .1 Installer: company or person specializing in wet sprinkler systems with documented experience.
  - .2 Supply grooved joint couplings, fittings, valves, grooving tools and specialties from a single manufacturer. Use date stamped castings for coupling housings, fittings, valve bodies, for quality assurance and traceability.

#### 1.5 MAINTENANCE MATERIAL SUBMITTALS

- .1 Extra Materials:
  - .1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.
  - .2 Provide spare sprinklers and tools in accordance with NFPA 13.

#### 1.6 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements:
  - .1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
  - .2 Storage and Protection:
    - .1 Store materials indoors in dry location.
    - .2 Store and protect materials from exposure to harmful weather conditions and at temperature and humidity conditions recommended by manufacturer.
  - .3 Packaging Waste Management: remove for reuse by manufacturer of pallets, crates, padding, and packaging materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

## PART 2 - PRODUCTS

### 2.1 DESIGN REQUIREMENTS

- .1 Devices and equipment for fire protection service: ULC approved for use in wet pipe sprinkler systems.

### 2.2 ABOVE GROUND PIPING SYSTEMS

- .1 Provide fittings for changes in direction of piping and for connections.
  - .1 Make changes in piping sizes through tapered reducing pipe fittings, bushings will not be permitted.
  - .2 Perform welding in shop; field welding will not be permitted.

### 2.3 PIPE, FITTINGS AND VALVES

- .1 Pipe:
  - .1 Ferrous: to NFPA 13.
  - .2 Copper tube: to NFPA 13.
- .2 Fittings and joints to NFPA 13:
  - .1 Ferrous: screwed, welded, flanged or roll grooved.
    - .1 Grooved joints designed with two ductile iron housing segments, pressure responsive gasket, and zinc-electroplated steel bolts and nuts. Cast with offsetting angle-pattern bolt pads for rigidity and visual pad-to-pad offset contact.
  - .2 Copper tube: screwed, soldered, brazed, grooved.
  - .3 Plain-end fittings with mechanical couplings and fittings which use steel gripping devices to bite into pipe when pressure is applied will not be permitted.
  - .4 Rubber gasketed grooved-end pipe and fittings with mechanical couplings are permitted in pipe sizes 32 mm and larger.
  - .5 Fittings: ULC approved for use in wet pipe sprinkler systems.
  - .6 Ensure fittings, mechanical couplings, and rubber gaskets are supplied by same manufacturer.
  - .7 Side outlet tees using rubber gasketed fittings are not permitted.
  - .8 Sprinkler pipe and fittings: metal.
- .3 Valves:
  - .1 ULC listed for fire protection service.
  - .2 Gate valves: open by counterclockwise rotation.
- .4 Pipe hangers:
  - .1 ULC listed for fire protection services in accordance with NFPA.

### 2.4 INSPECTOR'S TEST CONNECTION

- .1 Locate inspector's test connection at hydraulically most remote part of each system, provide test connections approximately 3 m above floor for each sprinkler system or portion of each sprinkler system equipped with alarm device.
- .2 Provide test connection piping to location where discharge will be readily visible and where water may be discharged without property damage.



WET PIPE SPRINKLER SYSTEMS

- .3 Provide discharge orifice of same size as corresponding sprinkler orifice.

## 2.5 SIGNS

- .1 Attach properly lettered Bilingual and approved metal signs to each valve and alarm device to NFPA 13.
- .2 Permanently fix hydraulic design data nameplates to riser of each system.

## PART 3 - Execution

### 3.1 MANUFACTURER'S INSTRUCTIONS

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

### 3.2 INSTALLATION

- .1 Install, inspect and test to acceptance in accordance with NFPA 13 and NFPA 25.

### 3.3 PIPE INSTALLATION

- .1 Install piping straight and true to bear evenly on hangers and supports. Do not hang piping from plaster ceilings.
- .2 Keep interior and ends of new piping and existing piping thoroughly cleaned of water and foreign matter.
- .3 Keep piping systems clean during installation by means of plugs or other approved methods. When work is not in progress, securely close open ends of piping to prevent entry of water and foreign matter.
- .4 Inspect piping before placing into position.

### 3.4 DISINFECTION

- .1 Disinfect new piping and existing piping.
- .2 Fill piping systems with solution containing minimum of 50 parts per million of chlorine and allow solution to stand for minimum of 24 hours.
- .3 Flush solution from systems with clean water until maximum residual chlorine content is not greater than 0.2 part per million or residual chlorine content of domestic water supply.
- .4 Obtain at least two consecutive satisfactory bacteriological samples from piping, analyzed by certified laboratory, and submit results prior to piping being placed into service.

### 3.5 FIELD PAINTING

- .1 Clean, pretreat, prime, and paint new systems including valves, piping, conduit, hangers, supports, miscellaneous metalwork, and accessories.
- .2 Apply coatings to clean, dry surfaces, using clean brushes.
- .3 Clean surfaces to remove dust, dirt, rust, and loose mill scale.
- .4 Immediately after cleaning, provide metal surfaces with 1 coat of pretreatment primer applied to

minimum dry film thickness of 0.3 mil, and one coat of zinc chromate primer applied to minimum dry film thickness of 1.0 mil.

.5 Provide primed surfaces with following:

.1 Piping in Finished Areas:

- .1 Provide primed surfaces with 2 coats of paint to match adjacent surfaces.
- .2 Provide valves and operating accessories with 1 coat of red alkyd gloss enamel applied to minimum dry film thickness of 1.0 mil.
- .3 Provide piping with 50 mm wide red enamel bands spaced at maximum of 6 m intervals throughout piping systems.

3.6 FIELD QUALITY CONTROL

.1 Site Test, Inspection:

- .1 Perform test to determine compliance with specified requirements in presence of Departmental Representative.
- .2 Test, inspect, and approve piping before covering or concealing.
- .3 Preliminary Tests:
  - .1 Hydrostatically test each system at 200 psig for a 2 hour period with no leakage or reduction in pressure.
  - .2 Flush piping with potable water in accordance with NFPA 13.
  - .3 Test alarms and other devices.
  - .4 Test water flow alarms by flowing water through inspector's test connection. When tests have been completed and corrections made, submit signed and dated certificate in accordance with NFPA 13.
- .4 Formal Tests and Inspections:
  - .1 Do not submit request for formal test and inspection until preliminary test and corrections are completed and approved.
  - .2 Submit written request for formal inspection at least 15 days prior to inspection date.
  - .3 Repeat required tests as directed.
  - .4 Correct defects and make additional tests until systems comply with contract requirements.
  - .5 Furnish appliances, equipment, instruments, connecting devices, and personnel for tests.
  - .6 Authority of Jurisdiction will witness formal tests and approve systems before they are accepted.
- .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 Schedule site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.

3.7 CLEANING

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

- .1 Remove surplus materials, excess materials, rubbish, tools and equipment.
- .2 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

END OF SECTION

## PART 1 - GENERAL

### 1.1 REFERENCES

- .1 American National Standards Institute (ANSI)/American Society of Mechanical Engineers (ASME)
  - .1 ANSI/ASME B1.20.1-2013, Pipe Threads, General Purpose (Inch).
  - .2 ANSI/ASME B16.18-2012, Cast Copper Alloy Solder Joint Pressure Fittings.
- .2 ASTM International
  - .1 ASTM A49-12, Standard Specification for Heat-Treated Carbon Steel Joint Bars.
  - .2 ASTM A126-04(2014), Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
  - .3 ASTM A182/A182M-14b, Standard Specification for Specification for Forged or Rolled Alloy and Stainless Steel Pipe Flanges, Forged Fittings, and Valve Parts for High Temperature Service.
  - .4 ASTM A193/A193M-14a, Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature or High Pressure Service and Other Special Purpose Applications.
  - .5 ASTM A194/A194M-14a, Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High-Pressure and High-Temperature Service, or Both.
  - .6 ASTM A216/A216M-14, Standard Specification for Steel Castings, Carbon Suitable for Fusion Welding for High-Temperature Service.
  - .7 ASTM B62-09, Standard Specification for Composition Bronze or Ounce Metal Castings.
  - .8 ASTM B85/B85M-14, Standard Specification for Aluminum-Alloy Die Castings.
  - .9 ASTM B209-14, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
  - .10 ASTM B283-14a, Standard Specification for Copper and Copper Alloy Die Forgings (Hot-Pressed).
- .3 Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS)
  - .1 MSS SP-25-2008, Standard Marking System for Valves, Fittings, Flanges and Unions.
  - .2 MSS SP-61-2009, Pressure Testing of Valves.
  - .3 MSS SP-70-06, Grey Iron Gate Valves, Flanged and Threaded Ends.
  - .4 MSS SP-71-05, Grey Iron Swing Check Valves, Flanged and Threaded Ends.
  - .5 MSS-SP-80-2008, Bronze Gate Globe, Angle and Check Valves.
  - .6 MSS SP-82-1992, Valve Pressure Testing Methods.

### 1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Provide manufacturer's printed product literature and data sheets for equipment and systems and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
  - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
  - .2 Submit data for valves specified in this Section.

### 1.3 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for valves for incorporation into manual.
- 1.4 MAINTENANCE MATERIAL SUBMITTALS
  - .1 Extra Materials/Spare Parts:
    - .1 Furnish following spare parts:
      - .1 Valve seats: one for every 10 valves each size, minimum 1.
      - .2 Discs: one for every 10 valves, each size. Minimum 1.
      - .3 Stem packing: one for every 10 valves, each size. Minimum 1.
      - .4 Valve handles: 2 of each size.
      - .5 Gaskets for flanges: one for every 10 flanged joints.
- 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, 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 valves from nicks, scratches, and blemishes.
    - .3 Replace defective or damaged materials with new.
  - .4 Develop Construction Waste Management Plan related to Work of this Section.
  - .5 Packaging Waste Management: remove for reuse by manufacturer of pallets, crates, padding, and packaging materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

## PART 2 - PRODUCTS

### 2.1 VALVES - BRONZE

- .1 Valves:
  - .1 Except for specialty valves, to be single manufacturer.
  - .2 Products to have CRN registration numbers.
- .2 End Connections:
  - .1 Connection into adjacent piping/tubing:
    - .1 Steel pipe systems: screwed ends to ANSI/ASME B1.20.1.
    - .2 Copper tube systems: solder ends to ANSI/ASME B16.18.
- .3 Gate Valves:
  - .1 Requirements common to gate valves, unless specified otherwise:
    - .1 Standard specification: MSS SP-80.
    - .2 Bonnet: union with hexagonal shoulders.
    - .3 Connections: screwed with hexagonal shoulders.

- .4 Inspection and pressure testing: to MSS SP-80. Tests to be hydrostatic.
- .5 Packing: non-asbestos.
- .6 Handwheel: non-ferrous.
- .7 Handwheel Nut: bronze to ASTM B62.
- .2 NPS 2 and under, non-rising stem, solid wedge disc, Class 125
  - .1 Body: with long disc guides, screwed bonnet with stem retaining nut.
  - .2 Operator: handwheel.
- .3 NPS 2 and under, non-rising stem, solid wedge disc, Class 150:
  - .1 Body: with long disc guides, screwed bonnet with stem retaining nut.
  - .2 Operator: handwheel.
- .4 NPS 2 and under, rising stem, split wedge disc, Class 125:
  - .1 Body: with long disc guides, screwed bonnet.
  - .2 Disc: split wedge, bronze to ASTM B283, loosely secured to stem.
  - .3 Operator: handwheel.
- .5 NPS 2 and under, rising stem, solid wedge disc, Class 125:
  - .1 Body: with long disc guides, screwed bonnet.
  - .2 Operator: handwheel.
- .6 NPS 2 and under, rising stem, solid wedge disc, Class 150:
  - .1 Body: with long disc guides, screwed bonnet.
  - .2 Operator: handwheel.
- .4 Check Valves:
  - .1 Requirements common to check valves, unless specified otherwise:
    - .1 Standard specification: MSS SP-80.
    - .2 Connections: screwed with hexagonal shoulders.
  - .2 NPS 2 and under, swing type, bronze disc, Class 125:
    - .1 Body: Y-pattern with integral seat at 45 degrees, screw-in cap with hex head.
    - .2 Disc and seat: renewable rotating disc, two-piece hinge disc construction; seat: regrindable.
  - .3 NPS 2 and under, swing type, bronze disc:
    - .1 Body: Y-pattern with integral seat at 45 degrees, screw-in cap with hex head.
    - .2 Disc and seat: renewable rotating disc, two-piece hinge disc construction; seat: regrindable.
  - .4 NPS 2 and under, swing type, composition disc, Class 200:
    - .1 Body: Y-pattern with integral seat at 45 degrees, screw-in cap with hex head.
    - .2 Disc: renewable rotating disc of number 6 composition to suit service conditions, bronze two-piece hinge disc construction.
  - .5 NPS 2 and under, horizontal lift type, composition disc, Class 150:
    - .1 Body: with integral seat, union bonnet ring with hex shoulders, cap.
    - .2 Disc: renewable no. 6 composition rotating disc in disc holder having guides top and bottom, of bronze to ASTM B62.
  - .6 NPS 2 and under, vertical lift type, bronze disc, Class 125:
    - .1 Disc: rotating disc having guides top and bottom, disc guides, retaining rings.
- .5 Silent Check Valves:
  - .1 NPS 2 and under:
    - .1 Body: cast high tensile bronze to ASTM B62 with integral seat.
    - .2 Pressure rating: Class 125.
    - .3 Connections: screwed ends to ANSI B1.20.1 and with hex. shoulders.
    - .4 Disc and seat: renewable rotating disc.
    - .5 Stainless steel spring, heavy duty.
    - .6 Seat: regrindable.

## 2.2 VALVES - CAST IRON

- .1 Valves:
  - .1 Except for specialty valves, to be of single manufacturer.
- .2 Standard specifications:
  - .1 Gate valves: MSS SP-70.
  - .2 Check valves: MSS SP-71.
- .3 Requirements common to valves, unless specified otherwise:
  - .1 Body, bonnet: cast iron to ASTM B209 Class B.
  - .2 Connections: flanged ends plain face to ANSI B16.1.
  - .3 Inspection and pressure testing: to MSS SP-82.
  - .4 Bonnet gasket: non-asbestos.
  - .5 Stem: to have precision-machined Acme or 60 degrees V threads, top screwed for handwheel nut.
  - .6 Stuffing box: non-galling two-piece ball-jointed packing gland, gland bolts and nuts.
  - .7 Gland packing: non-asbestos.
  - .8 Handwheel: die-cast aluminum alloy to ASTM B85/B85M or malleable iron to ASTM A49. Nut of bronze to ASTM B62.
  - .9 Identification tag: with catalogue number, size, other pertinent data.
- .4 All products to have CRN registration numbers.
- .5 Gate Valves
  - .1 NPS 2 1/2 - 8, non-rising stem, inside screw, bronze trim, solid wedge disc:
    - .1 Body and multiple-bolted bonnet: with bosses in body and bonnet for taps and drains, full length disc guides designed to ensure correct re-assembly, Class 125.
    - .2 Disc: solid offset taper wedge, bronze to ASTM B62.
    - .3 Seat rings: renewable bronze to ASTM B62, screwed into body.
    - .4 Stem: bronze to ASTM B62.
    - .5 Disc: solid offset taper wedge, cast iron to ASTM A126 Class B, secured to wrought steel stem.
    - .6 Seat: integral with body.
    - .7 Stem: wrought steel.
    - .8 Operator: handwheel.
  - .2 NPS 2 1/2-8, outside screw and yoke (OS Y), bronze trim, solid wedge disc:
    - .1 Body and multiple-bolted bonnet: with bosses in body and bonnet for taps and drains, full length disc guides designed to ensure correct re-assembly, yoke, yoke hub, yoke sleeve and nut. Class 125.
    - .2 Disc: solid offset taper wedge, bronze to ASTM B62 up to NPS 3, cast iron with bronze disc rings on other sizes, secured to stem through integral forged T-head disc-stem connection.
    - .3 Seat rings: renewable bronze screwed into body.
    - .4 Stem: nickel-plated steel.
    - .5 Disc: solid offset taper all-cast iron, secured to stem through integral forged T-head disc-stem connection.
    - .6 Seat rings: integral with body.
    - .7 Stem: nickel-plated steel.
    - .8 Pressure-lubricated operating mechanism.
    - .9 Operator: handwheel.
- .6 Check Valves
  - .1 Swing check valves, Class 125:

- .1 Body and bolted cover: with tapped and plugged opening on each side for hinge pin. Grooved or flanged ends: plain faced with smooth finish.
- .2 Up to NPS 16: cast iron to ASTM A126 Class B.
- .3 Disc: rotating for extended life.
- .4 Up to NPS 6: bronze to ASTM B62.
- .5 Seat rings: renewable bronze to ASTM B62 screwed into body.
- .6 Hinge pin, bushings: renewable bronze to ASTM B62.
- .7 Disc: A126 Class B, secured to stem, rotating for extended life.
- .8 Seat: cast iron, integral with body.
- .9 Hinge pin: exelloy; bushings: malleable iron.
- .10 Identification tag: fastened to cover.
- .11 Hinge: stainless steel.

.7 Silent Check Valves

- .1 Construction:
  - .1 Body: malleable iron with integral seat.
  - .2 Pressure rating: Class 125.
  - .3 Connections: grooved ends.
  - .4 Disc: bronze renewable rotating disc.
  - .5 Seat: renewable, EPDM.
  - .6 Stainless steel spring, heavy duty.

