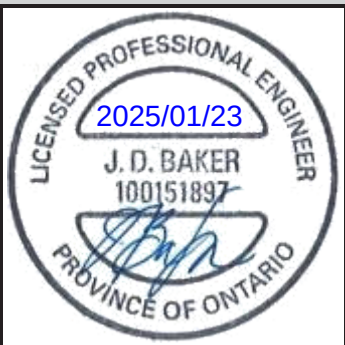
TECHNICAL SPECIFICATION SEAL SHEET		DATE OF ISSUE: 1/23/2025	
CLIENT	Town of Greater Napanee	ISSUED FOR THE FOLLOWING PURPOSE(S) ONLY:	
PROJECT:	Napanee WPCP	MOE Approval	☐
		Tender	✓
CLIENT REF No	RFT-UT-2025-01	Building Permit	☐
LOCATION:	300 Water Street West, Napanee, ON	Construction	☐

NOTE: The Professional Seals on this page are in respect to the technical specification comprising Divisions 1 through 44 inclusive. Each seal is limited to the discipline as noted below.

Sheet 1 of 3

SITE CIVIL			
ARCHITECTURAL			
STRUCTURAL			

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Sheet 2 of 3

PROCESS MECHANICAL	LICENSED PROFESSIONAL ENGINEER 2025/01/23 A. T. SEYMOUR 100515838 PROVINCE OF ONTARIO	LICENSED PROFESSIONAL ENGINEER 2025/01/23 J. D. BAKER 100151897 PROVINCE OF ONTARIO	
BUILDING MECHANICAL	LICENSED PROFESSIONAL ENGINEER 01/23/2025 J. J. GORDON 100078762 PROVINCE OF ONTARIO		
ELECTRICAL	LICENSED PROFESSIONAL ENGINEER B. A. MACCULLOCH 100140752 2025-01-23 PROVINCE OF ONTARIO	LICENSED PROFESSIONAL ENGINEER J. E. SMELKO 43006501 2025-01-23 PROVINCE OF ONTARIO	

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Sheet 3 of 3			
INSTRUMENTATION AND CONTROL			
TELECOM			

DESCRIPTION OF PROVISIONAL ITEMS

PART 1 GENERAL

1.1 DESCRIPTION

.1 This section provides a detailed description of the work to be included in the provisional items indicated on page 3 of the Form of Tender, item 2.2 Schedule of Provisional Items.

PART 2 PROVISIONAL ITEMS

2.1 ITEM NO. P1 – VARIOUS DEMOLITION WORK

.1 All work associated with the demolition of the existing WPCP buildings as identified on Drawing C0100.

.1 Administration Building
.2 Headworks and Inlet Channel
.3 Existing Septage Receiving Station
.4 Primary Clarifier #1
.5 Primary Clarifier #2
.6 Operations Building #1
.7 Operations Building #2
.8 Existing Gravity Thinkener
.9 Existing Chlorine Contact Tank #1 (CCT#1)
.10 Existing Aeration Tanks and Secondary Clarifiers

- Note that the demolition of the existing Alum Tanks and containment area, yard piping and existing electrical services are not to be included in this provisional sum (i.e. this work is not provisional and is part of the base contract).

2.2 ITEM NO. P2 – EXISTING DIGESTERTANK WALL BRICK AND MORTAR REPAIRS

.1 Supply and installation of the new Brick and Mortar to the digester exterior brick walls. Refer to structural drawings and specification for details.

.2 Supply and installation of new parapet framing and flashing on Digester #1.

2.3 ITEM NO. P3 – NOT YET DEFINED.

PART 3 EXECUTION (NOT APPLICABLE)

END OF SECTION

PROVISION OF CONTRACT DOCUMENTS

PART 1 GENERAL

1.1 DESCRIPTION

.1 Following execution of the Contract, an “Approved for Construction” digital revision of the drawings and specifications, which incorporates all addenda issued during the tendering period, will be prepared by the Contract Administrator and provided to the contractor for their review. The contractor shall review the “Approved for Construction” drawings and specifications to confirm that all addenda are included and confirm his acceptance in writing to the Contract Administrator.

.2 The “Approved for Construction” drawings will be provided to the contractor for their initial review no later than 3 weeks following execution of the contract. No claims for delays by the contractor will be considered relating to this schedule.

.3 Following acceptance of the “Approved for Construction” drawings and specifications by the contractor, the Contract Administrator will supply the following items to the contractor:

.1 Access to download the entire set of “Approved for Construction” drawings and specifications in PDF format.

.4 If the contractor requires printed copies of the drawings or specifications, they can be purchased, at the contractor’s expense, from the copying company used by the Contract Administrator. Alternatively, the contractor can reproduce the drawings from the PDF version provided.

.5 Electronic drawings in AutoCAD/Revit format are available to the contractor if so requested. Contractor will be responsible to sign a release form provided by the Contract Administrator prior to receiving AutoCAD/Revit drawings. AutoCAD drawings will only be provided on a case-by-case basis at the Contract Administrators’s discretion and the contractor will be expected to justify the need for the AutoCAD drawings. Note that some ACAD drawings may require additional Autodesk software to be fully compatible (i.e. Civil3D 2010, Revit, etc.).

END OF SECTION

SUMMARY OF WORK

PART 1 GENERAL

1.1 SECTION INCLUDES

.1 Title and description of Work.

.2 Contractor use of premises.

.3 Owner occupancy.

1.2 WORK COVERED BY CONTRACT DOCUMENTS

.1 Work of this Contract comprises construction of a new Water Pollution Control Plant (WPCP) at 300 Water Street West, Napanee. The work associated with this contract includes, but is not limited to, the following:

.1 Construction of a new WPCP, including all architectural, civil, structural, mechanical, electrical, instrumentation and process elements as defined within the contract documents.

.2 Rehabilitation of elements of the existing anaerobic digester as defined within the contract documents.

.3 Coordination and connection of the WPCP with the existing wastewater collection system and existing outfall.

.4 Work covered by the contract documents includes Construction of, and Commissioning of the facility as per Section 01 91 13 – Commissioning (Cx) and Division 01 contract documentation requirements.

1.3 CONTRACTOR USE OF PREMISES

.1 Contractor has unrestricted use of site provided that all relevant Town of Greater Napanee municipal by-laws are adhered to including but not limited to noise, traffic, use of highways and accessibility.

.2 Coordinate use of premises under direction of Contract Administrator.

.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 Contract Administrator.

.6 The contractor shall provide all work and/or material required to achieve this including but not limited to temporary pumping, flow diversion structures, temporary power, and intermediate alarming.

.7 Provide 24hr monitoring of all temporary equipment that is not connected and monitored by the alarm monitoring and dialing device as require to ensure 24 hours per day 7 days per week monitoring of the system.

1.4 OWNER OCCUPANCY

.1 Cooperate with Owner in scheduling operations to minimize conflict and to facilitate Owner usage.

1.5 ON-SITE DOCUMENTS

.1 Maintain at job site documents as indicated in Section 01 31 00 – Project Management and Coordination.

.2 Maintain at job site, a minimum of one copy of 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 and Other Safety Related Documents
- .11 Documents as specified.
- .12 On-going, up-to-date As-Built markups

1.6 PERMITS AND FEES

.1 Owner will be responsible for plumbing permits, road cut and boulevard permits.

.2 The Contractor will be responsible for:

- .1 electrical permits per the Electrical Safety Authority (ESA) will be the responsibility of the contractor.
- .2 TSSA permit for the installation and inspection of the new dual fired boiler installation, new digester gas piping and anerobic digester modifications.
- .3 All other applicable permit and connection fee’s, including NG gas permits.

.3 Hydro One cost will be covered under an allowance.

.4 Bell cost will be covered under an allowance

.5 Office furniture will be covered under an allowance

.6 Other items as defined through the contract documentation and the Allowances Specification 01 21 00.

.7 The work shall not commence until all Ministry of Environment, Conservation and Parks (MECP) approvals have been issued including the Environmental Compliance Approval and the Permit to Take Water, the applications for both of which have been submitted.

1.7 CONTRACT METHOD

.1 Construct the work under the lump sum contact as outlined in the Form of Tender.

.2 Work will be paid on a percent completion basis with a breakdown, as described in various specifications, with insufficient items and detail to track the work progress, at a minimum broken down by specification sections.

1.8 WORK BY OTHERS

.1 Cooperate with other contractors in carrying out their respective works and carrying out instructions from the Contract Administrator.

.2 Coordinate work with that of other Contactors. In any part of work under this Contract depends for its proper execution or result upon work of another Contractor, report promptly to Contract Administrator, in writing, any defect which may interfere with proper execution of Work.

1.9 PARTIAL OWNER OCCUPANCY [NOT USED]

.1 Schedule and substantially complete designated portion so Work for Owner's occupancy prior to Substantial Performance of entire Work as require to phase and complete the project as per the approved schedule and in accordance with the Contract Administrator.

1.10 ALTERATIONS, ADDITIONS OR REPAIRS TO EXISTING FACILITIES

.1 Execute work with least possible interference or disturbance to public and normal use of premises. Arrange with the Contract Administrator to facilitate execution of work.

.2 The existing plant shall remain in operations for the duration of the project. Contractor shall not interfere with day-to-day operations of the existing facility and will facilitate a smooth transition from the operation of the existing plant to the new sewage works.

1.11 EXISTING SERVICES

.1 Notify the Contract Administrator and utility companies of intended interruption of services and obtain required permission and permits.

.2 Where work involves breaking into or connecting to existing services, give the Contract Administrator a minimum 72 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 vehicular traffic and services.

.3 Provide alternative routes for vehicular traffic as required.

.4 Establish location and extent of service lines in area of work before starting work. Notify Engineer of findings.

.5 Submit schedule to and obtain approval of Contract Administrator for any shutdown or closure of active service or facility including power and communications services. Adhere to approved schedule and provide notice to affected parties.

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

.7 Where unknown services are encountered, immediately advise the Contract Administrator and confirm findings in writing. The contractor is responsible to be familiar with the existing As-Built/Facility Drawing package and shall assume that previously abandoned work has been left, buried underground.

.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.

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION

3.1 RECOMMENDED SEQUENCE OF CONSTRUCTION

.1 Prepare schedule, sequencing and plan, complete preliminary planning for all required temporary electrical connections and process termination locations.

.2 Engage equipment suppliers, issue purchase orders and coordinate the shop drawing process in order to begin equipment fabrication as soon as possible.

.3 Complete the site set up including Erosion and Sediment Controls Plan and monitoring.

.4 Obtain all require permits

.5 Complete the Rigid Inclusion Column Ground Improvement as specified in Division 31.

.6 Install sub-drains, shoring and temporary dewatering as necessary to complete the construction of the deep foundations, tanks, structures, foundations and yard piping.

.7 Construct the buildings, install equipment, tie-in digester basement, plan and coordinate and execute all tie-ins with all trades.

.8 Install and test all mechanical, electrical and process components in both permanent and temporary power conditions.

.9 Complete outfall tie-in to existing chlorine contract tank.

.10 Coordinate partial tie-in of incoming sewer. Partially test all services and process functionality on partial load. Once validated, complete main sewer tie-in at the existing headworks Manhole #2.

.11 Commission the new facility in coordination with the Owner and Contract Administrator.

.12 Complete Demolition of existing facility, 1 year following substantial completion or as directed by the Contract Administrator.

END OF SECTION

ALLOWANCES

PART 1 DEMOLITION

.1 Inclusion of Allowances in the Tender Price is not to be construed as implying that any or all of the Allowances will be expended.

.2 Expend each allowance as directed by Contract Administrator.