2.3 VALVES - CAST STEEL

.1 Valves:

- .1 To be of single manufacturer.
- .2 Test valves individually.

.2 Requirements common to valves, unless specified otherwise:

- .1 Pressure-temperature ratings: to ANSI B16.34.
- .2 Inspections and tests: to API 598.
- .3 Pressure testing: to MSS SP-61.
- .4 Flanged valves:
  - .1 Face-to-face dimensions: to ANSI B16.10.
  - .2 Flange dimensions: to ANSI B16.5 with 1.6 mm raised face.
- .5 Handwheel: non-heating type with raised rim of die-cast aluminum alloy to ASTM B85 or malleable iron to ASTM A49.
- .6 Markings: to MSS SP-25.
- .7 Identification:
  - .1 Plate showing catalogue number, size, material of body disc, stem seat, fluid, pressure-temperature rating.
  - .2 Body markings: manufacturer, size, primary service rating, material symbol.
- .8 CRN registration number required for all products.

.3 Gate Valves

- .1 NPS 2 1/2 - 12, rising stem, OS Y, solid wedge disc, flanged ends, Class 150:
  - .1 Body and multiple-bolted integral yoke and bonnet: cast steel to ASTM A216/A216M WCB, with full length disc guides designed to ensure correct re-assembly.
  - .2 Body/bonnet joint: flat face with corrugated metallic gasket.
  - .3 Bonnet studs: to ASTM A193/A193M Type B7.
  - .4 Bonnet nuts: to ASTM A194/A194M Type 2H.
  - .5 Stuffing box: including non-galling two-piece ball jointed packing gland, with swing-type eye bolts and nuts.



- .6 Gland packing: containing corrosion inhibitor to prevent stem pitting.
  - .7 Yoke sleeve: Ni-Resist, minimum melting point above 954 degrees C.
  - .8 Hydraulic grease fitting: for lubrication of yoke sleeve bearing surfaces.
  - .9 Disc: with disc stem ring to connect to stem, guided throughout its travel.
    - .1 NPS 2 1/2 - 6: solid corrosion and heat resistant 13% chromium steel with minimum hardness of 350 HB.
    - .2 NPS 8 and larger: carbon steel faced with corrosion and heat resistant 13% chromium steel with minimum hardness of 350 HB.
  - .10 Seat ring: seamless carbon steel with hard-faced cobalt-chromium-tungsten alloy seating surface, slipped in, seal welded, ground to match disc.
  - .11 Stem: heat treated corrosion and heat resistant 13% chromium steel with accurately-cut precision-machined Acme or 60 degrees V threads, top screwed for handwheel nut, T-head disc-stem connection.
  - .12 Operator: Handwheel
- .4 Check Valves
- .1 NPS 2 1/2 and over, flanged ends, Class 150: swing check.
    - .1 Body and multiple-bolted cap: cast steel to ASTM A216/A216M WCB.
    - .2 Cap studs: to ASTM A193/A193M Type B7.
    - .3 Cap nuts: to ASTM A194/A194M Type 2H.
    - .4 Body/cap joint: male-female face with corrugated metallic gasket.
    - .5 Disc: heat treated corrosion and heat resistant 13% chromium steel.
    - .6 Seat rings: heat treated corrosion and heat resistant 13% chromium steel, slipped in, seal welded, ground to match disc.
    - .7 Hinge: ASTM A182/A182M.
    - .8 Hinge pin: ASTM A182/A182M.
    - .9 Hinge pin plugs: ASTM A182/A182M.
- .5 Silent Check Valves
- .1 Construction:
    - .1 Body: cast steel with integral seat.
    - .2 Pressure rating: Class 125.
    - .3 Connections: flanged ends.
    - .4 Double bronze disc with SS seat and stem. Renewable disc, seat, stem and spring. Spring rating must match system design for silent operation and installation.
    - .5 Stainless steel spring, heavy duty.
    - .6 Seat: regrindable.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for installation in accordance with manufacturer's written instructions.
  - .1 Visually inspect substrate in presence of 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 rising stem valves in upright position with stem above horizontal.

GENERAL DUTY VALVES FOR  
PLUMBING PIPING

---

- .2 Remove internal parts before soldering.
- .3 Install valves with unions at each piece of equipment arranged to allow servicing, maintenance, and equipment removal.

3.3 COMMISSIONING

- .1 As part of commissioning activities, develop schedule of valves and record thereon identifier, location, service, purchase order number and date, manufacturer, identification data specified above.

3.4 CLEANING

- .1 Clean in accordance with Section 01 74 11 - Cleaning.
  - .1 Remove surplus materials, excess materials, rubbish, tools and equipment.
- .2 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

3.5 PROTECTION

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

END OF SECTION

## PART 1 - GENERAL

### 1.1 REFERENCES

- .1 American Society of Mechanical Engineers (ASME)
  - .1 ASME B31.1-2012, Power Piping.
- .2 ASTM International
  - .1 ASTM A307-14, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
  - .2 ASTM A563-07a(2014), 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 SP58-2009, Pipe Hangers and Supports - Materials, Design and Manufacture.
  - .2 MSS SP69-2003, Pipe Hangers and Supports - Selection and Application.
- .5 Underwriter's Laboratories of Canada (ULC)

### 1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Provide manufacturer's printed product literature and data sheets for hangers and supports and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
  - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
  - .2 Submit shop drawings for:
    - .1 Bases, hangers and supports.
    - .2 Connections to equipment and structure.
- .4 Certificates:
  - .1 Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .5 Manufacturers' Instructions:
  - .1 Provide manufacturer's installation instructions.

### 1.3 CLOSEOUT SUBMITTALS

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

### 1.4 DELIVERY, STORAGE AND HANDLING

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

Requirements and with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements:

.1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

.3 Packaging Waste Management: remove for reuse by manufacturer of pallets, crates, padding, and packaging materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

## PART 2 - PRODUCTS

### 2.1 SYSTEM DESCRIPTION

.1 Design Requirements:

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

### 2.2 GENERAL

.1 Fabricate hangers, supports and sway braces in accordance with MSS SP58.

### 2.3 RISER CLAMPS

- .1 Steel or cast iron pipe: galvanized carbon steel to MSS SP58, type 42, UL listed, FM approved.
- .2 Copper pipe: carbon steel copper plated to MSS SP58, type 42.
- .3 Bolts: to ASTM A307.
- .4 Nuts: to ASTM A563.

### 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 EQUIPMENT ANCHOR BOLTS AND TEMPLATES

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

## 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 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.

### 3.3 HANGER SPACING

- .1 Plumbing piping: to Canadian Plumbing Code, Provincial Code, and authority having jurisdiction.

- .2 Fire protection: to applicable fire code.

### 3.4 HANGER INSTALLATION

- .1 Install hanger so that rod is vertical under operating conditions.

- .2 Adjust hangers to equalize load.

- .3 Support from structural members. Where structural bearing does not exist or inserts are not in suitable locations, provide supplementary structural steel members.

### 3.5 HORIZONTAL MOVEMENT

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

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

### 3.6 FINAL ADJUSTMENT

- .1 Adjust hangers and supports:

- .1 Ensure that rod is vertical under operating conditions.

- .2 Equalize loads.

- .2 Adjustable clevis:

- .1 Tighten hanger load nut securely to ensure proper hanger performance.

- .2 Tighten upper nut after adjustment.

- .3 C-clamps:

- .1 Follow manufacturer's recommended written instructions and torque values when tightening C-clamps to bottom flange of beam.

- .4 Beam clamps:

- .1 Hammer jaw firmly against underside of beam.

### 3.7 FIELD QUALITY CONTROL

#### .1 Manufacturer's Field Services:

- .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.
- .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
- .3 Schedule site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.

### 3.8 CLEANING

- .1 Clean in accordance with Section 01 74 11 - Cleaning.
  - .1 Remove surplus materials, excess materials, rubbish, tools and equipment.
- .2 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

END OF SECTION

## PART 1 - GENERAL

### 1.1 REFERENCES

- .1 Canadian General Standards Board (CGSB)
  - .1 CAN/CGSB-24.3-92, Identification of Piping Systems.
- .2 National Fire Protection Association (NFPA)
  - .1 NFPA 13-2013, Standard for the Installation of Sprinkler Systems.

### 1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Product Data:
  - .2 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
  - .3 Product data to include paint colour chips, other products specified in this section.
- .4 Samples:
  - .1 Submit samples in accordance with Section 01 33 00 - Submittal Procedures.
  - .2 Samples to include nameplates, labels, tags, lists of proposed legends.

### 1.3 QUALITY ASSURANCE

- .1 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Health and Safety:
  - .1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

### 1.4 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .3 Waste Management and Disposal:
  - .1 Packaging Waste Management: remove for reuse by manufacturer of pallets, crates, padding, and packaging materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
  - .2 Dispose of unused paint and coating material at official hazardous material collections site approved by Departmental Representative.
  - .3 Do not dispose of unused paint and coating material into sewer system, into streams, lakes, onto ground or in locations where it will pose health or environmental hazard.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURER'S EQUIPMENT NAMEPLATES

- .1 Metal or plastic laminate nameplate mechanically fastened to each piece of equipment by manufacturer.
- .2 Lettering and numbers raised or recessed.
- .3 Information to include, as appropriate:
  - .1 Equipment: manufacturer's name, model, size, serial number, capacity.
  - .2 Motor: voltage, Hz, phase, power factor, duty, frame size.
- .4 For submerged equipment, nameplates are to be securely fastened to nearby wall within easy access of associated equipment.

## 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 white anodized aluminum, 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.

## 2.3 EXISTING IDENTIFICATION SYSTEMS

- .1 Apply existing identification system to new work.
- .2 Where existing identification system does not cover for new work, use identification system specified this section.
- .3 Before starting work, obtain written approval of identification system from Departmental Representative.

## 2.4 PIPING SYSTEMS GOVERNED BY CODES



.1 Identification:

- .1 Sprinklers: to NFPA 13.

2.5 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
Storm water	Green	STORM
Sanitary	Green	SAN
Plumbing vent	Green	SAN. VENT
Sprinklers	Red	SPRINKLERS

## 2.6 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.

## 2.7 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.

## 2.8 CONTROLS COMPONENTS IDENTIFICATION

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

## 2.9 LANGUAGE

- .1 Identification in English and French.
- .2 Use one nameplate and label for both languages.

## PART 3 - EXECUTION

### 3.1 MANUFACTURER'S INSTRUCTIONS

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

### 3.2 INSTALLATION

- .1 Perform work in accordance with CAN/CGSB-24.3 except as specified otherwise.
- .2 Provide ULC and CSA registration plates as required by respective agency.

### 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 "S" hooks.

3.6 CLEANING

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

END OF SECTION

## PART 1 - GENERAL

### 1.1 REFERENCES

- .1 American Society for Testing and Materials International (ASTM)
  - .1 ASTM C335-10e1, Standard Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.
  - .2 ASTM C449/C449M-07(2013), Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.
  - .3 ASTM C547-12, Mineral Fiber Pipe Insulation.
- .2 Canadian General Standards Board (CGSB)
  - .1 CGSB 51-GP-52Ma-89, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
- .3 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (MSDS).
- .4 Manufacturer's Trade Associations
  - .1 Thermal Insulation Association of Canada (TIAC): National Insulation Standards (Revised 2004).
- .5 Underwriters' Laboratories of Canada (ULC)
  - .1 CAN/ULC-S102-10, Surface Burning Characteristics of Building Materials and Assemblies.
  - .2 CAN/ULC-S702-09, Thermal Insulation, Mineral Fibre, for Buildings
  - .3 CAN/ULC-S702.2-10, Thermal Insulation, Mineral Fibre, for Buildings, Part 2: Application Guidelines.

### 1.2 DEFINITIONS

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

### 1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.
    - .1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00 - Submittal Procedures.

- .3 Shop Drawings:
  - .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
    - .1 Shop drawings: submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
- .4 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.
  - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
  - .2 Instructions: submit manufacturer's installation instructions.

#### 1.4 QUALITY ASSURANCE

- .1 Qualifications:
- .2 Installer: specialist in performing work of this Section, and have at least 3 years successful experience in this size and type of project, qualified to standards of TIAC.
- .3 Health and Safety:
  - .1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

#### 1.5 DELIVERY, STORAGE AND HANDLING

- .1 Packing, shipping, handling and unloading:
  - .1 Deliver, store and handle in accordance with manufacturer's written instructions and Section 01 61 00 - Common Product Requirements.
  - .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
  - .3 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .2 Storage and Protection:
  - .1 Protect from weather, construction traffic.
  - .2 Protect against damage.
  - .3 Store at temperatures and conditions required by manufacturer.
- .3 Waste Management and Disposal:
  - .1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
  - .2 Place excess or unused insulation and insulation accessory materials in designated containers.
  - .3 Divert unused metal materials from landfill to metal recycling facility approved by Departmental Representative.
  - .4 Dispose of unused adhesive material at official hazardous material collections site approved by Departmental Representative.

## PART 2 - PRODUCTS

### 2.1 FIRE AND SMOKE RATING

- .1 In accordance with CAN/ULC-S102.

- .1 Maximum flame spread rating: 25.
- .2 Maximum smoke developed rating: 50.

## 2.2 INSULATION

- .1 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 C-2: mineral fibre blanket faced with factory applied vapour retarder jacket (as scheduled in PART 3 of this section).
  - .1 Mineral fibre: to CAN/ULC-S702, ASTM C547.
  - .2 Jacket: to CGSB 51-GP-52Ma.
  - .3 Maximum "k" factor: to CAN/ULC-S702, ASTM C547.

## 2.3 INSULATION SECUREMENT

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

- .1 Stainless steel:
  - .1 Type: 304.
  - .2 Thickness: 0.25 mm.
  - .3 Finish: stucco embossed.
  - .4 Joining: longitudinal and circumferential slip joints with 50 mm laps.
  - .5 Fittings: 0.5 mm thick die-shaped fitting covers with factory-attached protective liner.
  - .6 Metal jacket banding and mechanical seals: stainless steel, 19 mm wide, 0.5 mm thick at 300 mm spacing.

## 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 manufacturer's instructions and this specification.
  - .3 Use two layers with staggered joints when required nominal wall thickness exceeds 75 mm.
  - .4 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.
    - .1 Install hangers, supports outside vapour retarder jacket.
  - .5 Supports, Hangers:
    - .1 Apply high compressive strength insulation, suitable for service, at oversized saddles and shoes where insulation saddles have not been provided.
- 3.4 REMOVABLE, PRE-FABRICATED, INSULATION AND ENCLOSURES
  - .1 Application: at valves, flanges and unions at equipment.
  - .2 Design: to permit periodic removal and replacement without damage to adjacent insulation.
  - .3 Insulation:
    - .1 Insulation, fastenings and finishes: same as system.
    - .2 Jacket: SS.
- 3.5 PIPING INSULATION SCHEDULES
  - .1 Includes valves, valve bonnets, strainers, flanges and fittings unless otherwise specified.
  - .2 TIAC Code: C-2 with vapour retarder jacket.
    - .1 Insulation securements: tape, contact adhesive.
    - .2 Seals: lap seal adhesive, lagging adhesive.
    - .3 Installation: TIAC Code: 1501-C.
  - .3 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.

Application	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
Storm piping		C-2	25	25	25	25	25	25

.4 Finishes:

- .1 Exposed indoors: SS jacket.
- .2 Exposed in mechanical rooms: SS jacket.
- .3 Concealed, indoors: canvas on valves, fittings. No further finish.
- .4 Finish attachments: SS screws, at 150 mm on centre. Seals: closed.
- .5 Installation: to appropriate TIAC code CRF/1 through CPF/5.

3.6 CLEANING

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

END OF SECTION



## PART 1 - GENERAL

### 1.1 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's printed product literature, specifications and data sheet for fixtures and equipment.
- .3 Shop Drawings.
  - .1 Submit shop drawings to indicate:
    - .1 Equipment, including connections, fittings, control assemblies and ancillaries. Identify whether factory or field assembled.
    - .2 Wiring and schematic diagrams.
    - .3 Dimensions and recommended installation.
    - .4 Pump performance and efficiency curves.
- .4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .5 Instructions: submit manufacturer's installation instructions.
- .6 Manufacturers' Field Reports: manufacturers' field reports specified.
- .7 Closeout submittals: submit maintenance and engineering data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals, include:
  - .1 Manufacturers name, type, model year, capacity and serial number.
  - .2 Details of operation, servicing and maintenance.
  - .3 Recommended spare parts list with names and addresses.

### 1.2 QUALITY ASSURANCE

- .1 Pre-Installation Meeting:
  - .1 Convene pre-installation meeting one week prior to beginning work of this section to:
    - .1 Verify project requirements.
    - .2 Review installation and substrate conditions.
    - .3 Co-ordination with other building subtrades.
    - .4 Review manufacturer's installation instructions and warranty requirements.
- .2 Health and Safety:
  - .1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

### 1.3 DELIVERY, STORAGE AND HANDLING

- .1 Waste Management and Disposal:
  - .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
  - .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
  - .3 Collect and separate for disposal paper, plastic, polystyrene, and corrugated cardboard

PLUMBING PUMPS

- packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.
- .4 Divert unused metal materials from landfill to metal recycling facility as approved by Departmental Representative.
- .5 Unused sealant materials must not be disposed of into sewer system, into streams, lakes, onto ground or in other location where it will pose health or environmental hazard.
- .6 Fold up metal and plastic banding, flatten and place in designated area for recycling.

PART 2 - PRODUCTS

2.1 SUMP PUMP SUBMERSIBLE

- .1 Capacity: as indicated on drawings.
  - .1 Pump Design:
    - .1 The pump(s) shall be automatically and firmly connected to the discharge connection, guided by no less than two guide bars extending from the top of the station to the discharge connection. There shall be no need for personnel to enter the wet-well. Sealing of the pumping unit to the discharge connection shall be accomplished by a machined metal-to-metal, watertight contact. Sealing of the discharge interface with a diaphragm, O-ring or profile gasket will not be acceptable. No portion of the pump shall bear directly on the sump floor.
  - .2 Approvals:
    - .1 The pump/motor assembly shall have CSA approval as one unit, per CSA standard C22.2-108. Proof of this approval shall be submitted by the pump manufacturer with the approval drawings. An approval of the motor unit only will not be acceptable.
    - .2 The pump/motor unit is also approved by CSA for service in Class I, Division 2, Groups A, B, C or D hazardous locations.
  - .3 Pump Construction:
    - .1 Major pump components shall be of grey cast iron, ASTM A-48, Class 35B, with smooth surfaces devoid of blow holes or other irregularities. All exposed nuts or bolts shall be of AISI type 304 stainless steel. All metal surfaces coming into contact with the pumpage, other than stainless steel or brass, shall be protected by an approved, sewage resistant coating.
    - .2 Sealing design shall incorporate metal-to-metal contact between machined surfaces. Critical mating surfaces where watertight sealing is required shall be machined and fitted with Nitrile or Viton rubber O-rings. Fittings will be the result of controlled compression of rubber O-rings in two planes and O-ring contact of four sides without the requirement of a specific torque limit.
    - .3 Rectangular cross sectioned gaskets requiring specific torque limits to achieve compression shall not be considered as adequate or equal. No secondary sealing compounds, elliptical O-rings, grease or other devices shall be used.
  - .4 Motor:
    - .1 The pump motor shall be a NEMA-B design induction type with a squirrel cage rotor, shell type design and be housed in an air filled, watertight chamber. The stator windings and leads shall be insulated with moisture resistant Class H insulation rated for 180°C (356°F). The stator shall be trickle impregnated with Class H resin and shall be heat-shrink fitted into the stator housing providing for superior heat transfer. The use of pins, bolts, screws or other fastening devices used to locate or hold the stator and that penetrate the stator housing are not acceptable. The motor shall be designed for continuous duty while handling pumped media of up to 40°C

- (104°F). The motor shall be capable of withstanding at least 15 evenly spaced starts per hour. The rotor bars and short circuit rings shall be made of aluminium. Three thermal switches shall be embedded in the stator end coils, one per phase winding, to monitor the stator temperature. These thermal switches shall be used in conjunction with and supplemental to external motor overload protection and shall be connected to the motor control panel.
- .2 The motor service factor (combined effect of voltage, frequency and specific gravity) shall be 1.15. The motor shall have a voltage tolerance of +/- 10%. The motor shall be designed for continuous operation in up to a 40°C (104°F) ambient and shall have a NEMA Class B maximum operating temperature rise of 80°C (176°F). A motor performance chart shall be provided upon request exhibiting curves for motor torque, current, power factor, input/output kW and efficiency. The chart shall also include data on motor starting and no-load characteristics.
- .5 Cable Entry Seal:
- .1 The cable entry seal design shall preclude specific torque requirements to insure a watertight and submersible seal. The cable entry shall consist of a single, cylindrical elastomer grommet, flanked by washers, all having a close tolerance fit against the cable outside diameter and the entry inside diameter and compressed by the body containing a strain relief function, separate from the function of sealing the cable. The assembly shall provide ease of changing the cable when necessary using the same entry seal.
- .6 Cooling System:
- .1 Motors are sufficiently cooled by the surrounding environment or pumped media. A water cooling jacket is not required.
- .7 Volute:
- .1 Pump volute shall be single-piece grey cast iron, Class 35B, non-concentric design with smooth passages large enough to pass any solids that may enter the impeller. Minimum inlet and discharge size shall be as specified.
- .8 Impeller:
- .1 The impeller shall be of grey cast iron, Class 35B, dynamically balanced, double-shrouded non-clogging design having a long throughlet without acute turns. The impeller shall be capable of handling solids, fibrous materials, heavy sludge and other matter found in wastewater. Whenever possible, a full vaned, not vortex, impeller shall be used for maximum hydraulic efficiency; thus, reducing operating costs. Mass moment of inertia calculations shall be provided by the pump manufacturer upon request. The impeller shall be retained with an Allen head bolt. All impellers shall be coated with acrylic resin primer.
- .9 Paint Standard:
- .1 The exterior of the pump, including all metal surfaces coming into contact with the pumpage shall be protected by a factory-applied spray coating of acrylic dispersion zinc phosphate primer and finished with a polyester, epoxidized resin paint. Prior to the final paint finish being applied, the pump components shall be primed and washed. The components shall then be assembled and washed a second time before the final topcoat is applied. The finish paint or top-coat shall be Flygt Duasolid™, applied externally to a minimum dry film thickness of not less than 100µm(microns). The film thickness shall be consistent with ISO 2808, method no.6.
- .10 Pump Shaft:

PLUMBING PUMPS

- .1 Pump and motor shaft shall be the same unit and shall be made of AISI type 431 stainless steel throughout. The pump shaft is an extension of the motor shaft. Couplings shall not be acceptable.
- .2 The use of stainless steel sleeves to protect a lesser grade of shaft material will not be considered equal.
- .11 Wear Rings:
  - .1 A wear ring system shall be used to provide efficient sealing between the volute and suction inlet of the impellers. The wear ring shall be stationary and made of brass, which is drive fitted to the volute inlet.
- .12 Mechanical Seals:
  - .1 Each pump shall be provided with a tandem mechanical shaft seal system consisting of two, totally independent seal assemblies. The seals shall operate in a lubricant reservoir that hydrodynamically lubricates the lapped seal faces at a constant rate. The lower, primary seal unit, located between the pumped liquid and the lubricant chamber, shall contain one stationary and one positively driven rotating tungsten-carbide ring. The upper, secondary seal unit, located between the lubricant chamber and the motor housing, shall contain one stationary ceramic seal ring and one positively driven rotating carbon seal ring. Each seal interface shall be held in contact by its own spring system. The seals shall require neither maintenance nor adjustment nor depend on direction of rotation for sealing. The position of both mechanical seals shall depend on the shaft. Mounting of the lower mechanical seal on the impeller hub will not be acceptable. For special applications, other seal face materials shall be available.
  - .2 The following seal types shall not be considered acceptable nor equal to the dual independent seal specified:
    - .1 shaft seals without positively driven rotating members, or conventional double mechanical seals containing either a common single or double spring acting between the upper and lower seal faces. Cartridge type systems will not be acceptable. No system requiring a pressure differential to offset pressure and to effect sealing shall be used.
  - .3 Each pump shall be provided with a lubricant chamber for the shaft sealing system. The lubricant chamber shall be designed to prevent overfilling and to provide lubricant expansion capacity. The drain and inspection plug, with positive anti-leak seal shall be easily accessible from the outside. The seal system shall not rely upon the pumped media for lubrication. The motor shall be able to operate dry without damage while pumping under load. The seal lubricant shall be non-toxic and FDA approved for potable water applications.
- .13 Bearings:
  - .1 The pump shaft shall rotate on two bearings. Motor bearings shall be permanently grease lubricated. The upper bearing shall be a single deep groove ball bearing. The lower bearing shall be a two row angular contact bearing to compensate for axial thrust and radial forces. Single row, or sleeve lower bearings are not acceptable.
- .14 Protection:
  - .1 All stators shall incorporate thermal switches in series to monitor the temperature of each phase winding. At 125°C (260°F) the thermal switches shall open, stop the motor and activate an alarm.
  - .2 A leakage sensor shall be included to detect water in the stator chamber. The Float Leakage Sensor (FLS) is a small float switch used to detect the presence of water in the stator chamber. When activated, the FLS will stop the motor and send an alarm

PLUMBING PUMPS

- both local and/or remote. Use of voltage sensitive solid state sensors and trip temperature above 125°C (260°F) shall not be allowed.
- .3 The thermal switches and FLS shall be connected to a Flygt MiniCAS II (Control & Status) monitoring unit mounted in the control panel.
- .15 Performance Guarantee & Standard Tests:
- .1 The pump performance shall conform to ISO 9906 :1999. The tests are intended to ascertain the performance of the pump and to compare this with the manufacturer's guarantee. The performance test of the pump(s) shall be carried out to determine the performance of the pump with respect to the discharge rate of flow, total head, power absorbed, etc. For a combined motor-pump unit (for example, submersible pump; or separate pump and motor with overall efficiency guaranteed), the guarantee covers the efficiency of the entire unit.
  - .2 The pump shall be tested for proper operation at rated power supply values and for electrical and mechanical integrity prior to shipment according to ISO 9906.
  - .3 On demand, the pump supplier will supply the following test results:
    - .1 Hydraulic test curve, proving that the pump meets the operating conditions in accordance with ISO 9906 :1999, Annex A;
    - .2 Current and power consumed during the test.
    - .3 Megger Test - verification of the electrical resistance to ground
    - .4 Wet Test - Submerged functional test and electrical verification of the rated current
    - .5 Dry Test - Test for 15 secs. Minimum in a dry condition with verification that current or power consumption draw does not exceed the normal dry rating
    - .6 Water Infiltration & Oil Check
    - .7 Monitoring Device Check - includes, but is not limited to, motor temperature sensors and leakage detectors
- .16 Cover Plate And Curb Frame
- .1 Square sump cover plate and curb frame shall be supplied with openings for simplex pump configurations. Cover plate includes 3" (76mm) NPT threaded vent and inspection cover. Size as indicated on drawings
  - .2 Control: as indicated on drawings.

### PART 3- EXECUTION

#### 3.1 MANUFACTURER'S INSTRUCTIONS

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

#### 3.2 INSTALLATION

- .1 Make piping and electrical connections to pump and motor assembly and controls as indicated.
- .2 Ensure pump and motor assembly do not support piping.
- .3 Align vertical pit mounted pump assembly after mounting and securing cover plate.

#### 3.3 FIELD QUALITY CONTROL

- .1 Site Tests/Inspection:
  - .1 Check power supply.
  - .2 Check starter protective devices.
- .2 Start-up, check for proper and safe operation.
- .3 Check settings and operation of hand-off-auto selector switch, operating, safety and limit controls, audible and visual alarms, over-temperature and other protective devices.
- .4 Adjust flow from water-cooled bearings.
- .5 Adjust impeller shaft stuffing boxes, packing glands.

#### 3.4 START-UP

- .1 Procedures:
  - .1 Check power supply.
  - .2 Check starter O/L heater sizes.
  - .3 Start pumps, check impeller rotation.
  - .4 Check for safe and proper operation.
  - .5 Check settings, operation of, limits, safety controls, over-temperature, audible/visual alarms, other protective devices.
  - .6 Test operation of hands-on-auto switch.
  - .7 Test operation of alternator.
  - .8 Adjust leakage through water-cooled bearings.
  - .9 Adjust shaft stuffing boxes.
  - .10 Adjust leakage flow rate from pump shaft stuffing boxes to manufacturer's recommendations.
  - .11 Check base for free-floating, no obstructions under base.
  - .12 Run-in pumps for 12 continuous hours.
  - .13 Check installation, operation of mechanical seals, packing gland type seals. Adjust as necessary.
  - .14 Adjust alignment of piping and conduit to ensure full flexibility.
  - .15 Eliminate causes of cavitation, flashing, air entrainment.
  - .16 Measure pressure drop across strainer when clean and with flow rates as finally set.

.17 Verify lubricating oil levels.

### 3.5 PV - SANITARY AND STORM WATER PUMPS

.1 Application tolerances:

- .1 Flow: plus 10%; minus 0%.
- .2 Pressure: plus 10%; Minus 5%.

.2 PV Procedures:

- .1 Fill sump at rate slower than capacity of pump #1.
- .2 Record levels at which pump #1 starts and stops. Determine flow rate by observing time taken to down water level.
- .3 Fill sump at rate faster than capacity of pump #1 but slower than capacities of pumps #1 and #2 operating in parallel.
- .4 Record levels at which pumps start and stop - water level rising and water level falling.
- .5 Verify operation of alternator.
- .6 Adjust water level controls as necessary.
- .7 Fill sump at rate faster than capacities of pumps #1 and #2 operating in parallel.
- .8 Record levels at pump starts and stops - water level rising and falling.
- .9 Check operation of alternator.
- .10 Adjust level controls as necessary.
- .11 Check level at which high water level alarm starts and stops. Adjust as necessary.

.3 Check removability of pumps for servicing without interfering with installation or operation of other equipment.

.4 Verify non-clog capability and maximum size of solids, using procedures recommended by manufacturer.

### 3.6 REPORTS

.1 Include:

- .1 PV results on approved PV Report Forms.
- .2 Product Information report forms.
- .3 Pump performance curves (family of curves) with final point of actual performance.

### 3.7 TRAINING

- .1 Provide training in accordance with Section 01 79 00 - Demonstration and Training.
  - .1 Provide 8 hours of training for new sump pumps and accessories.

END OF SECTION

## PART 1 - GENERAL

### 1.1 RELATED REQUIREMENTS

.1 Section 22 14 13 - Facility Drainage Piping.

### 1.2 REFERENCES

.1 ASTM International Inc.

- .1 ASTM B32-08(2014), Standard Specification for Solder Metal.
- .2 ASTM B306-13, Standard Specification for Copper Drainage Tube (DWV).

.2 Canadian Standards Association (CSA International).

- .1 CSA B67-1972(R1996), Lead Service Pipe, Waste Pipe, Traps, Bends and Accessories.
- .2 CAN/CSA-B70-12, Cast Iron Soil Pipe, Fittings and Means of Joining.
- .3 CAN/CSA-B125.3-12, Plumbing Fittings.

### 1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

- .1 Provide manufacturer's printed product literature and datasheets for adhesives, 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 and with manufacturer's written instructions.

.2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

.3 Packaging Waste Management: remove for reuse by manufacturer of pallets, crates, padding, and packaging materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

## PART 2 PRODUCTS

### 2.1 COPPER TUBE AND FITTINGS

.1 Above ground sanitary, storm, and vent Type DWV to: ASTM B306.

- .1 Fittings.
  - .1 Cast brass: to CAN/CSA-B125.3.
  - .2 Wrought copper: to CAN/CSA-B125.3.
- .2 Solder: lead free, tin-Antimony 95:5, to ASTM B32.

### 2.2 CAST IRON PIPING AND FITTINGS

.1 Above ground sanitary, storm, and vent: to CAN/CSA-B70.

- .1 Joints:
  - .1 Mechanical joints:
    - .1 Neoprene or butyl rubber compression gaskets: to CAN/CSA-B70.
  - .2 Hub and spigot:



- .1 Caulking lead: to CSA B67.

## 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 22 14 13 - Facility Drainage Piping.
- .2 Install in accordance with National Plumbing Code, Provincial Plumbing Code, and local authority having jurisdiction.

### 3.3 TESTING

- .1 Hydraulically test to verify grades and freedom from obstructions.

### 3.4 PERFORMANCE VERIFICATION

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

### 3.5 CLEANING

- .1 Clean in accordance with Section 01 74 11 - Cleaning.
- .2 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

END OF SECTION

## PART 1 - GENERAL

### 1.1 RELATED REQUIREMENTS

- .1 Section 22 14 13 - Facility Drainage Piping.

### 1.2 REFERENCES

- .1 ASTM International Inc.
  - .1 ASTM D2235-04(2011), Standard Specification for Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings.
  - .2 ASTM D2564-12, Standard Specification for Solvent Cements for Poly(Vinyl-Chloride) (PVC) Plastic Piping Systems.
- .2 Canadian Standards Association (CSA International)
  - .1 CAN/CSA-Series B1800-11, Thermoplastic Nonpressure Pipe Compendium - B1800 Series.
- .3 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (MSDS).

### 1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Provide manufacturer's printed product literature and datasheets for adhesives, and include product characteristics, performance criteria, physical size, finish and limitations.
  - .2 Provide two copies WHMIS MSDS - Material Safety Data Sheets in accordance with Section 01 35 29.06 - Health and Safety Requirements.

### 1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .3 Store at temperatures and conditions recommended by manufacturer.
- .4 Packaging Waste Management: remove for reuse by manufacturer of pallets, crates, padding, and packaging materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

---

## PART 2 - PRODUCTS

### 2.1 PIPING AND FITTINGS

- .1 For buried and above ground DWV piping to:
  - .1 CAN/CSA B1800.

### 2.2 JOINTS

- .1 Solvent weld for PVC: to ASTM D2564.
- .2 Solvent weld for ABS: to ASTM D2235.

## 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 22 14 13 - Facility Drainage Piping.
- .2 Install in accordance with National Plumbing Code, Provincial Plumbing Code, and local authority having jurisdiction.

### 3.3 TESTING

- .1 Hydraulically test to verify grades and freedom from obstructions.

### 3.4 PERFORMANCE VERIFICATION

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

### 3.5 CLEANING

- .1 Clean in accordance with Section 01 74 11 - Cleaning.
- .2 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

END OF SECTION

## PART 1 - GENERAL

### 1.1 REFERENCES

- .1 Canadian General Standards Board (CGSB)
  - .1 CAN/CGSB-1.181-99, Ready-Mixed Organic Zinc-Rich Coating.