PART 2 CASH ALLOWANCES

.1 Cash Allowances cover only the net cost to the Contractor of the items, materials, services or contract referred to, as verified by invoices to be submitted to Contract Administrator.

.2 The Contract Price, and not the cash allowances, includes all construction machinery and equipment, freight, handling, unloading, storage, installation, coordination, supervision, overhead and profit and other costs necessary to incorporate the allowance products, services, or contracts into the project, except as otherwise noted.

.3 Each cash allowance will be adjusted to actual cost as defined hereunder and contract price will be amended accordingly by written order.

.4 Contract Price will be adjusted by written order to provide for an excess or deficit to each cash allowance.

.5 Progress payments for work and material authorized under cash allowances will be made in accordance with contract terms of payment.

.6 The Contract Price and not cash allowance, includes contractor’s overhead and profit in connection with such cash allowance.

.7 Progress payments on accounts of work authorized under cash allowances shall be included in monthly certificate for payment.

.8 Schedule shall be prepared jointly by Contract Administrator and Contractor to show when items called for under cash allowances must be authorized by Contract Administrator for ordering purposes so that progress of work will not be delayed.

.9 Provide the following Cash Allowances.

.1 Include $30,000 excluding HST for the Utility Connection Fees (Hydro One and Bell) permit and approval fees associated with the field inspection

application to obtain approvals and use permits. This allowance is only to be used to reimburse the contractor for Utility Fee invoices.

.2 Include $10,000 excluding HST for the communications equipment and installation. This allowance is only to be used to reimburse the contractor for additional communications equipment and installation not currently identified in the contract documentation.

.3 Include $10,000 excluding HST for miscellaneous furniture and equipment not currently identified in the contract documentation.

.4 Include $25,000 excluding HST for additional analytical equipment not currently identified in the contract documentation.

PART 3 PRODUCTS (NOT APPLICABLE)

PART 4 EXECUTION (NOT APPLICABLE)

END OF SECTION

TESTING AND LABORATORY SERVICES

PART 1 GENERAL

1.1 SECTION INCLUDES

.1 Inspecting and testing by inspecting firms or testing laboratories designated by Contract Administrator

1.2 RELATED REQUIREMENTS SPECIFIED ELSEWHERE

.1 Particular requirements for inspection and testing to be carried out by testing laboratory designated by Contract Administrator are specified under various sections.

1.3 APPOINTMENT AND PAYMENT

.1 Contract Administrator will appoint and pay for services of testing laboratory except as follows:

.1 Inspection and testing required by laws, ordinances, rules, regulations or orders of public authorities.

.2 Inspection and testing performed exclusively for Contractor's convenience, and Contractor’s QA/QC program.

.3 Testing, adjustment and balancing of conveying systems, mechanical and electrical equipment and systems.

.4 Mill tests and certificates of compliance.

.5 Tests specified to be carried out by Contractor under the supervision of Contract Administrator.

.6 Additional tests specified in the following paragraph.

.2 Where tests or inspections by designated testing laboratory reveal Work not in accordance with contract requirements, pay costs for additional tests or inspections as required by Contract Administrator to verify acceptability of corrected work.

1.4 CONTRACTOR'S RESPONSIBILITIES

.1 Provide labour, equipment and facilities to:

.1 Provide access to Work to be inspected and tested.

.2 Facilitate inspections and tests.

.3 Make good Work disturbed by inspection and test.

.4 Provide storage on site for laboratory's exclusive use to store equipment and cure test samples.

.2 Notify Contract Administrator sufficiently in advance of operations to allow for assignment of laboratory personnel and scheduling of test.

.3 Where materials are specified to be tested, deliver representative samples in required quantity to testing laboratory.

.4 Pay costs for uncovering and making good Work that is covered before required inspection or testing is completed and approved by Contract Administrator.

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION (NOT APPLICABLE)

END OF SECTION

PROJECT MANAGEMENT AND COORDINATION

PART 1 GENERAL

1.1 SECTION INCLUDES

.1 Coordination work with other contractors and subcontractors under administration of Contract Administrator.

.2 Scheduled project meetings.

1.2 RELATED SECTIONS

.1 Section 01 11 00 Summary of Work.

.2 Section 01 91 13 – General Commissioning (Cx) Requirements.

1.3 DESCRIPTION

.1 Coordination of progress schedules, submittals, use of site, temporary utilities, construction facilities, and construction Work, with progress of Work of other contractors and subcontractors under instructions of Contract Administrator.

1.4 PROJECT MEETINGS

.1 Project meetings to be held at times and locations as determined by Contract Administrator.

.2 Contract Administrator will arrange project meetings, record and distribute minutes.

1.5 CONSTRUCTION ORGANIZATION AND START UP

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

.2 Establish time and location of meetings and notify parties concerned minimum 5 days before meeting.

.3 Agenda to include following:

.1 Appointment of official representative of participants in Work.

.2 Schedule of Work, progress scheduling in accordance with Section 01 32 00 Construction Progress Documentation.

.3 Schedule of submission of shop drawings, samples, colour chips in accordance with Section 01 33 00 Submittal Procedures.

.4 Requirements for temporary facilities, site sign, offices, storage sheds, utilities, fences in accordance with Section 01 51 00 Temporary Utilities.

.5 Delivery schedule of specified equipment in accordance with Section 01 32 00 Construction Progress Documentation.

.6 Site security in accordance with Section 01 52 00 Construction Facilities.

.7 Proposed changes, change orders, procedures, approvals required, mark up percentages permitted, time extensions, overtime, and administrative requirements.

.8 Record drawings in accordance with Section 01 78 00 Closeout Submittals.

.9 Maintenance manuals in accordance with Section 01 78 00 Closeout Submittals.

.10 Take over procedures, acceptance, and warranties in accordance with Section 01 77 00 Closeout Procedures and 01 78 00 Closeout Submittals.

.11 Monthly progress claims, administrative procedures, photographs, and holdbacks.

.12 Appointment of inspection and testing agencies or firms in accordance with Section 01 45 00 Quality Control.

.13 Insurances and transcript of policies.

.4 Comply with Contract Administrator's allocation of mobilization areas of site; for field offices and sheds, for access, traffic, and parking facilities.

.5 During construction coordinate use of site and facilities through Contract Administrator's procedures for intra project communications: Submittals, reports and records, schedules, coordination of drawings, recommendations, and resolution of ambiguities and conflicts.

.6 Comply with instructions of Contract Administrator for use of temporary utilities and construction facilities.

1.6 ON SITE DOCUMENTS

.1 Maintain at job site, one copy each of the following:

.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 and other Safety related documents.

.11 Manufacturers' installation and application instructions.

.12 Labour conditions and wage schedules.

.13 Other documents as specified.

1.7 SCHEDULES

.1 Submit preliminary construction progress schedule in accordance with Section 01 32 00 Construction Progress Documents to Contract Administrator coordinated with Contract Administrator's project schedule. Schedule to show anticipated progress stages and final completion of work within time period required by contract documents.

.2 After review, revise and resubmit schedule to comply with project schedule requirements.

.3 During progress of Work revise and resubmit at project progress meetings or as directed by Contract Administrator.

1.8 SUBMITTALS

.1 Make submittal to Contract Administrator for review.

.2 Submit preliminary shop drawings, product data and samples in accordance with Section 01 33 00 – Submittal Procedures for review for compliance with Contract Documents; for field dimensions and clearances, for relation to available space, and for relation to Work of other contracts. After review, revise and resubmit for transmittal to Contract Administrator.

.3 Submit requests for payment for review to Contract Administrator.

.4 Submit requests for interpretation of Contract Documents, and obtain instructions through Contract Administrator.

.5 Process change orders through Contract Administrator.

.6 Deliver closeout submittals for review by Contract Administrator.

.7 Coordinate commissioning through the Contract Administrator.

1.9 COORDINATION DRAWINGS

.1 Provide information required by Contract Administrator for preparation of coordination drawings.

.2 Review and approve revised drawings for submittal to Contract Administrator.

.3 Contract Administrator may furnish additional drawings for clarification. These additional drawings have same meaning and intent as if they were included with plans referred to in contract documents.

1.10 CLOSEOUT PROCEDURES

.1 Notify Contract Administrator when Work is considered ready for Substantial Performance.

.2 Accompany Contract Administrator on preliminary inspection to determine items listed for completion or correction.

.3 Comply with Contract Administrator's instructions for correction of items of Work listed in executed certificate of Substantial Performance and for access to Owner occupied areas.

.4 Notify Contract Administrator of instructions of items of Work determined in Contract Administrator's final inspection.

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION (NOT APPLICABLE)

END OF SECTION

CONSTRUCTION PROGRESS AND DOCUMENTATION

PART 1 GENERAL

1.1 RELATED SECTIONS

.1 Section 01 77 00 Closeout Procedures.

1.2 SCHEDULES REQUIRED

.1 Submit schedules as follows:

.1 Construction Progress Schedule.
.2 Submittal Schedule for Shop Drawings and Product Data.
.3 Submittal Schedule for Samples.
.4 Product Delivery Schedule.
.5 Cash Allowance Schedule for purchasing Products.
.6 Shutdown or closure activity.

1.3 FORMAT

.1 Prepare schedule in form of a horizontal bar chart.

.2 Provide a separate bar for each major item of work, trade or operation.

.3 Split horizontally for projected and actual performance.

.4 Provide horizontal time scale identifying first work day of each week.

.5 Format for listings: chronological order of start of each item of work.

.6 Identification of listings: By Systems description.

1.4 SUBMISSION

.1 Submit initial format of schedules within 15 working days after award of Contract.

.2 Submit schedules in electronic format as PDF files.

.3 Owner’s Representative will review schedule and return review copy within ten (10) working days after receipt.

.4 Resubmit finalized schedule within seven (7) working days after return of review copy.

.5 Submit revised progress schedule with each application for payment.

.6 Distribute copies of revised schedule to:

.1 Job site office.

.2 Subcontractors.

.3 Other concerned parties.

.7 Instruct recipients to report to Contractor within ten (10) working days, any problems anticipated by timetable shown in schedule.

1.5 CRITICAL PATH SCHEDULING

.1 Include complete sequence of construction activities.

.2 Include dates for commencement and completion of each major element of construction as follows.

.1 Site utilities and site works
.2 Foundation Work.
.3 All Concrete Works.
.4 Structural framing/Miscellaneous metals.
.5 Roofing Systems.
.6 Process Mechanical.
.7 Building Mechanical.
.8 Electrical
.9 Instrumentation and Controls
.10 Special Subcontractor Work.
.11 Process Equipment Installations.
.12 TSSA Review Stages.
.13 Finishes and Architectural Specialties

.3 Show projected percentage of completion of each item as of first day of month.

.4 Indicate progress of each activity to date of submission schedule.

.5 Show changes occurring since previous submission of schedule:

.1 Major changes in scope.
.2 Activities modified since previous submission.
.3 Revised projections of progress and completion.
.4 Other identifiable changes.

.6 Provide a narrative report to define:

.1 Problem areas, anticipated delays, and impact on schedule.
.2 Corrective action recommended and its effect.
.3 Effect of changes on schedules of other prime contractors.

1.6 SUBMITTALS SCHEDULE

.1 Include schedule for submitting shop drawings, product data, and samples.

.2 Indicate dates for submitting, review time, resubmission time, last date for meeting fabrication schedule.

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION (NOT APPLICABLE)

END OF SECTION

SUBMITTALS

PART 1 GENERAL

1.1 SECTIONS INCLUDE

.1 Shop drawings and product data.

.2 Samples.

.3 Certificates and transcripts.

.4 Request for Information

1.2 RELATED SECTIONS

.1 Section 01 32 00 – Construction Progress Documentation.

.2 Section 01 45 00 – Quality Control

.3 Section 01 78 00 – Closeout Submittals

1.3 ADMINISTRATIVE

.1 This section specifies general requirements and procedures for contractor's submissions of shop drawings, product data, samples and mock-ups to Contract Administrator 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 an extension of Contract Time and no claim for extension by reason of such default will be allowed.

.2 Do not proceed with work until relevant submissions are reviewed by Contract Administrator.

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

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

.7 Verify field measurements and affected adjacent Work are coordinated.

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

.9 Contractor's responsibility for deviations in submission from requirements of Contract Documents is not relieved by Contract Administrator review of submission, unless Contract Administrator gives written acceptance of specific deviations.

.10 Make any changes in submissions which Contract Administrator may require consistent with Contract Documents and resubmit as directed by Contract Administrator. When resubmitting, notify Contract Administrator in writing of revisions other than those requested.

.11 Notify Contract Administrator, in writing, when resubmitting, of any revisions other than those requested by Contract Administrator.

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

1.4 SUBMITTALS

.1 The term "shop drawings" means equipment cut-sheets, 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 Coordinate each submission with requirements of work and Contract Documents. Individual submissions will not be reviewed until all related information is available.

.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 fifteen (15) working days for Contract Administrator review of each submission.

.5 Adjustments made on shop drawings by Contract Administrator are not intended to change contract price. If adjustments affect value of Work, state such in writing to Contract Administrator immediately after receipt of approval of shop drawings. If value of work is to change, a change order must be issued prior to proceeding with work.

.6 Structural Attachments:

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

.7 Accompany submissions with transmittal letter, containing:

.1 Date.
.2 Project title and number.
.3 Contractor's (and subcontractors) name and address.
.4 Identification and quantity of each shop drawing, product data and sample.
.5 Equipment / Product unique tag number

.8 Submissions shall include:

.1 Date and revision dates.
.2 Project title and number.
.3 Specification section, subsection, unique tag number to be coordinated with the Contract Administrator, and other identifying numbers.
.4 Name and address of:
.1 Subcontractor.
.2 Supplier.
.3 Manufacturer.
.5 Contractor's stamp, signed by Contractor’s authorized representative certifying approval of submissions, verification of field measurements and compliance with Contract Documents.
.6 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 Contract Administrator review, distribute copies.

.10 Submit one electronic copy in PDF format of shop drawings for each requirement requested in specification Sections and as Contract Administrator may reasonably request.

.11 Submit electronic copy in PDF format of product data sheets or brochures for requirements requested in Specification Sections and as requested by Contract Administrator where shop drawings will not be prepared due to standardized manufacture of product.

.12 Delete information not applicable to project.

.13 Identify the particular product selections, all feature codes and details.

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

.15 Cross-reference product data information to applicable portions of Contract Documents.

.16 If upon review by Contract Administrator, no errors or omissions are discovered or if only minor corrections are made, copies will be returned and fabrication and installation of work may proceed. If shop drawings are rejected, noted copy will be returned and resubmission of corrected shop drawings, through same procedure indicated above, must be performed before fabrication and installation of work may proceed. All resubmissions must be complete, resubmission of parts of the shop drawing is not acceptable, whole submissions are required.

.17 Samples: examples of materials, equipment, quality, finishes, workmanship. Label samples with origin and intended use.

.18 Notify Contract Administrator in writing, at time of submission of deviations in samples from requirements of contract documents.

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

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

.21 Make changes in samples, which Contract Administrator may require, consistent with Contract Documents.

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

.23 Submit drawings stamped and signed by Professional Engineer registered or licensed in the Province of Ontario.

1.5 MOCK-UPS

.1 Mock-up: Field erection example of work complete with specified materials and workmanship.

.2 Provide mock-ups requested in various sections of specifications and as may be reasonably required by the Owners Representative.

.3 Erect mock-ups at locations acceptable to the Owners Representative.

.4 Reviewed and accepted mock-ups will become standards of workmanship and material against which installed work will be verified.

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

1.6 SAMPLES

.1 Submit samples requested in various sections of specification and as may be reasonably required by the Contract Administrator.

.2 Submit samples of adequate size and range of colours or textures to represent material in intended use on project.

.3 Unless the precise colour and pattern is specifically described in the contract documents, wherever a choice of colour or pattern is available in a specified product, submit accurate colour and pattern charts to the Engineer for selection.

.4 Material used on project shall match approved samples for quality, colour and texture, finish and performance. Do not proceed with work until samples are approved.

1.7 PROGRESS PHOTOGRAPHS

.1 Progress photograph to be electronically formatted and labelled as to location and view. These should be submitted monthly with the progress payment certificate.

1.8 SHOP DRAWINGS REVIEW

.1 The review of shop drawings by Contract Administrator is for the sole purpose of ascertaining conformance with the general concept. This review shall not mean that Contract Administrator approves the detail design inherent in the shop drawings, responsibility for which shall remain with the Contractor submitting same, and such review shall not relieve the Contractor of responsibility for errors or omissions in the shop drawings or of responsibility for meeting all requirements of the construction and contract documents. Without restricting the generality of the foregoing, the Contractor is responsible for dimensions to be confirmed and correlated at the job site, for information that pertains to fabrication processes or to techniques of construction and installation and for co-ordination of the work of all sub-trades.

1.9 STRUCTURAL ATTACHMENTS

.1 Contractor to engage a third party Professional Structural Engineer, licensed to practice in the Province of Ontario, for submission of stamped and signed shop

drawings indicating acceptable mounting procedures for all equipment which is suspended, mounted or otherwise attached, as per Section 01 91 13 – Commissioning (Cx) Requirements. The Structural Engineer to also verify correct installation of the equipment.

1.10 DOCUMENTATION REQURIED BEFORE CONSTRUCTION START

.1 Insurance Forms

.2 Performance Bond and Labour & Material Payment Bond as called for in the Information for Tenders and the General Conditions.

.3 WSIB Clearance Certificate, naming the project. This will also be required with each monthly progress claim, Workplace Safety and Insurance Board Clearance Certificate.

.4 Ministry of Labour Project Notice and Site-Specific Health and Safety Items.

1.11 STATUTORY DECLARATION

.1 Submit, with each monthly progress claim, a Statutory Declaration certifying that claim all payments for any liability for which the Owner might become responsible, if unpaid, have been paid.

1.12 AS-BUILT DRAWINGS

.1 Maintain contract drawings at site office for record purposes. Record accurately deviations from contract documents caused by site conditions, change orders, site instructions, and addenda. Mark in red ink. Provide one table for this set to be placed on. The As-Built records must be maintained up-to-date and prepared as the work progresses. In order for any progress payment to be issued, the contractor is required to review the as-built drawings with the Contract Administrator prior to submitting any/all progress claims.

.2 Consult Mechanical and Electrical Divisions for other particular requirements.

.3 Prior to start of Testing and Commissioning, finalize production of as-built drawings.

.4 Identify each drawing in lower right hand corner in letters at least 12mm high as follows: - AS BUILT DRAWINGS: THIS DRAWING HAS BEEN REVISED TO SHOW AS INSTALLED WORK" (Signature of Contractor) (date).

.5 Submit to Contract Administrator for approval and make corrections as directed.

.6 Commissioning to be performed using as-built drawings.

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

.8 Submit copies of as-built drawings for inclusion in final Operation and Maintenance Manuals.

1.13 SCHEDULE OF VALUES

.1 Itemize separately: individual sections of specifications, different phases of the work, bonds & permits, mobilization field supervision and layout, temporary facilities and controls, major equipment, material costs delivered, installation costs, each allowance, clean up, hand over and commissioning.

.2 Prior to submission of the first progress draw, submit a cash flow of all anticipated progress draw values by month for the entire project duration before deduction of holdback amounts and exclusive of anticipated changes.

1.14 PROGRESS REPORTS

.1 Contractor shall prepare daily reports of their operations. Daily report shall contain at least the following information:

- weather conditions
- manpower on the job in each trade
- major items of equipment on the job
- a brief summary of work accomplished that day
- materials, equipment, or owner-furnished items arriving or leaving site
- inspection reports
- significant events
- any tests made and their final results, if known
- any oral instructions received
- visitors to the job

.2 Contractor shall maintain a file of copies of all daily reports on the site and make it available to the Contract Administrator upon request.

.3 Commissioning forms, as further described in sections 01 91 13, 01 91 33, and 01 91 41, shall be prepared and submitted at appropriate times.

1.15 OPERATIONS AND MAINTENANCE MANUALS

.1 Prior to substantial performance, inspection, submit to Consultant, three (3) hard copies and a searchable, digital PDF of the of Instruction and Maintenance Manuals as follows:

.1 Bind data in 215 x 279mm, vinyl covered, locking three-ring loose-leaf binders.

.2 Enclose title sheet, labelled “Instruction and Maintenance Manual” with project name, list of contents, date and names of Owner, Consultant, and Contractor.

.3 Organize contents into applicable sections of work to parallel project specification breakdown. Mark each section by labelled tabs protected with celluloid covers fastened to hard paper dividing sheets.

.2 All operation and maintenance manuals to be submitted in English only.

.3 Neatly type lists and notes. Use clear drawings, diagrams or manufacturer’s literature.

.4 Contents:

.1 As called for in individual sections of these specifications.

.2 Maintenance instructions for exterior and interior floor, wall, and ceiling surfaces as well as all installed fittings as printed by manufacturer.

.3 Operating and maintenance instructions for mechanical, electrical and process equipment called for in Division 20 through 29 and 44 bound separately.

.4 Colour schedule; hardware schedule.

.5 Copies of all guarantees and warranties.

.6 Complete set of final approved shop drawings, bound separately, indicating corrections and charges made during fabrication and installation.

.7 Names, addresses, and phone numbers of sub-contractors and suppliers.

.8 WHMIS Manual described in Section 01 35 30.

1.16 MAINTENANCE MATERIALS

.1 Compile a complete list of all materials and spare parts contained within the various sections of the contract. Turn over these materials and spare parts to the Owners Representative and obtain receipt transmittal. Submit materials in unbroken cartons or if not available in cartons, strongly packed. Identify item, function, colour, room number, unit number, tag number and area materials used on an indelible tag affixed to the packaging.

1.17 DOCUMENTS REQUIRED FOR SUBSTANTIAL PERFORMANCE

.1 Documents required prior to Substantial Performance include:

.1 As-Built Record Drawings.

.2 Manuals of Instruction and Maintenance including:
- .1 Warranties
- .2 Final approved shop drawings
- .3 Schedules
- .4 WHMIS Manual.

.3 Post construction survey drawings.

.4 Mechanical
- .1 Testing, Adjusting and Balancing (TAB) reports
- .2 Operation and Maintenance Manual
- .3 Demonstration and Operating and Maintenance Instruction
- .4 Individual equipment certification and training session outlined in Mechanical Sections and mechanical process section.

.5 Electrical
- .1 Operation and Maintenance Manual
- .2 Electrical Inspection Certificate
- .3 F/A verification certificate (where applicable)
- .4 Demonstration and Operating and Maintenance Instruction

.6 Process
- .1 Operation and Maintenance Manual.
- .2 Commissioning and testing reports.
- .3 CAD “As-built” and/or record drawings.
- .4 Individual equipment certification by the manufacturers.
- .5 Training sessions as outlined by Division 01 91 41 and Division 44 have been completed.
- .6 Piping inspection reports.
- .7 Results of cleaning and disinfection.