### 1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Provide manufacturer's printed product literature, specifications and datasheets for piping and equipment and include product characteristics, performance criteria, physical size, finish and limitations.

### 1.3 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements:
  - .1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .3 Packaging Waste Management: remove for reuse by manufacturer of pallets, crates, padding, and packaging materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

## PART 2 - PRODUCTS

### 2.1 MATERIAL

- .1 Paint: zinc-rich to CAN/CGSB-1.181.
  - .1 Primers, Paints, Coating: In accordance with manufacturer's recommendations for surface conditions.

## 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

FACILITY DRAINAGE PIPING

- .1 Provide clearance around systems, equipment and components for observation of operation, inspection, servicing, maintenance and as recommended by manufacturer.
  - .2 Provide space for disassembly, removal of equipment and components as recommended by manufacturer without interrupting operation of other system, equipment, components.
- 3.4 DIELECTRIC COUPLINGS
- .1 General: compatible with system, to suit pressure rating of system.
  - .2 Locations: where dissimilar metals are joined.
  - .3 NPS 2 and under: isolating unions or bronze valves.
  - .4 Over NPS 2: isolating flanges.
- 3.5 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 Valves:
    - .1 Install in accessible locations.
    - .2 Remove interior parts before soldering.
    - .3 Install with stems above horizontal position unless indicated.
    - .4 Valves accessible for maintenance without removing adjacent piping.
    - .5 Install globe valves in bypass around control valves.
    - .6 Use butterfly valves at branch take-offs for isolating purposes except where specified.
    - .7 Install butterfly valves between weld neck flanges to ensure full compression of liner.
    - .8 Install gate valves where indicated.
  - .14 Check Valves:

FACILITY DRAINAGE PIPING

- .1 Install silent check valves on discharge of pumps and as indicated.
- .2 Install swing check valves in horizontal lines on discharge of pumps and as indicated.

3.6 FLUSHING OUT OF PIPING SYSTEMS

- .1 Before start-up, clean interior of piping systems in accordance with requirements of Section 01 74 11 - Cleaning.
- .2 Preparatory to acceptance, clean and refurbish equipment and leave in operating condition, including replacement of filters in piping systems.

3.7 PRESSURE TESTING OF EQUIPMENT AND PIPEWORK

- .1 Advise Departmental Representative 48 hours minimum prior to performance of pressure tests.
- .2 Pipework: test as specified in relevant sections of specifications.
- .3 Maintain specified test pressure without loss for 4 hours minimum unless specified for longer period of time in relevant mechanical sections.
- .4 Prior to tests, isolate equipment and other parts which are not designed to withstand test pressure or media.
- .5 Conduct tests in presence of Departmental Representative.
- .6 Pay costs for repairs or replacement, retesting, and making good. Departmental Representative to determine whether repair or replacement is appropriate.
- .7 Insulate or conceal work only after approval and certification of tests by Departmental Representative.

3.8 EXISTING SYSTEMS

- .1 Connect into existing piping systems at times approved by Departmental Representative.
- .2 Request written approval by Departmental Representative 10 days minimum, prior to commencement of work.
- .3 Be responsible for damage to existing plant by this work.

3.9 CLEANING

- .1 Clean in accordance with Section 01 74 11 - Cleaning.
  - .1 Remove surplus materials, excess materials, rubbish, tools and equipment.
- .2 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

END OF SECTION

## PART 1 - GENERAL

### 1.1 ADMINISTRATIVE REQUIREMENTS

#### .1 Pre-installation Meetings:

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

### 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 plumbing products and include product characteristics, performance criteria, physical size, finish and limitations.

#### .3 Shop Drawings:

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

#### .4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

#### .5 Instructions: submit manufacturer's installation instructions.

### 1.3 CLOSEOUT SUBMITTALS

#### .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

#### .2 Operation and Maintenance Data: submit operation and maintenance data for plumbing specialties and accessories for incorporation into manual.

- .1 Description of plumbing specialties and accessories, giving manufacturers name, type, model, year and capacity.
- .2 Details of operation, servicing and maintenance.
- .3 Recommended spare parts list.

### 1.4 DELIVERY, STORAGE AND HANDLING

#### .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.

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

#### .3 Storage and Handling Requirements:

- .1 Store materials off ground, indoors, in dry location, and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
- .2 Store and protect plumbing materials from nicks, scratches, and blemishes.

- .3 Replace defective or damaged materials with new.
- .4 Develop Construction Waste Management Plan related to Work of this Section.
- .5 Packaging Waste Management: remove for reuse by and return to manufacturer of pallets, crates, padding, and packaging materials as specified in Construction Waste Management Plan in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

## PART 2 - PRODUCTS

### 2.1 SUBMERSIBLE PUMP PIT CONTROLLER

- .1 The pump controller shall be Multitrode Multismart Model MSU3MP2 or equal.
- .2 The pump controller shall be BACnet compatible and capable of interfacing with the existing building BAS system (Johnson Controls Metasys). The pump controller shall be able to accommodate existing BAS system upgrades.
  - .1 Upon alarm, the pump controller shall alarm to the existing BAS paging system and have an audible/visible local alarm. The status of the sump pit shall be provided to the BAS system and an alarm status shall be indicated when the pump controller goes into alarm.
- .3 The pump controller shall provide user ready automatic control of pumps with an intuitive HMI interface. The pump controller shall contain pre-designed operational parameters that are selected and configured via the user interface (HMI). The minimum features available in the pump controller shall include:
  - .1 Pump control of up to 4 pumps; including pump grouping and pump alternation.
  - .2 Intelligent Hand-Off-Auto Control:
    - .1 Hand mode (semi-automatic, non-maintained manual mode), the pump switches off at the deactivation set point and then resets to Auto mode for the next pump run cycle.
    - .2 Hand mode (fully manual, maintained mode). To pump beyond the off (deactivation) set point, the Hand-Off-Auto button must be held down by the user for failsafe control.
  - .3 Level set point adjustment for pump activation, deactivation and station level alarms.
  - .4 Level device input capability shall include: 4-20mA analog signal, conductive probe or floats.
  - .5 Redundant level device input capability with automatic input fault control (input device switching).
  - .6 Selectable charge (fill) or discharge (empty) modes.
  - .7 Pre-configured station optimization features shall include:
    - .1 Maximum pump off time
    - .2 Maximum pumps to run
    - .3 Maximum starts per hour
    - .4 Inter-pump start and stop time delays
    - .5 Maximum pump run time
    - .6 Blocked pump detection
    - .7 Well washer control capability
    - .8 Well clean out control capability
    - .9 Pump operation control (profile programming) capability
  - .8 "Locked level" alarm function to indicate a level device fault.
    - .1 User-defined % change within a specified time period
    - .2 Different set point values for low use or high use time periods (user defined)
  - .9 Pump alternation modes shall include:
    - .1 Fixed lead pump assignment
    - .2 Normal alternation
    - .3 User defined alternation using N:1 ratio



- .4 Run most efficient pump using N:1 ratio
- .5 Alternation by the number of hours run or the number of starts within a specified time period
- .10 Pump decommissioning modes shall include:
  - .1 Decommissioned pump is automatically removed from the pump controller.
  - .2 Internal remote monitoring data tag shall flag the decommissioned status of a pump
- .11 Up to 4 unique user defined profiles of set points shall be available to control pumps during specific site conditions or events. Features shall include:
  - .1 Automatic profile change based on date and time
  - .2 Profile selection option from SCADA (remote control), digital input, logic tag or local display HMI
- .12 A datalogger for user-defined faults and events shall include:
  - .1 Recording of up to 50,000 events to internal flash memory
  - .2 Download capability of up to 10,000,000 events by writing directly to an SD card or USB
  - .3 FTP data transfer and download data capability of event and fault logs in the form of a (csv) file for Microsoft Excel analysis
- .13 3-phase supply voltage monitoring and supply fault management for the following conditions:
  - .1 Under-voltage
  - .2 Over-voltage
  - .3 Phase fail
  - .4 Phase rotation
- .14 Monitoring of dc power supply, battery voltage, and internal controller temperature
- .15 Energy, power and pump efficiency monitoring:
  - .1 kW, kVA, power factor, kWhr, KVAH calculation for each pump
  - .2 pump efficiency calculation (gallons per kWhr) for each pump
- .16 Motor protection features:
  - .1 3-phase current monitoring for each pump
  - .2 Over- and under-current trip
  - .3 Ground/earth fault
  - .4 Current phase imbalance fault
  - .5 I<sup>2</sup>T fault
  - .6 Insulation resistance testing for motor windings
- .17 Flow measurement: (when enabled with software key)
  - .1 Calculated flow via liquid level draw down data
- .18 VFD speed control capability. (when enabled with software key)
- .19 Fault module capability as follows:
  - .1 Pump hold out function
  - .2 Automatic restart function after fault condition is no longer present
  - .3 Manual reset of fault required (if user intervention of fault reset is selected)
- .20 Remote control via remote telemetry monitoring to include the following (when enabled with software key):
  - .1 Changing the mode of pumps (hand/off/auto operations)
  - .2 Reset of pump faults and station faults
  - .3 Changing pump and alarm set points
  - .4 Changing operational profiles
- .21 Security
  - .1 User defined password management for access to programming areas in the controller
  - .2 Automatic data logging of personnel who have entered the programming areas
  - .3 Automatic logging of all unsuccessful login attempts with a date and time stamp
  - .4 Digital input option for controlled access to programming areas
- .22 SD and USB type access ports shall be available for the following operations:
  - .1 Firmware upgrades
  - .2 Save and load pump controller configuration
  - .3 Download data logs

- .4 Export or import MODBUS and DNP3 points list
- .4 The pump controller shall have the option of interfacing with IEC61131-3 and IEC61499 compliant PLC programming languages to enhance functionality or interact with the pump controller.
  - .1 The pump controller shall have the option of using a simple logic engine to enhance functionality or interact with the pump controller.
- .5 The pump controller inputs and outputs shall be modular and shall be expandable.
  - .1 Available I/O types shall include:
    - .1 Digital inputs (voltage free input), also configurable as counters
    - .2 Digital outputs (240V, 5A resistive)
    - .3 Analog inputs (10bit)
    - .4 Analog outputs (10bit)
- .6 Digital Inputs shall be configurable based on specific pump sensor arrangements:
  - .1 Seal sensor (conductive)
  - .2 PTC Thermistor
  - .3 Flygt FLS & CLS
  - .4 Conductive probe (for liquid level sensing)
- .7 The pump controller shall include a graphical user interface (HMI) display for configuration settings, control operations, and advanced programming. The following display characteristics shall be provided:
  - .1 Liquid level in percentage, meters, feet or other custom defined units
  - .2 Set points for pump control and alarms
  - .3 Pump status (running or stopped)
  - .4 Pump availability
  - .5 Pump fault indication
  - .6 Pump Seal Failure Indicator
  - .7 3-phase voltage supply values
  - .8 Date and time indication
  - .9 User configurable options to display pump information and station status
- .8 The following parameters shall be available via a user key press from the main screen:
  - .1 Hours Run accumulators for each pump and the pump station with the following information:
    - .1 minutes run for last pump cycle
    - .2 total minutes (hourly)
    - .3 total hours today, total hours yesterday
    - .4 total hours this week, total hours last week
    - .5 total accumulated hours
  - .2 Pump Start accumulators for each pump & the station with the following comparisons
    - .1 pump starts this hour, pump starts last hour
    - .2 pump starts today, pump starts yesterday
    - .3 pump starts this week, pump starts last week
    - .4 total accumulated pump starts
  - .3 Flow values (when enabled with software key)
    - .1 station inflow rate
    - .2 pump flow rate
    - .3 total station volume
    - .4 overflow data (including overflow start time, duration, estimated volume)
  - .4 Power and Efficiency (Available on Multismart Model# MSU3MP2)
    - .1 pump efficiency in gallons or litres per KWHr - or KVAh

- .2 power in kW, KVA
- .3 power factor
- .4 energy accumulators per pump in KWHr and KVAH
- .5 Insulation resistance value for each pump motor in (Ohms)
- .6 I/O Status
  - .1 Digital I/O status and accumulated values
  - .2 Analog I/O status and values in (mA) or scaled values
  - .3 3-phase voltage, frequency, phase angle, power factor
- .7 Database viewer to review all statistics, data information and available tags in real time
- .8 Communications information and statistics
- .9 The pump controller display interface shall be capable of performing the following control operations:
  - .1 Pump control mode for each pump (Hand-Off-Auto)
  - .2 Pump fault reset
  - .3 Level alarm reset
- .10 The main screen shall include a Fault button which takes the user to a Fault screen and allows them to check all current and unacknowledged alarms.
  - .1 The fault screen will provide fault details along with a date and time stamp for each fault occurrence.
  - .2 A fault reset option shall be presented to the user when alarms can be acknowledged or reset.
- .11 The main screen shall include a History button which takes the user to a History screen which allows them to view the following information:
  - .1 Viewing of all faults and events
  - .2 Information filtering capability
- .12 The user configuration screens shall provide capability to change pump control settings as follows:
  - .1 Setup Wizard function to configure the pump controller settings by user input to specific questions
  - .2 Set point programming of alarms and pump activation/deactivation.
  - .3 Enable or disable alarms
  - .4 Set alternation mode for pumps
  - .5 Configure I/O as follows:
    - .1 Assign primary/backup level to any input, e.g. 4-20mA or conductive probe
    - .2 Assign pre-defined or user-defined faults to any digital input
    - .3 Zero and span analog inputs
    - .4 Configure digital output source
    - .5 Configure analog output source
  - .6 Configure faults as follows:
    - .1 display the fault to the local screen only
    - .2 manual reset (local) or remote reset operation before pump becomes available
    - .3 auto-restart (after fault condition clears) with configurable restart time
    - .4 auto-restart user-selectable number of times within time window before locking out
    - .5 customized text for fault and event name
  - .7 Configure station optimization parameters
  - .8 Configure supply protection
    - .1 Under and over voltage alarm points
    - .2 Volts phase imbalance and volts phase rotation set points
    - .3 DC supply alarm set point
  - .9 Configure motor protection

- .1 Under current set points
  - .2 Over current set points
  - .3 Ground/earth fault set points
  - .4 Phase failure set points
  - .10 Configure communications ports, speeds and addresses.
- .13 The pump controller configuration interface shall allow the user to save and restore pump controller configurations onto a portable SD card or USB storage device.
- .1 The pump controller shall allow for the import of DNP3 and Modbus point lists and custom logic scripts via the SD or USB ports.
  - .2 The pump controller configuration interface shall allow the user to backup system log files, alarm and event log files, and custom scripts via the SD or USB ports.
  - .3 Firmware upgrades shall be possible by using a firmware upgrade file on a portable SD card or USB storage device.
- .14 The pump controller shall include the following data communication ports:
- .1 (2) Ethernet ports (10Mbit/s)
  - .2 (2) RS232 ports (115kBit/s)
  - .3 (2) RS485 ports (115kBit/s)
  - .4 (1) USB device port
  - .5 (1) SD card port
- .15 The pump controller shall support the following communication types:
- .1 TCP/IP
  - .2 UDP
  - .3 RS232
  - .4 RS485
  - .5 Private radio over RS232
  - .6 PSTN
  - .7 Wireless LAN
  - .8 Cellular data
  - .9 Cellular voice
- .16 The pump controller shall support DNP3 (master & slave, level 2 compliant), including:
- .1 Change of state reporting
  - .2 Native date/time and quality stamps for each data point
  - .3 Event buffering for different classes of data
  - .4 Support for multiple masters and slaves to be configured on the unit
  - .5 DNP Security (for securing communications between master station and RTU)
- .17 The pump controller shall support Modbus (master & slave) including:
- .1 Modbus TCP
  - .2 Modbus RTU
  - .3 Modbus ASCII
  - .4 Support for multiple masters and slaves
- .18 The pump controller shall meet the following performance and environmental characteristics:
- .1 Central Processing Unit Speed: 566MHz
  - .2 Central Processing Unit RAM Size: 256MByte
  - .3 Central Processing Unit Flash Memory Size: 64MByte
  - .4 Real Time Clock

- .5 Working temperature -10°C to +60°C
- .6 Storage temperature -40°C to +90°C
- .7 Humidity 5% to 95% (non-condensing)
- .8 IP Rating Controller Base Unit: IP20, NEMA 1
- .9 Display Interface IP65, NEMA 4

.19 The pump controller shall be provided with a 5 year limited manufacturer's warranty.

## 2.2 SUBMERSIBLE PUMP FLOAT LEVEL CONTROLS

.1 The backup control system shall consist of one or more level sensing relays. The Backup Level Control Relays shall be Multitrode MTR, MTRA, SAFE-TL or equal.

.2 The level sensing relays shall be supplied with the following specifications:

- .1 The relay shall accept 2 or 3 level inputs from a conductive level probe or ball floats
- .2 All settings shall be dip switch programmable from the front panel and shall be as follows:
  - .1 Conductive probe sensitivity adjustment.
  - .2 Activation Delays.
  - .3 Charge/Discharge selection.
  - .4 Alarm Delay.
  - .5 Alarm Output Flashing/Steady.
- .3 Output Contact Rating: 250VAC, 5 Amps Resistive, 2 Amps Inductive

.3 Mounting and Installation: DIN Rail or 2 x #6 screws Base Mount

## 2.3 SUBMERSIBLE PUMP SUMP PIT LEVEL SENSOR

.1 Description: A Multi-Stage Level Sensing Device designed to detect liquid level at specified intervals in tanks or sumps and interface with an electronic controller for pump control and liquid level display. The Level Sensing Equipment shall be a MultiTrode Probe or equal.