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION (NOT APPLICABLE)

END OF SECTION

HEALTH AND SAFETY REQUIREMENTS

PART 1 GENERAL

1.1 REFERENCES

.1 Canadian Standards Association (CSA)

.1 CAN/CSA-Z259.1 Body Belts and Saddles for Work Positioning and Travel Restraint.

.2 CAN/CSA-Z259.10 Full body Harnesses.

.3 CAN/CSA-Z259.11 Energy Absorbers and Lanyards.

.4 CAN/CSA-Z259.2.1 Fall Arresters, Vertical Lifelines and Rails.

.5 FCC No. 301 Standard for Construction Operations.

.6 CSA Z275.2 Occupational Safety Code for Diving Operations.

.7 CSA Z275.4 Competency Standard for Divers Operations.

.8 CSA Z797, Code of Practice for Access Scaffold.

.2 FCC No. 302 Standard for Welding and Cutting.

.3 Transportation of Dangerous Goods Act Regulations.

.4 Occupational Health and Safety Regulation for Construction Projects, Revised Statutes of Ontario, Chapter 321, as amended Regulation 691.

.5 The Workplace Safety & Insurance Act 1997, and regulations as amended.

.6 Ontario Building Code 1997 Regulation 403/97 as amended.

.7 The Occupational Health and Safety Act – Revised Statues of Ontario, Revised Regulation 692/80.

.8 Consolidated Ontario MOL Regulations 860 WHMIS Regulations Under the Occupational Health and Safety Act

.9 Consolidated Ontario and Regulations Occupational Health and Safety Regulations under the Occupational Health and Safety Act.

.10 Canada Labour Code, Part 2.

.11 National Building Code of Canada.

.12 Department of Transportation and Works Occupational Health and Safety Manual.

1.2 RELATED SECTIONS

.1 Section 01 33 00 - Submittal Procedures.

.2 Section 01 35 43 - Environmental Procedures.

.3 Section 01 41 00 - Regulatory Requirements.

.4 Section 02 82 00.02 – Asbestos Abatement.

1.3 SUBMITTALS

.1 At least 10 (ten) working days prior to commencing any site work: submit to Contract Administrator copies of:

.1 A complete Site Specific Health and Safety Plan. Health and Safety Plan must include:

.1 Site-specific safety hazard assessment and measures to be taken to address the anticipated hazards.

.2 Contractor's and Sub-contractor's Safety Communication Plan. Must include contract information for all key contacts.

.3 Contract Administrator will review Contractor's site-specific Health and Safety Plan and provide comments to Contractor within 7 days after receipt of plan. Revise plan as appropriate and resubmit plan within 5 days after receipt of comments. Comments received from Contract Administrator should not be construed as approval and does not reduce the Contractor's overall responsibility for the Health and Safety of the construction site.

.4 Submit records, upon request, of the Contractor's Health and Safety meetings or daily/weekly tailgate meetings.

.2 If work entails confined space, submit the following:

.1 Copies of current confined space entry training certificates acceptable to WHSCC, as well as copies of confined space entry programs, confined space assessment, safe work practices and rescue plans.

.2 Acceptance of the Site Specific Health and Safety Plan and other submitted documents by the Contract Administrator shall only be viewed as acknowledgement that the contractor has submitted the required documentation under this specification section.

.3 Contract Administrator makes no representation and provides no warranty for the accuracy, completeness and legislative compliance of the Site Specific Health and Safety Plan and other submitted documents by this acceptance.

.4 Responsibility for errors and omissions in the Site Specific Health and Safety Plan and other submitted documents is not relieved by acceptance by Contract Administrator.

.5 Submit copies of reports or directions issued by Federal, Provincial or Territorial Health and Safety Inspectors.

.6 Submit copies of incident and accident reports.

.7 Submit WHMIS MSDS – Material Safety Data Sheets.

.8 Submit Workplace Safety and Insurance Board (WSIB) – Experience Rating Report.

1.4 FILING OF NOTICE

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

.2 If project requires diving, a separate Notice of Project needs to be filed with Provincial Authorities prior to commencement of work.

.3 Submit copies of Notice(s) of Project to the Contract Administrator.

.4 File all other required notices in accordance with Acts and Regulations of the Province of Ontario.

.5 Keep copy of Notice of Project onsite at all times.

1.5 PROJECT/SITE CONDITIONS

.1 Work at site will involve contact with the following hazardous materials:

.1 Watermain, water contaminated equipment, pipes, etc., the contractor will be responsible to clean any and all materials to their satisfaction in order to complete the project work.

.2 Silica in concrete (from concrete demolition and new concrete) and potentials soils.

.3 Corroded metals.

.4 Benzene in fuel oil, paints and adhesives (for new materials).

.5 Volatile organic compounds.

.2 On-site Hazards include, but are not limited to:

.1 Working near, under and/or adjacent to electrical wires.

.2 Working around heavy machinery and moving equipment.

.3 Working near, above and/or in water and/or sewage.

.4 Icy surfaces and/or ice covered water bodies.

.5 Falling hazards.

.6 Extreme temperatures or weather conditions

.7 Pressurized piping containing water or propane.

1.6 OCCUPATIONAL HEALTH AND SAFETY (SITE SPECIFIC HEALTH AND SAFETY PLANS)

.1 Conduct operations in accordance with latest edition of the Ontario Occupational Health and Safety (OHSA) Act and Regulations, with specific reference to codes and standards.

.2 Prepare a detailed Site Specific Health and Safety Plan that shall identify, evaluate and control job specific hazards and the necessary control measures to be implemented for managing hazards.

.3 Provide a copy of the Site Specific Health and Safety Plan upon request to Ministry of Labour and the Contract Administrator.

.4 The written Site Specific Health and Safety Plan shall incorporate the following:

.1 Hazard assessment results.

.2 Engineering and administrative demonstrative controls (work-practices and procedures) to be implemented for managing identified and potential hazards, and comply with applicable federal and provincial legislation and more stringent requirements that have been specified in these specifications.

.3 An organizational structure which shall establish the specific chain of command and specify the overall responsibilities of contractor's employees at the work site.

.4 A comprehensive work plan which shall:

.1 define work tasks and objectives of site activities/operations and the logistics and resources required to reach these tasks and objectives.

.2 establish personnel requirements for implementing the plan.

.5 A personal protected equipment (PPE) Program which shall detail PPE:

.1 Selection criteria based on site hazards.

.2 Use, maintenance, inspection and storage requirements and procedures.

.3 Decontamination and disposal procedures.

.4 Inspection procedures prior to, during and after use, and other appropriate medical considerations.

.5 Limitations during temperature extremes, heat stress and other appropriate medical consideration.

.6 An emergency response procedure, refer to Clause 1.5 Supervision and Emergency Response Procedure of this section for requirements.

.7 A hazard communication program for informing workers, visitors and individuals outside of the work area as required. This will include but not be limited to a visitor safety and orientation policy and program that will include education on hazards, required PPE and accompaniment while on site.

.8 A hearing conservation program in accordance with the OHS Regulations.

.9 A recent (current year) inspection form for all powered mobile equipment that will be used in fulfilling the terms of the contract. The inspection form shall, at a minimum, state that the equipment is in a safe operating condition.

.10 A complete listing of employee names, their driver's license classification, expiry date, endorsements and the type of equipment that they are qualified

to operate for the complete scope of work for this project. The Driver's License Number should not be provided as this is confidential information.

.11 An acceptable parking policy for all powered mobile equipment to be used on this project. The policy shall, at a minimum, be based on a hazard assessment that considers factors such as equipment type, potential for roll over, load capacity of the parking area, pedestrian and vehicular traffic, and potential for equipment tampering, equipment energy, and equipment contact with power lines.

.12 A health and safety training program which includes a safety training matrix.

.13 General safety rules.

.5 Periodically review and modify as required each component of the Site Specific Health and Safety Plan when a new hazard is identified during completion of work and when an error or omission is identified in any part of the Site Specific Health and Safety Plan.

.6 Review the completeness of the hazard assessment immediately prior to commencing work, when a new hazard is identified during completion of work and when an error or omission is identified.

.1 Be solely responsible for investigating, evaluating and managing any report of actual or potential hazards.

.2 Clearly define accident incident investigation procedures.

.3 Clearly define policy and processes for early and safe return to work.

.4 Retain copies of all completed hazard assessments at the project site and make available to the Contract Administrator immediately upon request.

.7 Implement all requirements of the Site Specific Health and Safety Plan.

.1 Ensure that every person entering the project site is informed of requirements under the Site Specific Health and Safety Plan.

.2 Take all necessary measures to immediately implement any engineering controls, administrative contacts, personal protective equipment required or termination of work procedures to ensure compliance with the Site Specific Health and Safety Plan.

1.7 CONTRACTORS HEALTH AND SAFETY OFFICER

.1 The contractor shall employ/designate a Contractor's H&S Coordinator (CSO).

.2 The CSO shall:

.1 Be responsible for developing, implementing, daily enforcement, monitoring and updating of the Site Specific Health and Safety Plan.

.2 Be responsible for the delivery of the site safety orientation and ensure that the personnel who have not been orientated are not permitted to enter the site. This applies to workers, inspectors and visitors.

.3 Report directly to and be under direction of the Site Superintendent or Contractor's Project Manager.

.4 Prior to mobilization on-site, hold an orientation meeting with the contractors, subcontractors and Contract Administrator to review project occupational health and safety. Include but not limit meeting to a review of:

.1 Site Specific Health and Safety Plan.

.2 Construction Safety Measures.

.3 Supervision and Emergency Rescue Procedures.

.4 Hazard Assessments

.5 Maintain a daily log of inspections, meetings, infractions and mitigating measures. Log is to be filed daily and copies to be provided to the Site Superintendent and Contract Administrator.

1.8 HEALTH AND SAFETY COMMITTEE

.1 Establish an Occupational Health and Safety Committee where ten or more workers are employed on the job site as per the OH&S Act and Regulations.

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.

.3 Where safety risks exist, the contractor must stop the work until such time as the risk can be mitigated to a safe level.

.4 Take appropriate steps to ensure that the hazards are mitigated to a safe level, workers are notified of the hazards and how to protect themselves. As well, workers must be provided with any new safe work practices or information regarding mitigation of the risk.

1.10 UNFORSEEN HAZARDS

.1 Should any unforeseen or peculiar safety-related factor, hazard, or condition become evident 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. Advise Contract Administrator verbally and in writing.

1.11 INSTRUCTION AND TRAINING

.1 Workers shall not participate in or supervise any activity on the work site until they have been trained to a level required by this job function and responsibility. Training shall as a minimum thoroughly cover the following:

.1 Federal and Provincial Health and Safety Legislation requirements including roles and responsibilities of workers and person(s) responsible for implementing, monitoring and enforcing health and safety requirements.

.2 Safety and health hazards associated with working on a contaminated site including recognition of symptoms and signs which might indicate over exposure to hazards.

.3 Limitations, use, maintenance and disinfection-decontamination of personal protective equipment associated with completing work.

.4 Limitations, use, maintenance and care of engineering controls and equipment.

.5 Limitations and use of emergency notifications and response equipment including emergency response protocol.

.6 Work practices and procedures to minimize the risk of an accident and hazardous occurrence from exposure to a hazard.

.2 Provide and maintain training of workers, as required, by Federal and Provincial legislation.

.3 Provide copies of all training certificates to Contract Administrator for review, before a worker is to enter the work site.

.4 Authorized visitors shall not access the work site until they have been:

.1 Notified of the names of persons responsible for implementing, monitoring and enforcing the Site Specific Health and Safety Plan.