.2 Construction: Where the level sensing technique utilizes a sensing device inserted into the liquid, all cavities within each sensor unit assembly shall be PVC injected to seal the unit and prevent any moisture from entering the sensor assembly. Where a sensor unit consists of a multi-sensored probe, each sensor on the probe shall be rotated 90 degrees horizontally from the previous sensor along the probe length to eliminate tracking between sensors. Level sensing probes shall be pressure injected with an epoxy resin at final assembly to encapsulate all internal components and connections, thereby creating a rigid, sealed, homogeneous unit.

.3 Cable: The flexible cable used for the Level Sensing Probe shall be comprised of PVC/PVC multi-conductor construction with a common oversheath that is water and oil resistant. The multi-conductor cable shall be identified with numbering and text along the entire length of the outer sheath at required intervals. Individual conductors of the multi-conductor cable shall be numbered and colored for easy identification, as well as connection to the pump controls. Cables shall be secured to the top of probe bodies by synthetic rubber compression fittings for strain relief. Flexible cables shall be rated to physically support the combined weight of the level sensing probe and any suspended cable connected to the probe.

.4 Mounting and Installation: Mounting connections shall be stainless steel. The mounting assembly for probes shall include a device available to maintenance personnel to clean the level sensing probe at desired maintenance intervals.

.5 Failsafe Functionality: Two wires shall be run across the length of the probe, one red and one black. Each wire shall connect to each other on the bottom of the probe. When used with a MultiSmart Pump Controller or Safe Smart Relay, the connection of these wires to the designated inputs on the

controls will provide fail-safe functionality (monitoring for the probe).

#### 2.4 SUBMERSIBLE PUMP CONTROL PANEL CONSTRUCTION & ASSEMBLY

- .1 Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to the following:
  - .1 Control Panel Equipment:
    - .1 Multitrode
    - .2 Square D
    - .3 Products of other manufacturers assembled to provide all specified functions, including reliability equal to or exceeding that of the manufacturers listed above.

- .2 General Requirements:
  - .1 Control Panels shall be manufactured in accordance with ISO 9000-2001 specifications and shall be so constructed for the application of a ULC Listing Label by an approved UL Control Panel Assembly Facility.
  - .2 All electrical connections shall be properly inspected and torqued in compliance with ISO specifications. External connections to the control panel shall be by way of numbered terminal blocks.
  - .3 Control Panels shall be properly checked and load tested with power applied. A control panel test log shall be supplied with the control panel.
  - .4 Control Panels shall be supplied from a UL approved control panel assembly facility with all of the required labels properly attached.
  - .5 The controller shall include an aux. contact for high-level alarm.
  - .6 The control panel shall include terminals for all field connections.
  - .7 The control panel shall include a lightning suppressor.
  - .8 The control panel shall be intrinsically safe to UL 998A.
  - .9 The control panel shall include additional aux. alarm dry contacts.
- .3 Control Panel Enclosure Environmental Rating:
  - .1 Control Panel Enclosure rating shall be specified in accordance with the project requirements or the contract drawings as either NEMA 3R, 12, 4 (Painted Steel) or 4X (Stainless Steel).
- .4 Control Panel Enclosure Specific Construction Requirements:
  - .1 Enclosure shall be sized according to physical and functional device requirements.
  - .2 Enclosure seams shall be continuously welded and ground smooth.
  - .3 Enclosure door opening flange trough shall exclude liquids and contaminants.
  - .4 Enclosure shall include an integral body grounding stud and sub-panel mounting studs.
  - .5 Enclosure shall be wall mounted, unless otherwise specified.
  - .6 Enclosure door shall have hidden hinges for a clean, aesthetic appearance.
  - .7 Enclosure door opening angle shall be standard, full access, 135 degree opening radius.
  - .8 Enclosure door shall be interchangeable and removable by pulling a captive hinge pin.
  - .9 Enclosure door shall have a high-impact thermoplastic data pocket mounted on the inner side of the enclosure door.
  - .10 Enclosure door shall have a seamless, foam-in-place, one-piece gasket to provide an oil-tight, dust-tight seal against contaminants.
  - .11 Enclosure shall have a three-point latching system with a zinc die-cast handle that is painted with black textured polyester powder paint.
  - .12 Enclosure handles shall be capable of being padlocked.
  - .13 Steel sub-panel shall be white.
  - .14 When enclosure cut-outs for instruments and other devices are required, holes shall be cut, punched, or drilled and finished with rounded edges.
  - .15 A door stiffener shall be used where applicable to prevent door deflection under instrument loading or operation.
  - .16 Enclosure shall have a dead front with interior swing door.
- .5 Instrument Location Requirements:
  - .1 Instruments or control devices designated for sub-panel (back) mounting shall be located in a manner that will allow for maintenance and adjustment.
  - .2 Instrument mounting height shall not exceed 6'-6" to the top of the instrument and shall not be lower than 3'-0" to the bottom of the instrument (unless otherwise specified).
- .6 Wiring Requirements:
  - .1 Wiring for AC and DC control circuits shall be Type SIS or Type MTW stranded copper and

- shall be sized for the applied voltage and current. Unless otherwise noted, control circuit wiring shall not be smaller than No. 16 AWG.
- .2 Cable wiring for analog signal circuits shall be twisted, shielded pairs of stranded copper conductors that shall not be smaller than No. 20 AWG.
  - .3 Wiring for special signalling equipment such as communications, digital data, and multiplexed signals shall be provided by the equipment supplier.
  - .4 Wiring shall be numbered and marked at each termination point.
  - .5 Terminal blocks for internal or external wiring shall be DIN rail mounted, individual screw compression type terminals with machine printed labels.
- .7 Nameplate Requirements:
- .1 Nameplates are defined as inscribed, plastic plates mounted above or near a panel face mounted component. Unless otherwise noted, nameplates shall be engraved, rigid, laminated plastic with an adhesive back. Nameplate color shall be white with black letters.
  - .2 Component Labels are defined as printed, vinyl labels mounted above, below or near a sub-panel (back) mounted component for identification. Printed vinyl labels shall be white in color with black letters and an adhesive back.
- .8 Grounding:
- .1 Control Panel enclosure shall be properly grounded in accordance with the National Electrical Code and local code requirements.
  - .2 Each analog signal loop shall only have its shield wire connected to ground at a single point for the loop. Shields shall be grounded at control panels where signals are input to the receiving device and not at the source of the transmitting device.
- .9 Electrical Transient (Surge) Protection:
- .1 All electrical and electronic components of the Control Panel shall be protected against damage due to electrical transients induced in interconnecting lines from lightning discharges and surges in nearby electrical systems.
  - .2 The transient surge protector shall be rated for 25kA per phase or larger.
- .10 Circuit Breakers:
- .1 Power Circuit Breakers shall be thermal magnetic type designed for AC current with a minimum interrupting capacity of 15,000 amperes.
  - .2 Control Circuit Breakers shall be in accordance with section UL 489 with a minimum interrupting capacity of 10,000 amperes.
  - .3 Main disconnect circuit breaker provided within panel.
- .11 Control Power Transformers:
- .1 Control Power Transformers required to provide control system and accessory power shall be machine tool type control transformers with epoxy encapsulated coils or resin impregnated coils, high quality silicon steel laminations, copper magnet wire, moulded-in terminals and 55° C rise (Class 10 insulation system).
- .12 Voltage/Phase Monitor:
- .1 The voltage-phase monitor shall continually measure the voltage of each of the three phases of the incoming power to the equipment and provide protection for three phase motors, as well as sensitive electronics, etc. The phase monitor shall sense the following conditions: under- and over-voltage, voltage unbalance, phase loss and phase reversal.



- .13 Control Relays:
  - .1 Control relays shall be square base type, 120VAC or 12VDC (based on design schematic).
  - .2 Control relays shall be 4PDT (4 Pole, Double Throw) with normally closed/normally open contacts rated at 120VAC, 5 amps minimum.
  - .3 Control relays shall include an integrated test button and relay energized flag indicator.
- .14 Full Voltage Magnetic Motor Controller:
  - .1 The motor controller shall be a NEMA rated, full voltage, non-reversing, across the line contactor and overload relay combination.
  - .2 The motor overload relay shall be an ambient compensated type with inverse-time-current characteristic and shall be provided with heaters or sensors in each phase matched to nameplate full load current of the specific motor to which it connects .
- .15 GFCI Convenience Receptacle:
  - .1 There shall be a 120VAC, 15 Amp GFCI rated convenience receptacle mounted on the dead front swing door of the control panel. Receptacle circuit shall be protected by a thermal magnetic circuit breaker.
- .16 Enclosure Condensation Heater:
  - .1 There shall be a 120VAC, 50 watt enclosure heater inside the control panel.
  - .2 The heater shall be a silicone rubber, insulated strip type enclosure heater.
  - .3 The heater shall be Chromalox Model #SL-B-2-5-55P, or approved equal.
  - .4 The heater shall be installed with thermostat.
- .17 Local Alarm (Flashing Light):
  - .1 There shall be a Flashing Alarm Light mounted on top of the control panel enclosure for local alarm indication. The flashing alarm light shall be supplied according to the following specifications:
    - .1 UL Recognized for use with UL NEMA Type 3R, 4, 4X, 12 & 13 Enclosures.
    - .2 Shatter Resistant Lexan globe, U.V. Stabilized and Flame Retardant.
  - .2 The Flashing Alarm Light shall be by Ingram Products, or approved equal.
  - .3 The visual alarm shall be accompanied by an audible alarm. The local alarm shall include a silence pushbutton.

## 2.5 CHAIN HOIST

- .1 Capacity: 450 kg.
- .2 Type: Wall-mounted.
- .3 Hoist to be provided by same manufacturer as associated sump pump. Install hoist to manufacturer's instructions for installation in unreinforced concrete masonry unit wall. Hoist to be similar to existing system installed in Room B18. Coordinate installation height with Departmental Representative and manufacturer.

## 2.6 FLOOR MOUNTED FLOOD SENSOR

- .1 Floor mounted flood sensor shall be provided with sump pump. Sensor shall be connected to BAS through sump pump control panel and shall provide alarm to BAS upon moisture detection.

## 2.7 GUIDE BARS

- .1 Type: 2-bar system, wall-mounted in sump pit.

- .2 Install guide bars to manufacturer's recommendations. Size and material to match existing guide bars. For pits without existing guide bars, match size and material of guide bars in sump pit B18. Coordinate spacing of bars with sump pump accessories.

### 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.
  - .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 data sheet.

#### 3.3 INSTALLATION

- .1 Install in accordance with National Plumbing Code of Canada, provincial codes, and local authority having jurisdiction.
- .2 Install in accordance with manufacturer's instructions and as specified.

#### 3.4 START-UP

- .1 Timing: start-up only after:
  - .1 Pressure tests have been completed.
  - .2 Disinfection procedures have been completed.
  - .3 Certificate of static completion has been issued.
  - .4 Water treatment systems operational.
- .2 Provide continuous supervision during start-up.

#### 3.5 CLOSEOUT ACTIVITIES

- .1 Training: provide training in accordance with Section 01 79 00 - Demonstration and Training.
  - .1 Provide 8 hours of training for new sump pumps and accessories.

#### 3.6 CLEANING

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

facility.

### 3.7 PROTECTION

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

END OF SECTION

## PART 1 - GENERAL

### 1.1 REFERENCES

- .1 American National Standards Institute/American Society of Mechanical Engineers (ANSI/ASME)
  - .1 ANSI/ASME B31.1-2012, Power Piping.
  - .2 ANSI/ASME Boiler and Pressure Vessel Code-2015:
    - .1 BPVC 2015 Section I: Power Boilers.
    - .2 BPVC 2015 Section V: Nondestructive Examination.
    - .3 BPVC 2015 Section IX: Welding and Brazing Qualifications.
- .2 American National Standards Institute/American Water Works Association (ANSI/AWWA)
  - .1 ANSI/AWWA C206-11, Field Welding of Steel Water Pipe.
- .3 American Welding Society (AWS)
  - .1 AWS C1.1M/C1.1-2012, Recommended Practices for Resistance Welding.
- .4 Canadian Standards Association (CSA International)
  - .1 CSA W48-14, Filler Metals and Allied Materials for Metal Arc Welding.
  - .2 CSA B51-14, Boiler, Pressure Vessel and Pressure Piping Code.
  - .3 CSA-W117.2-12, Safety in Welding, Cutting and Allied Processes.
  - .4 CSA W178.1-14, Certification of Welding Inspection Organizations.
  - .5 CSA W178.2-14, Certification of Welding Inspectors.

### 1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

### 1.3 QUALITY ASSURANCE

- .1 Qualifications:
  - .1 Welders:
    - .1 Welding qualifications in accordance with CSA B51.
    - .2 Use qualified and licensed welders possessing certificate for each procedure performed from authority having jurisdiction.
    - .3 Submit welder's qualifications to Departmental Representative.
    - .4 Each welder to possess identification symbol issued by authority having jurisdiction.
  - .2 Inspectors:
    - .1 Inspectors qualified to CSA W178.2.
  - .3 Certifications:
    - .1 Registration of welding procedures in accordance with CSA B51.
    - .2 Copy of welding procedures available for inspection.
    - .3 Safety in welding, cutting and allied processes in accordance with CSA-W117.2.

### 1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .3 Packaging Waste Management: remove for reuse by manufacturer of pallets, crates, padding, and

PIPE WELDING

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

**PART 2 - PRODUCTS**

**2.1 ELECTRODES**

- .1 Electrodes: in accordance with CSA W48 Series.

**PART 3 - EXECUTION**

**3.1 APPLICATION**

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

**3.2 QUALITY OF WORK**

- .1 Welding: in accordance with ANSI/ASME B31.1, B31.3, ANSI/ASME Boiler and Pressure Vessel Code, Sections I and IX and ANSI/AWWA C206, using procedures conforming to AWS B3.0, AWS C1.1, and applicable requirements of provincial authority having jurisdiction.

**3.3 INSTALLATION REQUIREMENTS**

- .1 Identify each weld with welder's identification symbol.
- .2 Backing rings:
  - .1 Where used, fit to minimize gaps between ring and pipe bore.
  - .2 Do not install at orifice flanges.
- .3 Fittings:
  - .1 NPS 2 and smaller: install welding type sockets.
  - .2 Branch connections: install welding tees or forged branch outlet fittings.

**3.4 INSPECTION AND TESTS - GENERAL REQUIREMENTS**

- .1 Review weld quality requirements and defect limits of applicable codes and standards with Departmental Representative before work is started.
- .2 Formulate "Inspection and Test Plan" in co-operation with Departmental Representative.
- .3 Do not conceal welds until they have been inspected, tested and approved by inspector.
- .4 Provide for inspector to visually inspect welds during early stages of welding procedures in accordance with Welding Inspection Handbook. Repair or replace defects as required by codes and as specified.

**3.5 SPECIALIST EXAMINATIONS AND TESTS**

- .1 General:
  - .1 Perform examinations and tests by specialist qualified to CSA W178.1 and CSA W178.2 and approved by Departmental Representative.

PIPE WELDING

---

- .2 To ANSI/ASME Boiler and Pressure Vessels Code, Section V, CSA B51 and requirements of authority having jurisdiction.
- .3 Inspect and test 10% of welds in accordance with "Inspection and Test Plan" by non-destructive visual examination.
  
- .2 Hydrostatically test welds to ANSI/ASME B31.1.
- .3 Visual examinations: include entire circumference of weld externally and, wherever possible, internally.
- .4 Failure of visual examinations:
  - .1 Upon failure of welds by visual examination, perform additional visual examinations as directed by Departmental Representative of total of up to 10 additional welds.
  
- 3.6 DEFECTS CAUSING REJECTION
  - .1 As described in ANSI/ASME B31.1 and ANSI/ASME Boiler and Pressure Vessels Code.
  
- 3.7 REPAIR OF WELDS WHICH FAILED TESTS
  - .1 Re-inspect and re-test repaired or re-worked welds at Contractor's expense.
  
- 3.8 CLEANING
  - .1 Clean in accordance with Section 01 74 11 - Cleaning.
  - .2 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

END OF SECTION

## PART 1 - GENERAL

### 1.1 DESIGN REQUIREMENTS

- .1 Confirm with Departmental Representative that Design Criteria and Design Intents are still applicable.
- .2 Commissioning personnel to be fully aware of and qualified to interpret Design Criteria and Design Intents.

### 1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Final Report: submit report to Departmental Representative.
  - .1 Include measurements, final settings and certified test results.
  - .2 Bear signature of commissioning technician and supervisor
  - .3 Report format to be approved by Departmental Representative before commissioning is started.
  - .4 Revise "as-built" documentation, commissioning reports to reflect changes, adjustments and modifications to EMCS as set during commissioning and submit to Departmental Representative in accordance with Section 01 78 00 - Closeout Submittals.
  - .5 Recommend additional changes and/or modifications deemed advisable in order to improve performance, environmental conditions or energy consumption.

### 1.3 CLOSEOUT SUBMITTALS

- .1 Provide documentation, O M Manuals, and training of O M personnel for review of Departmental Representative before interim acceptance in accordance with Section 01 78 00 - Closeout Submittals.

### 1.4 COMMISSIONING

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

### 1.5 COMPLETION OF COMMISSIONING

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

### 1.6 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 Commission each system using procedures prescribed by the Departmental Representative.
- .3 Commission integrated systems using procedures prescribed by Departmental Representative.
- .4 Debug system software.
- .5 Optimize operation and performance of systems by fine-tuning PID values and modifying CDLs as required.

### 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 After setting, test zero and span in 10% increments through entire range while both increasing and decreasing pressure.
  - .7 Transmitters above 0.5% error will be rejected.
  - .8 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 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 Commissioning Coordinator 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 start-up 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 Commissioning Coordinator and Departmental Representative to verify reported results.

### 3.3 ADJUSTING

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

### 3.4 DEMONSTRATION

- .1 Demonstrate to Departmental Representative operation of systems including sequence of operations in regular and emergency modes, under normal and emergency conditions, start-up, shut-down interlocks and lock-outs in accordance with Section 01 79 00 - Demonstration and Training.

END OF SECTION

## PART 1 - GENERAL

### 1.1 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures, supplemented and modified by requirements of this Section.
- .2 Submit training proposal complete with hour-by-hour schedule including brief overview of content of each segment to Departmental Representative 30 days prior to anticipated date of beginning of training.
  - .1 List name of trainer, and type of visual and audio aids to be used.
  - .2 Show co-ordinated interface with other EMCS mechanical and electrical training programs.

### 1.2 QUALITY ASSURANCE

- .1 Provide bilingual, competent instructors thoroughly familiar with aspects of EMCS installed in facility.
- .2 Departmental Representative reserves right to approve instructors.

### 1.3 INSTRUCTIONS

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

### 1.4 TIME FOR TRAINING

- .1 1 day = 7 hours including two 15 minute breaks and excluding lunch time.

### 1.5 TRAINING MATERIALS

- .1 Provide materials for on-site 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).

### 1.6 TRAINING PROGRAM

- .1 To begin before 30 day test period at time mutually agreeable to Contractor and Departmental Representative.
  - .1 Train O M personnel in functional operations and procedures to be employed for system operation.
  - .2 Supplement with on-the-job training during 30 day test period.
  - .3 Include overview of system architecture, communications, operation of computer and peripherals, report generation.
  - .4 Introduction to Direct Digital Controls.
  - .5 Identification of Control Components.
  - .6 Review of DDC Network Diagram for building.
  - .7 Review of shop drawings for building.
  - .8 Detailed discussion of sequences of operation
  - .9 Walk through of mechanical systems.

## 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 AND ABBREVIATIONS

#### .1 Acronyms used in EMCS:

- .1 AEL - Average Effectiveness Level
- .2 AI - Analog Input
- .3 AO - Analog Output
- .4 MCU - Master Control Units
- .5 LCU- Local Control Units
- .6 TCU - Terminal Control Unit
- .7 RC - Room Controller
- .8 CAB - Canadian Automated Building (CAB) Protocol
- .9 CAD - Computer Aided Design
- .10 CDL - Control Description Logic
- .11 CDS - Control Design Schematic
- .12 COSV - Change of State or Value
- .13 CPU - Central Processing Unit
- .14 DI - Digital Input
- .15 DO - Digital Output
- .16 DP - Differential Pressure
- .17 ECU - Equipment Control Unit
- .18 EMCS - Energy Monitoring and Control System
- .19 HVAC - Heating, Ventilation, Air Conditioning
- .20 IDE - Interface Device Equipment
- .21 I/O - Input/Output
- .22 ISA - Industry Standard Architecture
- .23 LAN - Local Area Network
- .24 NC - Normally Closed
- .25 NO - Normally Open
- .26 OS - Operating System
- .27 O&M - Operation and Maintenance
- .28 OWS - Operator Work Station
- .29 PC - Personal Computer
- .30 PCI - Peripheral Control Interface
- .31 PCMCIA - Personal Computer Micro-Card Interface Adapter
- .32 PID - Proportional, Integral and Derivative.
- .33 RAM - Random Access Memory
- .34 ROM - Read Only Memory
- .35 SP - Static Pressure
- .36 USB - Universal Serial Bus
- .37 UPS - Uninterruptible Power Supply
- .38 WAN- Wide Area Network

### 1.2 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 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.

### 1.3 SYSTEM DESCRIPTION

- .1 Refer to control schematics, points schedule, sequences of operation and related Divisions of specifications 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 and/or shown on the control drawings.
  - .3 Data communications equipment necessary to effect EMCS data transmission system.
  - .4 Field control devices.
  - .5 Software/Hardware complete with full documentation.
  - .6 Complete operating and maintenance manuals.
  - .7 Training of site personnel.
  - .8 Acceptance tests, technical support during commissioning, full documentation.
  - .9 Wiring interface co-ordination of equipment supplied by others.
- .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.
  - .5 Metric references: in accordance with CAN/CSA Z234.1.
- .4 The network design to be a fully distributed network, with each primary system having its own locally mounted dedicated controller. Any failure in the network shall **not** in any way affect the control of these primary systems. Connecting hardware points from one system to more than one controller is not acceptable. Any points associated with a system are to be connected to one dedicated controller.
- .5 All wiring associated with the EMCS communication network as well as all control wiring and conduit associated with the EMCS at 50 volts or less. Wire and conduit above 50 volts by Electrical Division.

### 1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Make submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit for review:
  - .1 Equipment list within 10 days after award of contract.
  - .2 List existing field control devices to be re-used.
- .3 Quality Control:
  - .1 Provide equipment and material from manufacturer's regular production, CSA certified, manufactured to standard quoted plus additional specified requirements.
  - .2 Where CSA certified equipment is not available submit such equipment to inspection authorities for special inspection and approval before delivery to site.
  - .3 For materials whose compliance with organizational standards/codes/specifications is not

regulated by organization using its own listing or label as proof of compliance, furnish certificate stating that material complies with applicable referenced standard or specification.

- .4 Permits and fees: in accordance with general conditions of contract.
- .5 Submit certificate of acceptance from authority having jurisdiction to Departmental Representative.
- .6 Existing devices intended for re-use: submit test report.

#### 1.5 QUALITY ASSURANCE

- .1 Ensure qualified supervisory personnel continuously direct and monitor Work and attend site meetings.
- .2 Health and Safety:
  - .1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

#### 1.6 DELIVERY, STORAGE AND HANDLING

- .1 Material Delivery Schedule: provide Departmental Representative with schedule within 2 weeks after award of Contract.
- .2 Waste Management and Disposal:
  - .1 Separate waste materials for recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

### PART 2 - PRODUCTS

#### 2.1 ACCEPTABLE SYSTEMS, MANUFACTURERS

- .1 Johnson Controls - 30 Edgewater Street, Ottawa, ON, K2L 1V8

### PART 3 - EXECUTION

#### 3.1 MANUFACTURER'S RECOMMENDATIONS

- .1 Installation: to manufacturer's recommendations.

END OF SECTION

## PART 1 - GENERAL

### 1.1 DESIGN REQUIREMENTS

.1 Preliminary Design Review: to contain following contractor and systems information.

- .1 Sketch of site-specific system architecture.
- .2 Specification sheets for each item.
- .3 Sample CDL and graphics (systems schematics).

### 1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures and coordinate with requirements in this Section.
- .2 Submit preliminary design document within 5 working days after contract award, for review by Departmental Representative.
- .3 Shop Drawings to consist of 3 hard copies and 1 soft copy of design documents, shop drawings, product data and software.
- .4 Hard copy to be completely indexed and coordinated package to assure compliance with contract requirements and arranged in same sequence as specification and cross-referenced to specification section and paragraph number.
- .5 Soft copy to be in PDF structured using menu format for easy loading and retrieval on OWS.
- .6 Submittals shall consist of:
  - .1 Data sheets of all products.
  - .2 List of materials of all proposed devices and equipment.
  - .3 Sequence of operation, in text form.
  - .4 Application programs.
  - .5 Point Schedules
  - .6 Controls schematics and system diagrams.
- .7 Submit shop drawings in a package which contains the various schedules and drawings which completely describe the control system installed. At a minimum the shop drawing package to contain the following:
- .8 Network drawing showing the network connection of all network control units, programmable control units, terminal control units and operator workstations to indicate the location of each of these elements.
- .9 Schematic control diagram for each system being controlled. Where there are typical systems a drawing to be provided for each system. This drawing to be on a AB size sheet (11 x 17) and shall include a title block which includes as a minimum the drawing title, drawing number, project title, contractor's name, contractor's address, contractor's phone and fax numbers, contractor's project number and a section to provide a record for revision information.
- .10 The schematic control diagram to include a bill of materials which provides a list of all part numbers and descriptions for the control components on the drawing list to include field equipment as well as panel mounted components.
- .11 The contractor to include with the shop drawing submittal drawings, showing all wiring details for the connections of sensors, transducers, relays and contactors these details to show terminal numbers and be referenced to the appropriate schedules and drawings.



- .12 The contractor to supply with the shop drawing package a complete point schedule to show every point connected to the system. This schedule to be in tabular format and provide the point identification, point type, wire tag, termination details reference, referenced drawings, device mounting location and device code numbers.
- .13 The point schedule to provide at a minimum the following information on the software attributes of the point:
  - .1 Tag name - ex. EPT-1
  - .2 Point type - ex. AO-3
  - .3 System name - ex. A/C-1
  - .4 Object name - H-VLV.
  - .5 Expanded ID- Heating control valve
  - .6 Units of measurement - %.
- .14 The point schedule to provide at a minimum the following information on the digital controller to which the point is connected:
  - .1 Controller type - ex. Unitary controller
  - .2 Controller address ex. 256.
  - .3 Cable destination - the termination at the controller, ex. AO-1.
  - .4 Terminal numbers - the termination at the controller.
- .15 The point schedule to provide at minimum the following information on the control panel:
  - .1 Panel identification
  - .2 Panel location
  - .3 Reference drawing
- .16 The point schedule to provide at a minimum the following information on any intermediate device which may be associated with the point:
  - .1 Device part number
  - .2 Location of the device.
  - .3 Reference details.
- .17 The point schedule to provide at a minimum the following information on any field device which may be associated with the point;
  - .1 Device part number
  - .2 Location of the devices
  - .3 Reference details
- .18 The contractor to supply with the shop drawing package a complete room schedule, to show the equipment associated with the room controls. Schedule to be in tabular format and provide the room number and location, terminal unit number, part numbers for the terminal unit controller, sensors and actuators. Included on this schedule terminal unit type, size, minimum flow and maximum flow.
- .19 Sequence of operation for each system controlled. Sequence to be in complete conformance with the sequence of operations included with this specification. Any changes require the approval of the Owner's Representative in writing. Sequence to include all modes of operation including fail safe, emergency and fire modes.
- .20 Valve schedule including design flow, CV, size, type, actuator, pressure drop and maximum shut off pressure differential for each control valve.
- .21 Damper schedule including design air flow, size, type actuator and torque requirements for each

control damper.

- .22 Catalogue cut sheets of all equipment used. This includes, but is not limited to DDC panels, peripherals, sensors, actuators, dampers, control air system components, etc.

### 1.3 PRELIMINARY SHOP DRAWING REVIEW

- .1 Submit preliminary shop drawings within 30 working days of award of contract and include following:
  - .1 Specification sheets for each item. To include manufacturer's descriptive literature, manufacturer's installation recommendations, specifications, drawings, diagrams, performance and characteristic curves, catalogue cuts, manufacturer's name, trade name, catalogue or model number, nameplate data, size, layout, dimensions, capacity, other data to establish compliance.
  - .2 Detailed system architecture showing all points associated with each controller including signal levels, pressures where new EMCS ties into existing control equipment.
  - .3 Spare point capacity of each controller by number and type.
  - .4 Controller locations.
  - .5 Valves: complete schedule listing including following information: designation, service, manufacturer, model, point ID, design flow rate, design pressure drop, required Cv, Valve size, actual Cv, spring range, pilot range, required torque, actual torque and close off pressure (required and actual).

### 1.4 DETAILED SHOP DRAWING REVIEW

- .1 Submit detailed shop drawings within 60 working days after award of contract and before start of installation and include following:
  - .1 Corrected and updated versions (hard copy only) of submissions made during preliminary review.
  - .2 Interface wiring diagrams showing termination connections and signal levels for equipment to be supplied by others.
  - .3 Shop drawings for each input/output point, sensors, transmitters, showing information associated with each particular point including:
    - .1 Sensing element type and location.
    - .2 Transmitter type and range.
    - .3 Associated field wiring schematics, schedules and terminations.
    - .4 Complete Point Name Lists.
    - .5 Setpoints, curves or graphs and alarm limits (high and low, 3 types critical, cautionary and maintenance), signal range.
    - .6 Software and programming details associated with each point.
    - .7 Manufacturer's recommended installation instructions and procedures.
    - .8 Input and output signal levels or pressures where new system ties into existing control equipment.
  - .4 Control schematics, narrative description, CDL's fully showing and describing automatic and manual procedure required to achieve proper operation of project, including under complete failure of EMCS.
  - .5 Graphic system schematic displays of water systems with point identifiers and textual description of system, and typical floor plans as specified.
  - .6 Complete system CDL's including companion English language explanations on same sheet but with different font and italics. CDL's to contain specified energy optimization programs.
  - .7 Listing and example of specified reports.

### 1.5 QUALITY ASSURANCE

- .1 Preliminary Design Review Meeting: Convene meeting within 45 working days of award of contract to:

- .1 Undertake functional review of preliminary design documents, resolve inconsistencies.
  - .2 Resolve conflicts between contract document requirements and actual items (e.g.: points list inconsistencies).
  - .3 Review interface requirements of materials supplied by others.
  - .4 Review "Sequence of Operations".
- .2 Contractor's programmer to attend meeting.
- .3 Departmental Representative retains right to revise sequence or subsequent CDL prior to software finalization without cost to Departmental Representative.

## **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 RELATED REQUIREMENTS

- .1 Section 25 01 11 - EMCS: Start-up, Verification and Commissioning
- .2 Section 25 05 02 - EMCS: Submittals and Review Process

### 1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals in accordance with Section 01 78 00 - Closeout Procedures, supplemented and modified by requirements of this Section.
- .2 Submit Record Documents, As-built drawings, Operation and Maintenance Manual to Departmental Representative in English and French.
- .3 Provide soft copies and hard copies in hard-back, 50 mm 3 ring, D-ring binders.
  - .1 Binders to be 2/3 maximum full.
  - .2 Provide index to full volume in each binder.
  - .3 Identify contents of each manual on cover and spine.
  - .4 Provide Table of Contents in each manual.
  - .5 Assemble each manual to conform to Table of Contents with tab sheets placed before instructions covering subject.

### 1.3 AS-BUILTS

- .1 Provide 1 copy of detailed shop drawings generated in Section 25 05 02 - EMCS: Submittals and Review Process and include:
  - .1 Changes to contract documents as well as addenda and contract extras.
  - .2 Test procedures and reports: provide records of start-up procedures, test procedures, checkout tests and final commissioning reports as specified in Section 25 01 11 - EMCS: Start-up, Verification and Commissioning.
  - .3 Basic system design and full documentation on system configuration.
- .2 Submit for final review by Departmental Representative.
- .3 Provide before acceptance 4 hard and 1 soft copy incorporating changes made during final review.

### 1.4 O M MANUALS

- .1 Custom design O M Manuals (both hard and soft copy) to contain material pertinent to this project only, and to provide full and complete coverage of subjects referred to in this Section.
- .2 Provide 2 complete sets of hard and soft copies prior to system or equipment tests
- .3 Include complete coverage in concise language, readily understood by operating personnel using common terminology of functional and operational requirements of system. Do not presume knowledge of computers, electronics or in-depth control theory.
- .4 Functional description to include:
  - .1 Functional description of theory of operation.
  - .2 Design philosophy.
  - .3 Specific functions of design philosophy and system.
  - .4 Full details of data communications, including data types and formats, data processing and

- disposition data link components, interfaces and operator tests or self-test of data link integrity.
- .5 Explicit description of hardware and software functions, interfaces and requirements for components in functions and operating modes.
  - .6 Description of person-machine interactions required to supplement system description, known or established constraints on system operation, operating procedures currently implemented or planned for implementation in automatic mode.
- .5 System operation to include:
- .1 Complete step-by-step procedures for operation of system including required actions at each OWS.
  - .2 Operation of computer peripherals, input and output formats.
  - .3 Emergency, alarm and failure recovery.
  - .4 Step-by-step instructions for start-up, back-up equipment operation, execution of systems functions and operating modes, including key strokes for each command so that operator need only refer to these pages for keystroke entries required to call up display or to input command.
- .6 Maintenance: document maintenance procedures including inspection, periodic preventive maintenance, fault diagnosis, repair or replacement of defective components, including calibration, maintenance, repair of sensors, transmitters, transducers, controller and interface firmware's, plus diagnostics and repair/replacement of system hardware.
- .7 System configuration document:
- .1 Provisions and procedures for planning, implementing and recording hardware and software modifications required during operating lifetime of system.
  - .2 Information to ensure co-ordination of hardware and software changes, data link or message format/content changes, sensor or control changes in event that system modifications are required.
- .8 Programmer control panel documentation: provide where panels are independently interfaced with BECC, including interfacing schematics, signal identification, timing diagrams, fully commented source listing of applicable driver/handler.

## PART 2 - PRODUCTS

### 2.1 NOT USED

- .1 Not Used.

## PART 3 - EXECUTION

### 3.1 NOT USED

- .1 Not Used.

END OF SECTION

EMCS: IDENTIFICATION

**PART 1 - GENERAL**

.1 REFERENCES

.2 Canadian Standards Association (CSA International).

.1 CSA C22.1-02, The Canadian Electrical Code, Part I (19th Edition), Safety Standard for Electrical Installations.