.2 Briefed on safety and health hazards present on the site.

.3 Instructed in the proper use and limitations of personal protective equipment.

.4 Briefed as the emergency response protocol including notification and evacuation process.

.5 Informed of practices and procedures to minimize risks from hazards and applicable to activities performed by visitors.

.6 Accompanied while on site, and provided with the appropriate PPE.

.5 All workers will be instructed and trained on the hazards associated with work they will perform and how to protect themselves. This will include a review of all safe work practices, the reporting and documentation of hazards, reporting accidents and injuries as well as, formal training in areas of high risk (i.e. fall protection, power line hazards, traffic control persons training).

.6 The work site shall have the appropriate number of persons trained in emergency and Standard First Aid according to the First Aid Regulations.

1.12 CONSTRUCTION SAFETY MEASURES

.1 Observe construction safety measures of National Building Code, latest edition, Provincial Government, OH&S Act and Regulations, Workplace Health and Safety

Compensation Commission and Municipal Authority provided that in any case of conflict or discrepancy more stringent requirements shall apply.

.2 Administer the project in a manner that will ensure, at all times, full compliance with Federal and Provincial Acts, regulations and applicable safety codes and the Site Specific Health and Safety Plan.

.3 Provide Contract Administrator with copies of all orders, directions and any other documentation, issued by the Ministry of Labour, immediately after receipt.

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 and authority having jurisdiction, and in consultation with Contract Administrator.

1.14 HEALTH AND SAFETY MONITORING

.1 Periodic inspections of the contractor's work may be carried out by the Contract Administrator to maintain compliance with the Health and Safety Program. Inspections will include visual inspections as well as testing and sampling as required.

.2 The contractor shall be responsible for any and all costs associated with delays as a result of contractor's failure to comply with the requirements outlined in this section.

1.15 NOTIFICATION

.1 For projects exceeding thirty (30) days or more, the contractor shall, prior to the commencement of work, notify in writing the Ministry of Labour with the following information:

.1 Name and location of construction site.

.2 Company name and mailing address of contractor doing the work.

.3 The number of workers to be employed.

.4 A copy of the Site Specific Health and Safety Plan if requested.

1.16 CORRECTION OF NON-COMPLIANCE

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

.2 Provide Contract Administrator with written report of action taken to correct non-compliance of health and safety issues identified within ten (10) working days.

.3 Contract Administrator may stop work if non-compliance of health and safety regulations is not corrected.

1.17 WHMIS

.1 Ensure that all controlled products are in accordance with the Workplace Hazardous Materials Information System (WHMIS) Regulations and Chemical Substances of the OH&S Act and Regulations regarding use, handling, labelling, storage, and disposal of hazardous materials.

.2 Deliver copies of relevant Material Safety Data Sheets (MSDS) to job site and the Contract Administrator. The MSDS must be acceptable to Labour Canada and Health and Welfare Canada for all controlled products that will be used in the performance of this work. All MSDS should be located in accessible locations for all workers and visitors throughout the site, bound and organized in binders.

.3 Train workers required to use or work in close proximity to controlled products as per OH&S Act and Regulations.

.4 Label controlled products at jobsite as per OH&S and Regulations and WHMIS.

.5 Provide appropriate emergency facilities as specified in the MSDS where workers might be exposed to contact with chemicals, e.g. eye-wash facilities, emergency shower.

.1 Workers to be trained in use of such emergency equipment.

.6 Contractor shall provide appropriate personal protective equipment as specified in the MSDS where workers are required to use controlled products.

.1 Properly fit workers for personal protective equipment

.2 Train workers in care, use and maintenance of personal protective equipment.

.7 No controlled products are to be brought on-site without prior approved MSDS.

.8 The MSDS are to remain on site at all times.

1.18 OVERLOADING

.1 The Contractor’s Full Time CSO and/or Site Superintendent shall ensure no part of work or associated equipment is subjected to loading that will endanger its safety or will cause permanent deformation.

1.19 FALSEWORK

.1 Design and construct falsework in accordance with CSA S269.1.

1.20 SCAFFOLDING

.1 Design, erect, inspect, operate, modify, and dismantle scaffolding in accordance with CSA Z797, the OH&S Act and Regulations, and the scaffold manufacturer’s written instructions.

.2 Provide trained and certified Competent Scaffold Erectors for all scaffold erection, modification and dismantling. Training certification must be valid at time of erection, modification and dismantling of scaffold.

.3 Conduct and document daily inspections of scaffolding by trained and certified Competent Scaffold Inspectors or Erectors. Training certification must be valid at the time of inspection.

.4 Provide a scaffold tagging system as described in CSA Z797.

.5 Ensure that all industry best practices for safe scaffold usage, including fall protection, proper loading, safe access, electrical hazards, exit door management and other concerns are strictly adhered to.

1.21 WORKING AT HEIGHTS

.1 Ensure that fall restraint or fall arrest devices are used by all workers working at elevations greater than 3.05 meters above grade or floor level in accordance with CSA Z259, where alternate fall protection systems are not provided in accordance with Occupational Health and Safety Act and Regulations O.Reg. 297/13.

.2 All workers performing work at height and who will be required to utilize a fall arrest system must be trained in a fall protection program certified by the WHSCC. Training must be current and valid at the time of use.

.3 Prior to working at height workers shall be instructed in a Contractor Safe Work Practice for working at height and associated Rescue Plan for working at heights, developed specific to the work to be performed, locations and risks.

1.22 PERSONAL PROTECTIVE EQUIPMENT

.1 Ensure workers on the jobsite use personal protective equipment appropriate to the hazards identified in the Site Specific Health and Safety Plan and those workers are trained in the proper care, use, and maintenance of such equipment.

.2 PPE selections shall be based on an evaluation of the performance characteristics of the PPE relative to the requirements and limitations of the site, task-specific conditions, duration and hazards and potential hazards identified on site. PPE must also be fitted for the worker.

.3 Provide workers and visitors to the site with proper respiratory protection equipment.

.1 No work shall be performed in an area where an airborne contaminant exceeds recommendations of the ACGIH, do not meet the appropriate standards for the specific contaminants or are not in accordance with the OHS regulations..

.2 Respiratory protection shall be provided in accordance with the requirements of the Occupational Health and Safety Branch, Services NL and these specifications.

.3 Establish, implement and maintain a respirator inspection and maintenance program in accordance with the CSA standard identified in the OHS Regulations.

.4 Copies of all respirator owners' maintenance manuals shall be kept at all times at the contractor's site office.

.4 Provide and maintain a supply of dermal protection equipment to allow visitors and all workers proper dermal protection.

.1 Dermal protection shall be sufficient to act as a protective barrier between the skin and an airborne contaminant or hazardous material. Dermal protection shall also be provided for all physical hazards.

.2 Dermal protection equipment shall not be used after exceeding 75% of the break through time. The break through time shall be based on the contaminant which requires the least amount of time to break through the protective equipment

.3 Copies of all dermal protection user specifications, owners and maintenance manuals shall be kept at all times at the contractor's site office.

.4 Establish, implement and maintain air inspection program to ensure proper dermal protection in accordance with CSA, NIOSH, U.S. EPA and manufacturer's requirements.

.5 Provide all workers and up to five (5) visitors to the site with proper hearing protection. Workers and visitors shall not be exposed to noise levels greater than 85 dB (A) over an eight hour shift without proper hearing protection, in accordance with the Hearing Conservation Program.

.6 Provide all workers and up to five (5) visitors to the site with CSA approved eye protection sufficient to act as a protective barrier between the eye and airborne contaminants, hazardous materials and physical hazard.

.7 Provide workers and up to five (5) visitors to the site with CSA approved hard hats meeting the CSA Z94.1.

.8 Provide high visibility apparel as defined in Occupational Health and Safety Regulations.

.9 Provide CSA approved safety boots meeting CSA Z195.

.10 Provide other personal protective equipment, as may be required by the owner, depending on duties being performed.

1.23 TRAFFIC CONTROL

.1 Provide traffic control measures when working on, or adjacent to, roadways in accordance with the Ontario Traffic Manual (as amended) Book 7 Temporary Conditions and O.Reg 471/16.

1.24 EXCAVATION SAFETY

.1 Protect all excavations in accordance with Part III of O.Reg 471/16 Construction Projects.

1.25 CONFINED SPACE WORK

.1 Comply with the Ontario Occupational Health and Safety Regulations.

.2 Ensure a hazard assessment has been conducted related to the confined space and the work to be performed within the space.

.3 Provide approved air monitoring equipment where workers are working in confined spaces and ensure any test equipment to be used is calibrated, in good working order and used by trained persons.

.4 Ensure all required PPE is provided to the workers and workers are trained in its use, care and selection.

.5 Develop a confined space entry (CSE) program specific to the nature of work performed and in accordance with OH&S Act and Regulations and ensure supervisors and workers are trained in the confined space entry program. This shall include training on the CSE permit system, rescue plan, testing, communication equipment and all equipment and safe work procedures conducted in and around the confined space.

.1 Ensure that personal protective equipment and emergency rescue equipment appropriate to the nature of the work being performed is provided and used.

.6 Provide and maintain training of workers through a provider certified by the WHSCC.

.7 Provide Contract Administrator with a copy of an “Entry Permit” for each entry into the confined space to ensure compliance Provincial Legislation.

1.26 HAZARDOUS MATERIALS

.1 Should material resembling hazardous materials (e.g. asbestos/mould) not previously identified/documented be encountered during the execution of work, stop work and notify Contract Administrator. Do not proceed until written instructions have been received from Contract Administrator.

.2 Unless otherwise noted the services of a recognized Environmental Consultant to provide all air monitoring and testing services required by regulatory requirements for hazardous materials abatement and repair.

1.27 HEAVY EQUIPMENT

.1 Ensure mobile equipment used on jobsite is of the type specified in OH&S Act and Regulations fitted with a Roll Over Protective (ROP) Structure and Falling Object Protective (FOP) Structure.

.2 Provide certificate of training in Power Line Hazards for operators of heavy equipment.

.3 Obtain written clearance from the power utility where equipment is used in close proximity to (within 5.5 metres) overhead or underground power lines.

.4 Equip cranes with:

.1 A mechanism which will effectively prevent the hook assembly from running into the top boom pulley.

.2 A legible load chart.

.3 A maintenance log book.

1.28 TREE AND BRUSH CLEARING

.1 Ensure workers using chain saws wear the following safety equipment:

.1 CSA safety hat.

.2 Hearing protection, e.g. ear muffs.

.3 CSA approved chain saw pants.

.4 CSA approved chain saw boots.

.5 CSA approved eye protection.

.2 Ensure that all workers using brush saws wear the following safety equipment:

.1 CSA approved safety hat fitted with face screen or shield or approved safety glasses.

.2 Hearing protection, e.g. ear muffs.

.3 CSA approved safety footwear.

.3 Equip chain saws with a safety chain break.

.4 A safe work practice (SWP) must be developed, implemented and all workers trained in the SWP prior to undertaking such tasks and utilizing tree and brush clearing equipment.

1.29 WORK STOPPAGE

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

1.30 EQUIPMENT LOCK-OUT/TAG-OUT

.1 The Contractor shall coordinate and comply with CSA Z460-05 (R2010) “Control of Hazardous Energy – Lockout and Other Methods” for all machines, equipment and process requiring isolation.

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION (NOT APPLICABLE)

END OF SECTION

ENVIRONMENTAL PROTECTION

PART 1 GENERAL

1.1 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.

1.2 REFERENCE

.1 Contract Section 8: Natural Heritage Assessment Report provides requirements for the erosion and sediment control measures as well as the avoidance and mitigation measures to prevent contravention of the Endangered Species Act which shall be followed by the Contractor in execution of the Contract.

1.3 SUBMITTALS

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

.2 Prior to commencing construction activities or delivery of materials to site, submit Environmental Protection Plan for review and approval by Contract Administrator Environmental Protection Plan is to present comprehensive overview of known or potential environmental issues which must be addressed during construction.

.3 Address topics at level of detail commensurate with environmental issue and required construction tasks.

.4 Environmental protection plan shall include:

.1 Names of persons responsible for ensuring adherence to Environmental Protection Plan.

.2 Names and qualifications of persons responsible for training site personnel.

.3 Descriptions of environmental protection personnel training program.

.4 Erosion and sediment control plan which identifies 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.

.5 Drawings showing locations of proposed temporary excavations or embankments for haul roads, stream crossings, material storage areas, structures, sanitary facilities, and stockpiles of excess or spoil materials including methods to control runoff and to contain materials on site.

.6 Traffic control plans including measures to reduce erosion of temporary roadbeds by construction traffic, especially during wet weather. Plans include measures to minimize amount of mud transported onto paved public roads by vehicles or runoff.

.7 Work area plan showing proposed activity in each portion of area and identifying areas of limited use or non-use. Plan to include measures for marking limits of use areas including methods for protection of features to be preserved within authorized work areas.

.8 Spill Control Plan: including procedures, instructions, and reports to be used in event of unforeseen spill of regulated substance.

.9 Non-Hazardous solid waste disposal plan identifying methods and locations for solid waste disposal including clearing debris.

.10 Air pollution control plan detailing provisions to assure that dust, debris, materials, and trash, do not become air borne and travel off project site.

.11 Contaminant prevention plan that: identifies potentially hazardous substances to be used on job site; identifies intended actions to prevent introduction of such materials into air, water, or ground; and details provisions for compliance with Federal, Provincial, and Municipal laws and regulations for storage and handling of these materials.

.12 Waste water management plan that identifies 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.

.13 Historical, archaeological, cultural resources biological resources and wetlands plan that defines procedures for identifying and protecting historical, archaeological, cultural resources, biological resources and wetlands.

.14 Pesticide treatment plan: to be included and updated, as required.

1.4 FIRES

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

1.5 DISPOSAL OF WASTES

.1 Do not bury rubbish and waste materials on site.

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

ENVIRONMENTAL PROTECTION

1.6 DRAINAGE

.1 Provide temporary drainage and pumping as necessary to keep excavations and site free from water.

.2 Do not pump water containing suspended materials into waterways, sewer or drainage systems.

.3 Control disposal or runoff of water containing suspended materials or other harmful substances in accordance with local authority requirements.

1.7 SITE CLEARING AND PLANT PROTECTION

.1 Protect trees and plants on site and adjacent properties where 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.

.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 Contract Administrator.

1.8 WORK ADJACENT TO WATERWAYS

.1 Do not operate construction equipment in waterways.

.2 Do not use waterway beds for borrow material.

.3 Do not dump excavated fill, waste material or debris in waterways.

.4 Design and construct temporary crossings to minimize erosion to waterways.

.5 Do not skid logs or construction materials across waterways.

.6 Avoid indicated spawning beds when constructing temporary crossings of waterways.

.7 Do not blast under water or within 100 m of indicated spawning beds.

1.9 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 beyond application area, by providing temporary enclosures.

.4 Cover or wet down dry materials and rubbish to prevent blowing dust and debris. Provide dust control for temporary roads.

1.10 NOTIFICATION

.1 Contract Administrator will notify Contractor in writing of observed non-compliance with Federal, Provincial or Municipal environmental laws or regulations, permits, and other elements of environmental protection. Contractor: after receipt of such notice, inform Contract Administrator of proposed corrective action and take such action as approved by Contract Administrator.

.2 Contract Administrator may issue stop order of work until satisfactory corrective action has been taken.

.3 No time extensions will be granted or equitable adjustments allowed to Contractor for such suspensions.

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION (NOT APPLICABLE)

END OF SECTION

QUALITY CONTROL

PART 1 GENERAL

1.1 SECTIONS INCLUDE

.1 Inspection and testing, administrative and enforcement requirements.

.2 Tests and mix designs.

.3 Mock-ups.

.4 Mill tests.

.5 Equipment and system adjust and balance.

1.2 RELATED SECTIONS

.1 Section 01 21 00 – Allowances.

.2 Section 01 33 00 – Submittal Procedures

.3 Section 01 78 00 – Closeout Submittals

1.3 INSPECTION

.1 Allow Contract Administrator 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 Contract Administrator instructions.

.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 Contract Administrator may order any 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, Contract Administrator shall pay cost of examination and replacement.

1.4 INDEPENDENT INSPECTION AGENCIES

.1 Independent Inspection/Testing Agencies will be engaged by Contract Administrator for purpose of inspecting and/or testing portions of Work.

.2 Allocated costs: to Section 01 21 00 – Allowances and Section 01 29 83 – Payment Procedures: Testing Laboratory Services.

.3 Provide equipment required for executing inspection and testing by appointed agencies.

.4 Employment of inspection/testing agencies does not relax responsibility to perform Work in accordance with Contract Documents.

.5 If defects are revealed during inspection and/or testing, appointed agency will request additional inspection and/or testing to ascertain full degree of defect. Correct defect and irregularities as advised by Contract Administrator at no cost to Contract Administrator. Pay costs for retesting and reinspection.

1.5 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.

1.6 PROCEDURES

.1 Notify appropriate agency and Contract Administrator 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 an orderly sequence so as not to cause delay 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.

1.7 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 Contract Administrator 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 Contract Administrator it is not expedient to correct defective Work or Work not performed in accordance with Contract Documents, Owner may deduct from Contract Price difference in value between Work performed and that called for by Contract Documents, amount of which shall be determined by Contract Administrator.

QUALITY CONTROL

1.8 REPORTS

.1 Submit 3 copies of inspection and test reports to Contract Administrator, plus electronic copies in PDF format.

.2 Provide copy to Subcontractor of work being inspected or tested, manufacturer or fabricator of material being inspected or tested.

.3 Include copy of all inspection and test reports in Commissioning Manuals.

1.9 MOCK-UPS

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

.2 Construct in all locations acceptable to Contract Administrator as specified in specific Section.

.3 Prepare mock-ups for Contract Administrator review with reasonable promptness and in an orderly sequence, so as not to cause any delay in Work.

.4 Failure to prepare mock-ups in ample time is not considered sufficient reason for an extension of Contract Time and no claim for extension by reason of such default will be allowed.

.5 Remove mock-up at conclusion of Work or when acceptable to Contract Administrator

.6 Specification section identifies whether mock-up may remain as part of Work or if it is to be removed and when.

.7 Reviewed and accepted mock-ups will become standards of workmanship and material against which installed work will be verified.

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

1.10 EQUIPMENT AND SYSTEMS

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

.2 Mechanical – coordinate with mechanical division.

.3 Electrical – Coordinate with electrical division.

1.11 FIRE SEPARATIONS

.1 Provide fire separation labelling/stenciling as per Sections 07 84 00 Fire Stopping.

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION (NOT APPLICABLE)

END OF SECTION

TEMPORARY UTILITIES

PART 1 GENERAL

1.1 RELATED SECTIONS

.1 Section 01 52 00 - Construction Facilities.

.2 Section 01 56 00 - Temporary Barriers and Enclosures.

1.2 INSTALLATION AND REMOVAL

.1 Provide temporary utilities controls in order to execute work expeditiously.

.2 Remove from site all such work after use.

1.3 DEWATERING

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

.2 Refer to the attached Permit to Take Water Application for detailed dewatering requirement.

1.4 WATER SUPPLY (NOT APPLICABLE)

1.5 TEMPORARY HEATING AND VENTILATION

.1 Pay for costs of temporary heat and ventilation used during construction, including costs of installation, fuel operation, maintenance and removal of equipment. Use of direct, fired heaters discharging waste products into work areas will not be permitted unless prior approval is given by Contract Administrator.

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

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

- .1 Facilitate progress of Work.
- .2 Protect Work and products against dampness and cold.
- .3 Prevent moisture condensation on surfaces.
- .4 Provide ambient temperatures and humidity levels for storage, installation and curing of materials.
- .5 Provide adequate ventilation to meet health regulations for safe working environment.

.4 Maintain temperatures of minimum 10˚C and relative humidity less than 60% in areas where construction is in progress.

.1 Maintain minimum temperature of 10˚C or higher where specified as soon as finished work is commenced. Maintain until acceptance of structure by Contract Administrator.

.2 Maintain ambient temperature and humidity levels as required for comfort of office personnel.

.5 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.

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

.1 Conform with applicable codes and standards.

.2 Enforce safe practices.

.3 Prevent abuse of services.

.4 Prevent damage to finishes.

.5 Vent direct-fired combustion units to outside.

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

.8 Use of new or existing systems for temporary heating, ventilating or air conditioning will not be permitted.

1.6 TEMPORARY POWER AND LIGHT

.1 Provide and pay for temporary power during constructing for temporary lighting, heating, site construction trailers and operating of power tools in accordance with governing regulations and the Canadian Electrical Code, latest edition.

.2 Arrange for connection with Utility company. Pay all costs for installation, maintenance and removal of cables, distribution and branch panel boards, poles, lighting, heating and general power receptacles as required.

.3 Temporary power for electric cranes and other equipment requiring in excess of above is responsibility of Contractor.

.4 Provide and maintain temporary lighting throughout project. Ensure level of illumination on all floors and stairs is not less than 162 lx. Temporary lighting to consist of wiring, pig tail sockets and 75 watt shatterproof incandescent lamps to provide a minimum light level of 162 lux.

.5 Electrical power and lighting systems installed under this contract may be used for construction requirements only with prior approval of Contract Administrator 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.

.6 General contractor responsible for payment of all electrical energy charges associated with temporary power up to date of substantial completion.

1.7 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.

1.8 SANITARY FACILITIES

.1 Provide sanitary facilities for work force in accordance with governing regulations and ordinances.

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

.3 When permanent water and drain connections are completed, provide temporary water closets and urinals complete with temporary enclosures, inside building. Permanent facilities may be used on approval of Contract Administrator.

1.9 TEMPORARY COMMUNICATION FACILITIES

.1 Provide and pay for temporary telephone, fax, data hook up, lines and equipment necessary for own use and use of Contract Administrator.

1.10 SITE SIGN AND NOTICES

.1 Contractor is responsible for the construction of job sign frame and the installation of the plywood job sign. Locate job sign as directed by Contract Administrator so as to ensure good visibility by passing traffic.

.2 Construct timber job sign frame using two (2) 140 x 140mm timber posts set vertically in concrete to a ground depth of 1000mm or below the frost line, whichever is greater. Install three (3) 38 x 89mm horizontal timber braces. Attach plywood sign to timber frame using galvanized nails. Paint timber frame with two

(2) coats of white paint if using untreated timber. Backfill compact and level ground around job sign frame to the satisfaction of the Contract Administrator.

1.11 REMOVAL OF TEMPORARY FACILITIES

.1 Remove temporary facilities from site when directed by Contract Administrator.

.2 When project is closed down at end of construction season keep temporary facilities operational until close down or removal is approved by Contract Administrator.

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION (NOT APPLICABLE)

END OF SECTION

CONSTRUCTION FACILITIES

PART 1 GENERAL

1.1 SECTION INCLUDES

.1 Construction aids.