.3 SYSTEM DESCRIPTION

.4 Language Operating Requirements: provide identification for control items in English and French.

.5 ACTION AND INFORMATIONAL SUBMITTALS

.6 Submittals in accordance with Section 01 33 00 - Submittal Procedures supplemented and modified by requirements of this Section.

.7 Submit to Departmental Representative for approval samples of nameplates, identification tags and list of proposed wording.

**PART 2 - PRODUCTS**

2.1 NAMEPLATES FOR PANELS

.1 Identify by Plastic laminate, 3 mm thick Melamine, matte white finish, black core, square corners, lettering accurately aligned and engraved into core, mechanically attached with self-tapping screws.

.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 plastic tie.

.2 Sizes: 50 x 100 mm minimum.

.3 Lettering: minimum 5 mm high produced from laser printer in black.

.4 Data to include: point name and point address, make, model number.

.5 Companion cabinet: identify interior components using plastic enclosed cards with point name and point address.

2.3 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.

2.4 WIRING

.1 Supply and install numbered tape markings on wiring at panels, junction boxes, splitters, cabinets

**EMCS: IDENTIFICATION**

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.

**2.5 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.

**3.2 EXISTING PANELS**

- .1 Correct existing nameplates and legends to reflect changes made during Work.

**END OF SECTION**

## PART 1 - GENERAL

### 1.1 RELATED REQUIREMENTS

- .1 Section 25 05 54- EMCS: Identification
- .2 Section 25 08 20 - EMCS: Warranty and Maintenance.

### 1.2 REFERENCES

- .1 American National Standards Institute (ANSI)
  - .1 ANSI C2-2007, National Electrical Safety Code.
  - .2 ANSI/NFPA 70-2014, National Electrical Code.
- .2 CSA Group
  - .1 CAN/CSA-C22.3 No. 7-10, Underground Systems.
  - .2 CSA C22.2 No. 45.1-07(R2012), Electrical Rigid Metal Conduit.
  - .3 CSA C22.2 No. 56-13, Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.
  - .4 CSA C22.2 No. 83-M1985(R2013), Electrical Metallic Tubing.

### 1.3 SYSTEM DESCRIPTION

- .1 Electrical:
  - .1 Hard wiring between field control devices and EMCS field panels.
  - .2 Communication wiring between EMCS field panels and Master Control Unit (MCU).
  - .3 All control wiring 50 V and less for equipment supplied by Division 25 will be the responsibility of Division 25. Conduit and wire associated with this is the responsibility of Division 25.
- .2 Mechanical:
  - .1 Installation of devices requiring sheet metal trades to be mounted by Mechanical Contractor.

### 1.4 PERSONNEL QUALIFICATIONS

- .1 Qualified supervisory personnel to:
  - .1 Continuously direct and monitor all work.
  - .2 Attend site meetings.

### 1.5 EXISTING CONDITIONS

- .1 Repair all surfaces damaged during execution of work.

## PART 2 - PRODUCTS

### 2.1 SPECIAL SUPPORTS

- .1 Structural grade steel, primed and painted after construction and before installation.

### 2.2 WIRING

- .1 As per requirements of Division 26.
- .2 For 50V and above copper conductor with chemically cross-linked thermosetting polyethylene



insulation rated RW90 and 600V. Colour code to CSA 22.1.

.3 For wiring under 50 volts use FT6 rated wiring where wiring is not run in conduit. All other cases use FT4 wiring.

.4 Sizes:

.1 120V Power supply: to match or exceed breaker, size #12 minimum.

.2 Wiring for safeties/interlocks for starters, motor control centres, to be stranded, #14 minimum.

.3 Field wiring to digital device: #18AWG or 20AWG stranded twisted pair.

.4 Analog input and output: shielded #18 minimum solid copper or #20 minimum stranded twisted pair. Wiring must be continuous without joints.

.5 More than 4 conductors: #22 minimum solid copper.

.5 Terminations:

.1 Terminate wires with screw terminal type connectors suitable for wire size, and number of terminations.

## 2.3 CONDUIT

.1 As per requirements of Division 26.

.2 Electrical metallic tubing to CSA C22.2 No. 83. Flexible and liquid tight flexible metal conduit to CSA C22.2 No. 56. Rigid steel threaded conduit to CSA C22.2 No. 45.1.

.3 Junction and pull boxes: welded steel.

.1 Surface mounting cast FS: screw-on flat covers.

.2 Flush mounting: covers with 25 mm minimum extension all round.

.4 Cabinets: sheet steel, for surface mounting, with hinged door, latch lock, 2 keys, complete with perforated metal mounting backboard. Panels to be keyed alike for similar functions and or entire contract as approved.

.5 Outlet boxes: 100 mm minimum, square.

.6 Conduit boxes, fittings:

.1 Bushings and connectors: with nylon insulated throats.

.2 With push pennies to prevent entry of foreign materials.

.7 Fittings for rigid conduit:

.1 Couplings and fittings: threaded type steel.

.2 Double locknuts and insulated bushings: use on sheet metal boxes.

.3 Use factory "ells" where 90 degree bends required for 25 mm and larger conduits.

.8 Fittings for thin wall conduit:

.1 Connectors and couplings: steel, set screw type.

## 2.4 WIRING DEVICES, COVER PLATES

.1 Conform to CSA.

.2 Receptacles:

EMCS: FIELD INSTALLATION

- .1 Duplex: CSA type 5-15R.
- .2 Single: CSA type 5-15R.
- .3 Cover plates and blank plates: finish to match other plates in area.

2.5 SUPPORTS FOR CONDUIT, FASTENINGS, EQUIPMENT

- .1 Solid masonry, tile and plastic surfaces: lead anchors or nylon shields.
  - .1 Hollow masonry walls, suspended drywall ceilings: toggle bolts.
- .2 Exposed conduits or cables:
  - .1 50 mm diameter and smaller: one-hole steel straps.
  - .2 Larger than 50 mm diameter: two-hole steel straps.
- .3 Suspended support systems:
  - .1 Individual cable or conduit runs: support with 6 mm diameter threaded rods and support clips.
  - .2 Two or more suspended cables or conduits: support channels supported by 6 mm diameter threaded rod hangers.

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 Supply and install required equipment and modules to communicate data between new Control Panels and existing BAS (Johnson Controls Metasys) and allow for BAS upgrades in future.

3.2 SUPPORTS

- .1 Install special supports as required and as indicated.

3.3 ELECTRICAL GENERAL

- .1 Do complete installation in accordance with requirements of:
  - .1 Division 26, this specification.
  - .2 CSA 22.1 Canadian Electrical Code.
  - .3 ANSI/NFPA 70.
  - .4 ANSI C2.
- .2 Fully enclose or properly guard electrical wiring, terminal blocks, high voltage (above 70 V) contacts and mark to prevent accidental injury.
- .3 Do underground installation to CAN/CSA-C22.3 No.7, except where otherwise specified.
- .4 Conform to manufacturer's recommendations for storage, handling and installation.
- .5 Check factory connections and joints. Tighten where necessary to ensure continuity.
- .6 Install electrical equipment between 1000 and 2000 mm above finished floor wherever possible and adjacent to related equipment.
- .7 Protect exposed live equipment such as panel, mains, outlet wiring during construction for personnel safety.

- .8 Shield and mark live parts "LIVE 120 VOLTS" or other appropriate voltage.
- .9 Install conduits, and sleeves prior to pouring of concrete.
- .10 Holes through exterior wall and roofs: flash and make weatherproof.
- .11 Make necessary arrangements for cutting of chases, drilling holes and other structural work required to install electrical conduit, cable, pull boxes, outlet boxes.
- .12 Install cables, conduits and fittings which are to be embedded or plastered over, neatly and closely to building structure to minimize furring.

### 3.4 CONDUIT SYSTEM

- .1 Communication wiring shall be installed in conduit. Provide complete conduit system to link Building Controllers to BECC. Conduit sizes to suit wiring requirements and to allow for future expansion capabilities specified for systems. Maximum conduit fill not to exceed 40%. Design drawings do not show conduit layout.
- .2 Install conduits parallel or perpendicular to building lines, to conserve headroom and to minimize interference.
- .3 Do not run exposed conduits in normally occupied spaces unless otherwise indicated or unless impossible to do otherwise. Obtain approval from Departmental Representative before starting such work. Provide complete conduit system to link field panels and devices with main control centre. Conduit size to match conductors plus future expansion capabilities as specified.
- .4 Locate conduits at least 150 mm from parallel steam or hot water pipes and at least 50 mm at crossovers.
- .5 Bend conduit so that diameter is reduced by less than 1/10th original diameter.
- .6 Field thread on rigid conduit to be of sufficient length to draw conduits up tight.
- .7 Limit conduit length between pull boxes to less than 30 m.
- .8 Use conduit outlet boxes for conduit up to 32 mm diameter and pull boxes for larger sizes.
- .9 Fastenings and supports for conduits, cables, and equipment:
  - .1 Provide metal brackets, frames, hangers, clamps and related types of support structures as indicated and as required to support cable and conduit runs.
  - .2 Provide adequate support for raceways and cables, sloped vertically to equipment.
  - .3 Use supports or equipment installed by other trades for conduit, cable and raceway supports only after written approval from Departmental Representative.
- .10 Install polypropylene fish cord in empty conduits for future use.
- .11 Where conduits become blocked, remove and replace blocked sections.
- .12 Pass conduits through structural members only after receipt of Departmental Representative's written approval.
- .13 Conduits may be run in flanged portion of structural steel.
- .14 Group conduits wherever possible on suspended or surface channels.
- .15 Pull boxes:

- .1 Install in inconspicuous but accessible locations.
  - .2 Support boxes independently of connecting conduits.
  - .3 Fill boxes with paper or foam to prevent entry of construction material.
  - .4 Provide correct size of openings. Reducing washers not permitted.
  - .5 Mark location of pull boxes on record drawings.
  - .6 Identify AC power junction boxes, by panel and circuit breaker.
- .16 Install terminal blocks or strips indicated in cabinets to Electrical Division.
- .17 Install bonding conductor for 120 volt and above in conduit.

### 3.5 WIRING

- .1 Install multiple wiring in ducts simultaneously.
- .2 Do not pull spliced wiring inside conduits or ducts.
- .3 Use CSA certified lubricants of type compatible with insulation to reduce pulling tension.
- .4 Tests: use only qualified personnel. Demonstrate that:
  - .1 Circuits are continuous, free from shorts, unspecified grounds.
  - .2 Resistance to ground of all circuits is greater than 50 Megohms.
- .5 Provide Departmental Representative with test results showing locations, circuits, results of tests.
- .6 Remove insulation carefully from ends of conductors and install to manufacturer's recommendations. Accommodate all strands in lugs. Where insulation is stripped in excess, neatly tape so that only lug remains exposed.
- .7 Wiring in main junction boxes and pull boxes to terminate on terminal blocks only, clearly and permanently identified. Junctions or splices not permitted for sensing or control signal covering wiring.
- .8 Do not allow wiring to come into direct physical contact with compression screw.
- .9 Install ALL strands of conductor in lugs of components. Strip insulation only to extent necessary for installation.

### 3.6 WIRING DEVICES, COVER PLATES

- .1 Receptacles:
  - .1 Install vertically in gang type outlet box when more than one receptacle is required in one location.
  - .2 Cover plates:
    - .1 Install suitable common cover plate where wiring devices are grouped.
    - .2 Use flush type cover plates only on flush type outlet boxes.

### 3.7 STARTERS, CONTROL DEVICES

- .1 Install and make power and control connections as indicated. Power connections above 50V by Division 26.
- .2 Install correct over-current devices.
- .3 Identify each wire, terminal for external connections with permanent number marking identical to diagram.

.4 Performance Verification:

- .1 Operate switches and controls to verify functioning.
- .2 Perform start and stop sequences of contactors and relays.
- .3 Check that interlock sequences, with other separate related starters, equipment and auxiliary control devices, operate as specified.

3.8 GROUNDING

- .1 Install complete, permanent, continuous grounding system for equipment, including conductors, connectors and accessories.
- .2 Install separate grounding conductors in conduit within building.
- .3 Install ground wire in all PVC ducts and in tunnel conduit systems.
- .4 Tests: perform ground continuity and resistance tests, using approved method appropriate to site conditions.

3.9 TESTS

.1 General:

- .1 Perform following tests in addition to tests specified Section 25 08 20 - EMCS: Warranty and Maintenance.
- .2 Give 14 days written notice of intention to test.
- .3 Conduct in presence of Departmental Representative and authority having jurisdiction.
- .4 Conceal work only after tests satisfactorily completed.
- .5 Report results of tests to Departmental Representative in writing.
- .6 Preliminary tests:
  - .1 Conduct as directed to verify compliance with specified requirements.
  - .2 Make needed changes, adjustments, replacements.
  - .3 Insulation resistance tests:
    - .1 Megger all circuits, feeders, equipment for 120 - 600V with 1000V instrument. Resistance to ground to be more than required by Code before energizing.
    - .2 Test insulation between conductors and ground, efficiency of grounding system to satisfaction of Departmental Representative and authority having jurisdiction.

3.10 IDENTIFICATION

- .1 Refer to Section 25 05 54 - EMCS: Identification.

END OF SECTION

## PART 1 - GENERAL

### 1.1 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit detailed inspection reports to Departmental Representative.
- .3 Revise and submit to Departmental Representative in accordance with Section 01 78 00 - Closeout Submittals "As-built drawings" documentation and commissioning reports to reflect changes, adjustments and modifications to EMCS made during warranty period.

### 1.2 MAINTENANCE SERVICE DURING WARRANTY PERIOD

- .1 Provide services, materials, and equipment to maintain EMCS for warranty period or one year after date of substantial completion.
- .2 Emergency Service Calls:
  - .1 Initiate service calls when EMCS is not functioning correctly.
  - .2 Qualified control personnel to be available during warranty period to provide service to "CRITICAL" components whenever required at no extra cost.
  - .3 Furnish Departmental Representative with telephone number where service personnel may be reached at any time.
  - .4 Service personnel to be on site ready to service EMCS 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 FIELD QUALITY CONTROL

- .1 Rectify deficiencies revealed by maintenance inspections and environmental checks.
- .2 Continue system debugging and optimization.
- .3 Testing/verification of occupancy and seasonal-sensitive systems to take place during four (4) consecutive seasons, after facility has been accepted, taken over and fully occupied.
  - .1 Test weather-sensitive systems twice: first at near winter design conditions and secondly under near summer design conditions.

END OF SECTION

## PART 1 - GENERAL

### 1.1 REFERENCES

- .1 Canadian Standards Association (CSA International).
  - .1 CSA T529-95(R2000), Telecommunications Cabling Systems in Commercial Buildings (Adopted ANSI/TIA/EIA-568-A with modifications).
  - .2 CSA T530-99(R2004), Commercial Building Standard for Telecommunications Pathways and Spaces (Adopted ANSI/TIA/EIA-569-A with modifications).
- .2 Telecommunications Industries Association (TIA)/Electronic Industries Alliance (EIA)
  - .1 TIA/EIA-568-March 2004, Commercial Building Telecommunications Cabling Standards Set, Part 1 General Requirements Part 2 Balanced Twisted-Pair Cabling Components Part 3 Optical Fiber Cabling Components Standard.
  - .2 TIA/EIA-569-A-December 2001, Commercial Building Standard for Telecommunications Pathways and Spaces.

### 1.2 SYSTEM DESCRIPTION

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

### 1.3 DESIGN REQUIREMENTS

- .1 EMCS Local Area Network (EMCS-LAN).
  - .1 EMCS-LAN to be: to match existing BAS in building.
- .2 Network Medium.
  - .1 Network medium to be shielded twisted cable

## 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 OWS SYSTEM DESCRIPTION

.1 Existing.

**PART 2 - PRODUCTS**

2.1 OWS SYSTEM

.1 Existing.

**PART 3 - EXECUTION**

3.1 INSTALLATION REQUIREMENTS

- .1 Provide necessary power as required from local 120 V emergency power branch circuit panels for OWS's and peripheral equipment.
- .2 Provide necessary testing and commissioning procedures to ensure that new Controls equipment and all sump pump control panels are operational and visual on OWS / PMI.

**END OF SECTION**

## PART 1 - GENERAL

### 1.1 System Description

- .1 General: Network of controllers comprising of MCU('s), LCU('s), TCU('s) or RC('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 Controllers 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 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 with other controller. Secondary input used for reset such as outdoor air temperature may be located in other Controller(s).

### 1.2 DESIGN REQUIREMENTS

- .1 To include:
  - .1 Scanning of AI and DI connected inputs for detection of change of value and processing the detection of alarm conditions.
  - .2 Perform On-Off digital control of connected points, including the 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 conform 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 logic devices and associated field equipment.
    - .3 Lockable wall cabinet.
    - .4 Required communications equipment and wiring .
    - .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 12 bit analog-to-digital resolution.

- .2 Provide for following input signal types and ranges:
  - .1 4 - 20 mA;
  - .2 0-10V DC
  - .3 10 K ohm.
- .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 12 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 Controller's and associated hardware and software: operate in conditions of 0°C to 44°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 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.

## PART 2 - PRODUCTS

### 2.1 MASTER CONTROL UNIT (MCU)

- .1 Existing

### 2.2 LOCAL CONTROL UNIT (LCU)

- .1 The Local Control Unit (LCU) shall communicate between BMS Controllers and other BACnet devices. LCU's shall communicate with the MCU's and ASC's at a baud rate of not less than 78.8K baud using BACnet communications protocol.
- .2 LCU shall be;
  - .1 Same as existing systems used in BAS.