.2 Office and sheds.

.3 Parking.

.4 Project identification.

1.2 RELATED SECTIONS

.1 Section 01 35 29.06 – Health and Safety Requirements

.2 Section 01 51 00 - Temporary Utilities.

.3 Section 01 56 00 - Temporary Barriers and Enclosures.

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 Provide and maintain scaffolding in rigid, secure and safe manner.

.2 Erect scaffolding independent of walls. Remove promptly when no longer required. Refer to Section 01 35 29.06 – Health and Safety Requirements.

1.5 HOISTING

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

.2 Hoists cranes shall be operated by certified operator.

1.6 SITE STORAGE/LOADING

.1 Confine work and operations of employees by Contract Documents. Do not unreasonably encumber premises with products.

.2 Do not load or permit to load any part of Work with a weight or force that will endanger the Work.

CONSTRUCTION FACILITIES

1.7 CONSTRUCTION PARKING

.1 Parking will be permitted on site provided it does not disrupt performance of work and/or access to operational facilities.

.2 Provide and maintain adequate access to project site.

.3 Build and maintain temporary roads where indicated or directed by Contract Administrator and provide snow removal during period of Work.

.4 If authorized to use existing roads for access to project site, maintain such roads for duration of Contract and make good damage resulting from Contractor's use of roads.

1.8 CONTRACTOR'S SITE OFFICES

.1 Provide office heated to 22 oC, lighted 750 lx and ventilated, of sufficient size to accommodate site meetings and furnished with drawing laydown table, fax machine, telephone, file cabinet and chair. Provide an accessible washroom within the contractor's site office.

.2 Provide suitable space for weekly construction meetings for up to 12 persons (table, chair, A/V equipment)

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

.4 Subcontractors may provide their own offices as necessary. Direct location of these offices.

1.9 CONTRACT ADMINISTRATOR SITE OFFICE

.1 Provide temporary office for Contract Administrator.

.2 Inside dimensions minimum 4.8 m long x 3 m wide x 2.4 m high, with floor 0.3 m above grade, complete with 4 - 50% opening windows and one lockable door.

.3 Insulate building and provide heating system to maintain 22˚C inside temperature at -20˚C outside temperature.

.4 Finish inside walls and ceiling with plywood, hardboard or wallboard and paint in selected colours. Finish floor with 19mm thick plywood.

.5 Install electrical lighting system to provide min 750 lx using surface mounted, shielded commercial fixtures with 10% upward light component.

.6 Site office to have washroom facility complete with running water and sewage disposal. Maintain supply of washroom supplies.

.7 Equip office with drawing laydown table, file cabinet, two chairs, telephone, high speed internet.

.8 Maintain in clean condition.

1.10 EQUIPMENT, TOOL AND MATERIALS STORAGE

.1 Provide and maintain, in a 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 a manner to cause least interference with work activities.

1.11 SANITARY FACILITIES

.1 Provide sanitary facilities for work force in accordance with governing regulations and ordinances.

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

1.12 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.

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION (NOT APPLICABLE)

END OF SECTION

TEMPORARY BARRIERS AND ENCLOSURES

PART 1 GENERAL

1.1 SECTION INCLUDES

.1 Barriers.

.2 Environmental Controls.

.3 Traffic Controls.

.4 Fire Routes.

.5 Site Security.

1.2 RELATED SECTIONS

.1 Section 01 51 00 – Temporary Utilities.

.2 Section 01 52 00 – Construction Facilities.

1.3 INSTALLATION AND REMOVAL

.1 Provide temporary controls in order to execute Work expeditiously.

.2 Remove from site all such work after use.

1.4 SECURITY

.1 Provide temporary gates at the access to the site.

1.5 GUARD RAILS AND BARRICADES

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

.2 Provide as required by governing authorities.

1.6 WEATHER ENCLOSURES

.1 Provide weather tight closures to unfinished door and window openings, tops of shafts and other openings in floors and roofs.

.2 Close off floor areas where walls are not finished; seal off other openings; enclose building interior work for temporary heat.

.3 Erect enclosures to allow access for installation of materials and working inside enclosure.

.4 Design enclosures to withstand wind pressure and snow loading.

1.7 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.

1.8 ACCESS TO SITE

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

.2 Build and maintain temporary roads where indicated or directed and provide snow removal during period on work.

.3 If authorized to use existing roads for access to project site, maintain such roads for duration of Contract and make good damage resulting from Contractor's use of roads.

1.9 PUBLIC TRAFFIC FLOW

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

1.10 FIRE ROUTES

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

1.11 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.

1.12 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 Contract Administrator locations and installation schedule 3 days prior to installation.

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

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION (NOT APPLICABLE)

END OF SECTION

COMMON PRODUCT REQUIREMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

.1 Product quality, availability, storage, handling, protection, and transportation.

.2 Manufacturer's instructions.

.3 Quality of Work, coordination and fastenings.

1.2 RELATED SECTIONS

.1 Section 01 45 00 – Quality Control.

.2 Section 01 73 00 – Execution.

1.3 REFERENCES

.1 Within text of each specifications section, reference may be made to reference standards. Conform to these reference standards, in whole or in part as specifically requested in specifications.

.2 Conform to latest date of issue of referenced standards in effect on date of submission of Tenders, except where specific date or issue is specifically noted.

1.4 QUALITY

.1 Products, materials, equipment and articles (referred to as products throughout specifications) incorporated in Work shall be new, not damaged or defective, and of best quality (compatible with specifications) for purpose intended. If requested, furnish evidence as to type, source and quality of products provided.

.2 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.

.3 Should any dispute arise as to quality or fitness of products, decision rests strictly with Contract Administrator based upon requirements of Contract Documents.

.4 Within seven (7) working days of written request by Contract Administrator, submit following information for material and equipment proposed for supply:

.1 Name and address of manufacturer.

.2 trade name, model and catalogue number,

.3 performance, descriptive and test data,

.4 manufacturer’s installation or application instructions,

.5 evidence of arrangements to procure.

.5 Use products of one manufacturer for material and equipment of same type or classification unless otherwise specified.

.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.

1.5 AVAILABILITY

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

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

1.6 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 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 Contract Administrator.

.9 Touch-up damaged factory finished surfaces as per the manufacturer's factory requirements and to Contract Administrator satisfaction. Use touch-up materials to match original. Do not paint over name plates.

.10 For all mechanical or electrical equipment stored on site, refer to manufacturer's recommendations regarding maintenance required during storage, and prepare maintenance schedule detailing the rotation, lubrication and/or exercise requirements of the equipment while stored. Provide schedule to Contract Administrator, and demonstrate that the schedule is being followed during storage.

1.7 TRANSPORTATION

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

1.8 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 Contract Administrator in writing, of conflicts between specifications and manufacturer's instructions, so that Contract Administrator may establish course of action.

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

1.9 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 Contract Administrator if required Work is such as to make it impractical to produce required results.

.2 Do not employ anyone unskilled in their required duties. Contract Administrator 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 Contract Administrator, whose decision is final.

1.10 CO-ORDINATION

.1 Ensure cooperation of workers in laying out Work. Maintain efficient and continuous supervision.

.2 Be responsible for coordination and placement of openings, sleeves and accessories.

1.11 CONCEALMENT

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

.2 Before installation, inform Contract Administrator if there is interference. Install as directed by Contract Administrator.

1.12 REMEDIAL WORK

.1 Perform remedial work required to repair or replace parts or portions of Work identified as defective or unacceptable. Coordinate 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.

1.13 LOCATION OF FIXTURES

.1 Consider location of fixtures, outlets, and mechanical and electrical items indicated 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 Contract Administrator of conflicting installation. Install as directed.

.4 Submit field drawings to indicate relative position of various services and equipment when required by Contract Administrator.

1.14 FASTENINGS GENERAL

.1 Provide metal fastenings and accessories in same texture, colour and finish as base metal in which they occur. Prevent electrolytic action between dissimilar metals. Use non-corrosive fasteners, anchors and spacers for securing exterior work, unless stainless steel or other material is specifically requested in affected specification section.

.2 Space anchors within individual load limit or shear capacity and ensure they provide positive permanent anchorage. Wood plugs are not acceptable.

.3 Conceal fasteners where indicated. Space evenly and lay out neatly.

.4 Fastenings which cause Spalding or cracking are not acceptable.

.5 Obtain Contract Administrator's approval before using explosive actuated fastening devices. If approval is obtained comply with CSA Z166.

1.15 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.

1.16 PROTECTION OF WORK IN PROGRESS

.1 Prevent overloading of any part of building. Do not cut, drill or sleeve any load bearing structural member, unless specifically indicated without written approval of Contract Administrator.

1.17 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.

.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.

.3 Submit schedule to and obtain approval from Contract Administrator for any shut-down or closure of active services or facility. Adhere to approved schedule and provide notice to affected parties.

.4 Where unknown services are encountered, immediately advise Contract Administrator and confirm findings in writing.

.5 Remove abandoned services lines within 2m of structures. Cap or otherwise seal lines at cut-off points as directed by Contract Administrator.

1.18 SELECTION OF MATERIAL AND EQUIPMENT

.1 Material and equipment will be specified in the tender documents, and selected by Contractor, by one or more of the following methods:

.1 Specification by reference to a relevant Standard, such as CSA, ASTM, ULC, etc., select any material or equipment that meets or exceeds the specified.

.2 Specification by reference to an accepted product evaluation publication, such as the CGSB “Qualified Products List”, or CCMC Registry of Product Evaluations”, - select any manufacturer’s product so listed.

.3 Specification by Prescriptive or Performance specification – select any material or equipment meeting or exceeding specification.

.4 Specification by identification of one or more Manufacturer's specific product(s) as an "Acceptable Product", along with a listing of other manufacturers who may offer equivalent products – select any product so named, or select from equivalent product(s) of other listed manufacturers.

.2 "Acceptable Product" is deemed to be a complete and working commodity as described by a manufacturer's name, catalogue number, trade name, or any combination thereof, and will constitute the minimum standard of acceptance.

.3 Contract Administrator will determine acceptability of Contractor's selection of material and equipment at time of Shop Drawing review.

.4 When material or equipment is specified by a Standard, Prescriptive or Performance specification, upon request of the Contract Administrator, obtain from manufacturer an independent laboratory reporting, showing that material or equipment meets or exceeds the specified requirements.

1.19 SUBSTITUTION OF MATERIAL AND EQUIPMENT

.1 **Prior to Tender** closing bidders may propose addition of other manufacturer's names to those listed in the tender documents providing requests are made in writing at least 10 days prior to tender closing date or bid depository where bid depository is used. Contract Administrator will inform all prospective bidders of decision by addendum, issued at least 5 days prior to the tender closing date.

Where no manufacturer's names are listed, the onus is on contractor to provide material and equipment to meet performance specification.

.2 **After Contract award** substitutions of material or equipment, other than as selected by Contractor from those specified, will be considered by Contract Administrator only if:

.1 material or equipment selected from those specified are not available

.2 delivery date of material or equipment selected from those specified would unduly delay completion of the Contract; or

.3 alternative material or equipment to those specified, provided they are determined by the Contract Administrator to be equivalent to or better that those specified, and will result in a credit to the Contract amount.

.3 Requests for substitutions after Contract award must be accompanied by sufficient information in the form of shop drawings, manufacturer's literature, samples or other data to permit proper investigation of the substitutes used. Requests must also include statements of respective costs of material or equipment originally specified and the proposed substitution.

.4 Should a proposed substitution be accepted after Contract award either in part or in whole, assume full responsibility and costs when substitution affects other work

on Project. Contractor to pay for design or drawing changes required as a result of the substitution.