### 2.3 SOFTWARE

- .1 All software is existing.

### PART 3 - EXECUTION

#### 3.1 LOCATION

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

#### 3.2 INSTALLATION

- .1 Install Controllers in secure 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 Division 25 is responsible to run new MS/TP 18AWG cables from all new pump control panels to the communication closet located in the Mechanical room. See drawings for details.  
.5 Supply and install new Network Automation Engine NAE-35 (or NCE-25) and new Field Server Module in the Mechanical room, in IT closet.  
.6 Connect all new pump control panels (BACnet compatible) to Network Automation Engine NAE-35 (or NCE-25) and new Field Server Module and to existing Network Control Module (N2 communication protocol) and person machine interface (PMI).  
.7 Connect new pump control panels via new Network Automation Engine NAE-35 (or NCE-25) and new Field Server Module to existing BAS.

END OF SECTION

## PART 1 - GENERAL

### 1.1 RELATED SECTIONS:

- .1 Section 25 05 02 - EMCS: Submittals and Review Process
- .2 Section 25 05 03 - EMCS: Project Records Documents.
- .3 Section 25 05 54 - EMCS: Identification.
- .4 Section 25 08 20 - EMCS: Warranty and Maintenance.

### 1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit shop drawings and manufacturer's installation instructions in accordance with Section 25 05 02 - EMCS: Submittals and Review Process.
- .2 Include:
  - .1 Information as specified for each device.
  - .2 Manufacturer's detailed installation instructions.
- .3 Manufacturer's Instructions
  - .1 Submit manufacturer's installation instructions for specified equipment and devices.

### 1.3 EXISTING CONDITIONS

- .1 Repair surfaces damaged during execution of Work.

### 1.4 CLOSEOUT SUBMITTALS

- .1 Submit operating and maintenance data for inclusion in operation and maintenance manual in accordance with Section 25 05 03 - EMCS: Project Records Documents.

## PART 2 - PRODUCTS

### 2.1 GENERAL

- .1 Control devices of each category to be of same type and manufacturer.
- .2 Operating conditions: 0 - 32 DegC with 10 - 90 % RH (non-condensing) unless otherwise specified.
- .3 Terminations: use standard conduit box with slot screwdriver compression connector block unless otherwise specified.
- .4 Transmitters to be unaffected by external transmitters (eg. walkie talkies).
- .5 Account for hysteresis, relaxation time, maximum and minimum limits in applications of sensors and controls.
- .6 Devices to be installed in user occupied space must not exceed Noise Criteria (NC) of 35. Noise generated by any device must not be detectable above space ambient conditions.

### 2.2 CURRENT SENSING RELAYS

- .1 Requirements:

- .1 Complete with metering transformer ranged to match load, plug-in base and shorting shunt to protect current transformer when relay is removed from socket.
- .2 Suitable for single or 3 phase metering into single relay.
- .3 To have adjustable latch level, adjustable delay on latch and minimum differential of 10 % of latch setting between latch level and release level.
- .4 3-Phase application: provide for discrimination between phases.
- .5 To have adjustable latch level to allow detection of worst case selection. To be powered from control circuit of motor starter being metered. Relay and base to be mounted in adjacent auxiliary cabinet only if control circuit power to be brought into auxiliary cabinet. Adjustments to be acceptable from auxiliary cabinet.
- .6 Relay contacts: capable of handling 10 amps at 240 V AC.

### 2.3 PANELS

- .1 Either free-standing or wall mounted enameled steel cabinets with hinged and key-locked front door.
- .2 To be modular multiple panels as required to handle requirements with additional space to accommodate future capacity as required by Departmental Representative without adding additional cabinets.
- .3 Panels to be lockable with same key.

## 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, conduit and wire in accordance with manufacturer's recommended methods, procedures and instructions. Wiring and conduit above 50 volts by electrical Division. Coordinate requirements with Electrical Contractor.
- .3 Temperature transmitters, humidity transmitters, current-to-pneumatic transducers, solenoid air valves, controllers, relays: install in CSA 2 enclosures or as required for specific applications. Provide for electrolytic isolation in all cases when dissimilar metals make contact.
- .4 Support field-mounted transmitters, sensors on pipe stands or channel brackets.
- .5 Install wall mounted devices on plywood panel properly attached to wall.

### 3.2 IDENTIFICATION

- .1 Identify field devices properly.
- .2 Refer to Section 25 05 54 - EMCS: Identification.

### 3.3 TESTING

- .1 Calibrate and test field devices for accuracy and performance. Submit report detailing tests performed, results obtained to Departmental Representative for approval. Departmental Representative will verify results at random. Provide testing equipment and manpower necessary for this verification.

### 3.4 COMMISSIONING

- .1 Refer to Section 25 08 20 - EMCS: Warranty and Maintenance.

END OF SECTION



## PART 1 - GENERAL

### 1.1 DESIGN DOCUMENTATION

.1 Design documentation for each system to include, as a minimum:

- .1 Narrative type of Sequence of Operation.
- .2 Control Description Logic (CDL).
- .3 Input / Output Summary Schedules.
- .4 Schematics.

### 1.2 EMCS LANGUAGE DESIGN CRITERIA

- .1 The descriptor shall be unique.
- .2 Use existing.

### 1.3 I/O SUMMARY SCHEDULES

.1 General:

- .1 The EMCS contractor shall provide a complete I/O summary schedule similar to the one listed below, listing and describing all I/O's in detail.

### 1.4 CONTROL NARRATIVE SEQUENCE OF OPERATIONS

.1 Miscellaneous Equipment Status Points

- .1 The following equipment shall be monitored by the EMCS:
  - .1 Pump status (on/off) for each sump pump.
  - .2 Flood sensor for each sump room.
  - .3 High level alarm for each sump pit.
- .2 All monitored equipment shall have communication to pager, email, and printer via existing and upgraded BAS system using data communication protocol BACnet compatible.

## 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 RELATED REQUIREMENTS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 45 00 - Quality Control.
- .3 Section 01 61 00 - Common Product Requirements.
- .4 Section 01 74 11 - Cleaning.
- .5 Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .6 Section 01 78 00 - Closeout Submittals.

### 1.2 REFERENCES

- .1 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.
- .2 Reference Standards:
  - .1 CSA Group
    - .1 CSA C22.1-15, Canadian Electrical Code, Part 1 (23rd Edition), Safety Standard for Electrical Installations.
    - .2 CAN3-C235-83(R2010), 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 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Shop drawings:
  - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
  - .2 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.
  - .3 Identify on wiring diagrams circuit terminals and indicate internal wiring for each item of equipment and interconnection between each item of equipment.
  - .4 Indicate on drawings clearances for operation, maintenance, and replacement of operating equipment devices.
  - .5 If changes are required, notify Departmental Representative and consultant of these changes before they are made.
- .3 Certificates:
  - .1 Provide CSA certified equipment and material.
  - .2 Submit test results of installed electrical systems and instrumentation.
  - .3 Permits and fees: in accordance with General Conditions of contract.
  - .4 Submit certificate of acceptance from authority having jurisdiction upon completion of Work to Departmental Representative and Consultant.

### 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 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.
  - .7 Site records:
    - .1 Departmental Representative will provide 1 set of reproducible electrical drawings. Provide sets of white prints as required for each phase of work. Mark changes as work progresses and as changes occur. Include changes to existing mechanical systems, control systems and low voltage control wiring.
    - .2 Transfer information weekly to reproducibles, revising reproducibles to show work as actually installed.
    - .3 Use different colour waterproof ink for each service.
    - .4 Make available for reference purposes and inspection.
  - .8 As-Built drawings:
    - .1 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 ELECTRICAL SYSTEMS AS INSTALLED" (Signature of Contractor) (Date).
    - .2 Submit to Departmental Representative for approval and make corrections as directed.
    - .3 Submit completed reproducible as-built drawings with Operating and Maintenance Manuals.

#### 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 off ground in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.
- .4 Develop Construction Waste Management Plan related to Work of this Section.
- .5 Packaging Waste Management: remove for reuse and return of pallets, crates, padding, packaging materials as specified in Construction Waste Management Plan.

## PART 2 - PRODUCTS

### 2.1 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 and labels for control items in English and French.
- .4 Use one nameplate and label for both languages.

### 2.2 MATERIALS AND EQUIPMENT

- .1 Provide material and equipment in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Material and equipment to be CSA certified.
- .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 Control wiring and conduit: in accordance with Section 26 29 03 - Control Devices except for conduit, wiring and connections below 50 V which are related to control systems specified in mechanical sections.

### 2.4 WIRING TERMINATIONS

- .1 Ensure lugs, terminals, screws used for termination of wiring are suitable for either copper or aluminum conductors.

### 2.5 WIRING IDENTIFICATION

- .1 Identify wiring with permanent indelible identifying markings, numbered, 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.

### 2.6 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.

Prime	Auxiliary	
Up to 250 V	Yellow	
Up to 600 V	Yellow	Green

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- .1 Do complete installation in accordance with CSA C22.1 except where specified otherwise.

#### 3.2 NAMEPLATES AND LABELS

- .1 Ensure manufacturer's nameplates, CSA labels and identification nameplates are visible and legible after equipment is installed.

#### 3.3 MOUNTING HEIGHTS

- .1 Mounting height of equipment is from finished floor to centreline of equipment unless specified or indicated otherwise.
- .2 If mounting height of equipment is not specified or indicated, verify before proceeding with installation.
- .3 Install electrical equipment at following heights unless indicated otherwise.
  - .1 Panelboards: as required by Code or as indicated.

#### 3.4 CO-ORDINATION OF PROTECTIVE DEVICES

- .1 Ensure circuit protective devices such as overcurrent trips, relays and fuses are installed to required values and settings.

#### 3.5 FIELD QUALITY CONTROL

- .1 Conduct following tests in accordance with Section 01 45 00 - Quality Control.
  - .1 Circuits originating from branch distribution panels.
  - .2 Motors and associated control equipment including sequenced operation of systems where applicable.
  - .3 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.
- .2 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.

#### 3.6 CLEANING

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

01 74 21 - Construction/Demolition Waste Management and Disposal.

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

END OF SECTION

## PART 1 - GENERAL

### 1.1 RELATED REQUIREMENTS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 74 11 - Cleaning.
- .3 Section 01 78 00 - Closeout Submittals.

### 1.2 REFERENCES

- .1 CSA International
  - .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, 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.

## 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 EEMAC 1Y-2 and 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 and tubes as indicated.
- .4 Clamps or connectors for armoured cable, TECK cable, flexible conduit 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.

#### 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 EEMAC 1Y-2 and NEMA.

#### 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



WIRES AND CABLES (0-1000 V)

**PART 1 - GENERAL**

1.1 RELATED REQUIREMENTS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .3 Section 26 05 00 - Common Work Results for Electrical.
- .4 Section 26 05 20 - Wire and Box Connectors - (0-1000 V).
- .5 Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.

1.2 REFERENCES

- .1 CSA C22.2 No .0.3 96, Test Methods for Electrical Wires and Cables.
- .2 CAN/CSA C22.2 No. 131 M89, Type TECK 90 Cable.

1.3 PRODUCT DATA

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

1.4 DELIVERY, STORAGE AND HANDLING

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

**PART 2 - PRODUCTS**

2.1 BUILDING WIRES

- .1 Conductors: stranded for 10 AWG and larger. Minimum size: 12 AWG.
- .2 Copper conductors: size as indicated, with 600 or 1000 V insulation of cross-linked thermosetting polyethylene material rated RW90 XLPE, Jacketted.

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 Ethylene propylene rubber EP.
  - .2 Cross-linked polyethylene XLPE.
  - .3 Rating: 600 V.
- .4 Inner jacket: polyvinyl chloride material.
- .5 Armour: galvanized steel.

- .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 CONTROL CABLES

- .1 Type: 600 V stranded annealed copper conductors, sizes as indicated:
  - .1 Insulation: TW or RW90 XLPE.

## PART 3 - EXECUTION

### 3.1 FIELD QUALITY CONTROL

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

### 3.2 GENERAL CABLE INSTALLATION

- .1 Terminate cables in accordance with Section 26 05 20 - Wire and Box Connectors - (0-1000 V).
- .2 Cable Colour Coding: to Section 26 05 00 - Common Work Results for Electrical.
- .3 Conductor length for parallel feeders to be identical.
- .4 Lace or clip groups of feeder cables at distribution centres, pull boxes, and termination points.
- .5 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.

### 3.4 INSTALLATION OF TECK90 CABLE (0 -1000 V)

- .1 Group cables wherever possible on channels.
- .2 Install cable exposed, securely supported by straps or hangers.
- .3 Terminate cables in accordance with section 26 05 20 - Wires and Box Connectors 0-1000 V.

WIRES AND CABLES (0-1000 V)

3.5 INSTALLATION OF CONTROL CABLES

- .1 Install control cables in conduit.
- .2 Ground control cable shield.

END OF SECTION

## PART 1 - GENERAL

### 1.1 RELATED REQUIREMENTS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .3 Section 26 05 00 - Common Work Results for Electrical.

### 1.2 REFERENCES

- .1 Canadian Standards Association (CSA International)
  - .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.

### 1.4 DELIVERY, STORAGE AND HANDLING

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

## PART 2 - PRODUCTS

### 2.1 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 or turned edge covers.

## PART 3 - EXECUTION

### 3.1 JUNCTION, PULL BOXES AND CABINETS INSTALLATION

- .1 Install pull boxes in inconspicuous but accessible locations.
- .2 Only main junction and pull boxes are indicated. Install additional pull boxes as required by CSA C22.1.

### 3.2 IDENTIFICATION

- .1 Equipment Identification: to Section 26 05 00 - Common Work Results for Electrical.
- .2 Identification Labels: size 2 indicating system name, voltage and phase or as indicated.

END OF SECTION

## PART 1 - GENERAL

### 1.1 RELATED REQUIREMENTS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 74 11 - Cleaning.
- .3 Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

### 1.2 REFERENCES

- .1 Canadian Standards Association (CSA International)
  - .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.

### 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.

### 1.4 WASTE MANAGEMENT AND DISPOSAL

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

## PART 2 - PRODUCTS

### 2.1 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 expanded ends.
- .4 Flexible metal conduit: to CSA C22.2 No. 56, liquid-tight flexible metal.

### 2.2 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.

### 2.3 CONDUIT FITTINGS

- .1 Fittings: to CAN/CSA C22.2 No. 18, manufactured for use with conduit specified. Coating: same as conduit.
- .2 Ensure factory "ells" where 90 degrees bends for 25 mm and larger conduits.
- .3 Watertight connectors and couplings for EMT.
  - .1 Set-screws are not acceptable.

#### 2.4 EXPANSION FITTINGS FOR RIGID CONDUIT

- .1 Weatherproof expansion fittings with internal bonding assembly suitable for 100 mm linear expansion.
- .2 Watertight expansion fittings with integral bonding jumper suitable for linear expansion and 19 mm deflection.
- .3 Weatherproof expansion fittings for linear expansion at entry to panel.

#### 2.5 FISH CORD

- .1 Polypropylene.

### 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 Surface mount conduits.
- .3 Use rigid galvanized steel threaded conduit except where specified otherwise.
- .4 Use electrical metallic tubing (EMT) above 2.4 m not subject to mechanical injury.
- .5 Use flexible metal conduit for connection to motors in dry areas.
- .6 Use liquid tight flexible metal conduit for connection to motors or vibrating equipment in damp, wet or corrosive locations.
- .7 Minimum conduit size for lighting and power circuits: 21 mm.
- .8 Bend conduit cold:
  - .1 Replace conduit if kinked or flattened more than 1/10th of its original diameter.
- .9 Mechanically bend steel conduit over 19 mm diameter.
- .10 Field threads on rigid conduit must be of sufficient length to draw conduits up tight.
- .11 Install fish cord in empty conduits.
- .12 Remove and replace blocked conduit sections.

- .1 Do not use liquids to clean out conduits.
- .13 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 Do not pass conduits through structural members except as indicated.
  - .5 Do not locate conduits less than 75 mm parallel to steam or hot water lines with minimum of 25 mm at crossovers.
- 3.4 CLEANING
  - .1 Proceed in accordance with Section 01 74 11 - Cleaning.
  - .2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION



## PART 1 - GENERAL

### 1.1 RELATED REQUIREMENTS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 74 11 - Cleaning.

### 1.2 REFERENCES

- .1 CSA International
  - .1 CSA C22.2 No. 5-09, 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 Include time-current characteristic curves for breakers with interrupting capacity of 22,000 A symmetrical (rms) and over at system voltage .

## PART 2 - PRODUCTS

### 2.1 BREAKERS GENERAL

- .1 Moulded-case circuit breakers and accessory high-fault protectors: to CSA C22.2 No. 5
- .2 Bolt-on moulded case circuit breaker: quick- make, quick-break type, for manual and automatic operation with temperature compensation for 40 degrees C ambient.
- .3 Common-trip breakers: with single handle for multi-pole applications.
- .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.

### 2.2 THERMAL MAGNETIC BREAKERS

- .1 Moulded case circuit breaker to operate automatically by means of thermal and magnetic tripping devices to provide inverse time current tripping and instantaneous tripping for short circuit protection.

### 2.3 OPTIONAL FEATURES

- .1 Include:
  - .1 On-off locking device.
  - .2 Handle mechanism.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- .1 Install circuit breakers as indicated.

### 3.2 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