.5 Amounts of all credits arising from approval of substitutions after Contract award will be determined by Contract Administrator and the Contract amount will be reduced accordingly.

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION (NOT APPLICABLE)

END OF SECTION

EXAMINATION AND PREPARATION

PART 1 GENERAL

1.1 SECTION INCLUDES

.1 Field engineering survey services to measure and stake site.

.2 Survey services to establish and confirm inverts for Work.

.3 Recording of subsurface conditions found.

1.2 QUALIFICATIONS OF SURVEYOR

.1 Qualified registered land surveyor, licensed to practise in the Province of Ontario.

1.3 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 Contract Administrator.

.4 Report to Contract Administrator when reference point is lost or destroyed, or requires relocation because of necessary changes in grades or locations.

.5 Require surveyor to replace control points in accordance with original survey control.

1.4 SURVEY REQUIREMENTS

.1 Establish permanent bench marks on site, referenced to established bench marks by survey control points. Record locations, with horizontal and vertical data in Project Record Documents.

.2 Establish lines and levels, locate and lay out, by instrumentation.

.3 Stake for grading, fill placement.

.4 Establish pipe invert elevations.

.5 Stake batter boards for foundations.

.6 Establish foundation column locations and floor elevations.

.7 Establish lines and levels for mechanical and electrical work.

1.5 EXISTING SERVICES

.1 Where work involves breaking into or connecting to existing services, carry out work at times directed by authorities having jurisdiction, with minimum of disturbance to pedestrian and vehicular traffic.

.2 Before commencing work, establish location and extent of service lines in area of Work and notify Contract Administrator of findings.

.3 Remove abandoned service lines within 2 m of structures. Cap or otherwise seal lines at cut-off points as directed by Contract Administrator.

1.6 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 Contract Administrator 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 Contract Administrator.

1.7 RECORDS

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

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

1.8 SUBMITTALS

.1 Submit name and address of Surveyor to Contract Administrator.

.2 On request of Contract Administrator, 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.

1.9 SUBSURFACE CONDITIONS

.1 Promptly notify Contract Administrator in writing if subsurface conditions at Place of Work differ materially from those indicated in Contract Documents, or a reasonable assumption of probable conditions based thereon.

.2 The Contractor is required to be familiar with the existing As-Built and documents.

.3 After prompt investigation, should Contract Administrator determine that conditions do differ materially, instructions will be issued for changes in Work.

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION (NOT APPLICABLE)

END OF SECTION

EXECUTION

PART 1 GENERAL

1.1 SECTION INCLUDES

.1 Requirements and limitations for cutting and patching the Work.

1.2 RELATED SECTIONS

.1 Section 01 11 00 - Summary of Work.

.2 Section 01 33 00 - Submittal Procedures.

1.3 SUBMITTALS

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

.1 Structural integrity of any element of Project.
.2 Integrity of weather-exposed or moisture-resistant elements.
.3 Efficiency, maintenance, or safety of any operational element.
.4 Visual qualities of sight-exposed elements.
.5 X-ray all penetrations to identify rebar layout.
.6 Work of Owner or separate contractor.

.2 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.

1.4 PREPARATION

.1 Inspect existing conditions, including elements subject to damage or movement during cutting and patching.

.2 After uncovering, inspect conditions affecting performance of Work.

.3 Beginning of cutting or patching means acceptance of existing conditions.

.4 Provide supports to assure structural integrity of surroundings; provide devices and methods to protect other portions of project from damage.

EXECUTION

.5 Provide protection from elements for areas which may be exposed by uncovering work; maintain excavations free of water.

.6 Obtain Contract Administrator approval before cutting, boring or sleeving load-bearing members.

1.5 EXECUTION

.1 Execute cutting, fitting, and patching including excavation and fill, to complete Work.

.2 Fit several parts together, to integrate with other Work.

.3 Uncover Work to install ill-timed Work.

.4 Remove and replace defective and non-conforming Work.

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

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

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

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

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

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

.11 At penetration of fire rated wall, ceiling, or floor construction, completely seal voids with firestopping material in accordance with Section 07 84 00 - Firestopping, full thickness of the construction element.

.12 Refinish surfaces to match adjacent finishes: For continuous surfaces refinish to nearest intersection; for an assembly, refinish entire unit.

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

.14 Make cuts with clean, true, smooth edges.

.15 Where new work connects with existing, and where existing work is altered, cut, patch and make good to match existing work.

EXECUTION

1.6 WASTE MANAGEMENT AND DISPOSAL

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

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION (NOT APPLICABLE)

END OF SECTION

CLEANING

PART 1 GENERAL

1.1 GENERAL

.1 Conduct cleaning and disposal operations to comply with local ordinances and anti-pollution laws.

.2 Store volatile waste in covered metal containers and remove from premises at end of each working day.

.3 Provide adequate ventilation during use of volatile or noxious substances. Use for building ventilation systems is not permitted for this purpose.

1.2 RELATED SECTION

.1 Section 01 77 00 - Closeout Procedures.

.2 Section 01 74 21 – Construction Waste

1.3 PROJECT CLEANLINESS

.1 Maintain Work in tidy condition, free from accumulation of waste products and debris.

.2 Remove waste materials and debris from site at the end of each working day. Do not burn waste materials on site.

.3 Clear snow and ice from access to building.

.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 Clean interior areas prior to start of finish work, maintain areas free of dust and other contaminants during finishing operations.

.7 Store volatile waste in covered metal containers, and remove from premises at end of each working day.

.8 Provide adequate ventilation during use of volatile or noxious substances. Use of building ventilation systems is not permitted for this purpose.

.9 Use only cleaning materials recommended by manufacturer of surface to be cleaned, and as recommended by cleaning material manufacturer.

.10 Vacuum clean interior of building areas of dirt when ready to receive finishes and continue vacuum cleaning at least daily until building is ready for substantial completion or occupancy. Sweep floors and pavements clean on a daily basis.

.11 Schedule cleaning operations so that resulting dust, debris and other contaminants will not fall on wet, newly painted surfaces nor contaminate building systems.

.12 Areas in which electrical and mechanical equipment area located and ready for start-up and commissioning must be cleaned of all dusts and debris prior to any equipment being started up. After start up the areas are to be maintained dust free, filters replaced on a weekly basis, the internal areas of control panels, and equipment filters/fans etc. shall be vacuum cleaned on a weekly basis. If in the opinion of the Contract Administrator, there is excessive amounts of dust being drawn into the building through openings, penetrations or due to ambient construction activities outside the operating areas, the contractor will be responsible to provide additional air filtration to achieve a dust free environment.

1.4 FINAL CLEANING

.1 Refer to General Conditions.

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

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

.4 When the Work is Totally Performed, remove surplus products, tools, construction machinery and equipment. Remove waste products and debris other than that caused by the Owner or other Contractors.

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

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

.7 Leave the work broom clean before the inspection process commences.

.8 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.

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

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

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

.12 Wax, seal, shampoo or prepare floor finishes, as recommended by manufacturer.

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

.14 Broom clean and wash exterior walks, steps and surfaces; rake clean other surfaces of grounds.

.15 Remove dirt and other disfiguration from exterior surfaces.

.16 Clean roofs, gutters, downspouts and drainage systems. Clean areaways and sunken wells.

.17 Sweep and wash clean paved areas.

.18 Clean equipment and fixtures to a sanitary condition; clean or replace filters of mechanical and electrical equipment.

.19 Remove snow and ice from access to building.

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

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION (NOT APPLICABLE)

END OF SECTION

CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 GENERAL

1.1 SECTION INCLUDES

.1 Text, schedules and procedures for systematic Waste Management Program for construction, deconstruction, demolition, and renovation projects, including:

- .1 Diversion of Materials.
- .2 Waste Audit (WA) - Schedule A.
- .3 Waste Reduction Workplan (WRW) - Schedule B.
- .4 Demolition Waste Audit (DWA) - Schedule C.
- .5 Cost/Revenue Analysis Workplan (CRAW) - Schedule D.
- .6 Materials Source Separation Program (MSSP).
- .7 Canadian Governmental Responsibility for the Environment Resources - Schedule E.

1.2 DEFINITIONS

.1 Demolition Waste Audit (DWA): Relates to actual waste generated from project.

.2 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.

.3 Recyclable: Ability of product or material to be recovered at end of its life cycle and re-manufactured into new product for reuse by others.

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

.5 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.

.6 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.

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

.8 Separate Condition: Refers to waste sorted into individual types.

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

1.3 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 authorities having jurisdiction.

.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 recycling facility.

1.4 STORAGE, HANDLING AND PROTECTION

.1 Unless specified otherwise, materials for removal become Contractor's property.

.2 Protect, stockpile, store and catalogue salvaged items.

.3 Separate non-salvageable materials from salvaged items. Transport and deliver non-salvageable items to approved local 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 Department having jurisdiction.

.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.

1.5 DISPOSAL OF WASTES

.1 Do not bury OR burn rubbish or waste materials.

.2 Do not dispose of any waste into waterways, storm, or sanitary sewers.

.3 Remove materials from deconstruction as deconstruction/disassembly Work progresses.

.4 Prepare project summary to verify destination and quantities on a material-by-material basis as identified in pre-demolition material audit.

1.6 USE OF SITE AND FACILITIES

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

.2 Provide security measures approved by Owner's Representative.

1.7 SCHEDULING

.1 Coordinate Work with other activities at site to ensure timely and orderly progress of Work.

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION

3.1 APPLICATION

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

.2 CLEANING

.3 Remove tools and waste materials on completion of Work, and leave work area in clean and orderly condition.

.4 Clean-up work area as work progresses.

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

3.2 DIVERSION OF MATERIALS

.1 From following list, separate materials from general waste stream and stockpile in separate piles or containers, as reviewed by Owner's Representative and consistent with applicable fire regulations.

.1 Mark containers or stockpile areas.

.2 Provide instruction on disposal practices.

.2 On-site sale or distribution of salvaged materials to third parties is not permitted.

END OF SECTION

CLOSEOUT PROCEDURES

PART 1 GENERAL

1.1 RELATED SECTIONS

.1 Section 01 74 11 - Cleaning.

.2 Section 01 78 00 - Closeout Submittals.

.3 Section 01 91 13 – General Commissioning (Cx) Requirements.

1.2 FINAL INSPECTION AND DECLARATION PROCEDURES

.1 Contractor's Inspection: The Contractor and all Subcontractors shall conduct an inspection of Work, identify deficiencies and defects; repair as required. Notify the Contract Administrator in writing of satisfactory completion of the Contractor's Inspection and that corrections have been made. Request an Contract Administrator's Consultant's Inspection.

.2 Contract Administrator's Inspection: Contract Administrator and the Contractor will perform an inspection of the Work to identify obvious defects or deficiencies. The contractor shall correct Work accordingly.

.3 Completion: submit written certificate that the following have been performed:

.1 Work has been completed and inspected for compliance with Contract Documents.

.2 Defects have been corrected and deficiencies have been completed.

.3 Equipment and systems have been tested, adjusted and balanced and are fully operational.

.4 Certificates required by Fire Commissioner, Utility companies have been submitted.

.5 Operation of systems have been demonstrated to Owner's personnel.

.6 Commissioning of building/process/mechanical and electrical systems: completed in accordance with section 01 91 13 – Commissioning (Cx) Requirements and copies of final Commissioning Report submitted to Contract Administrator.

.7 Work is complete and ready for Final Inspection.

.4 Final Inspection: When items noted above are completed, request final inspection of Work by the Contract Administrator(s) and the Contractor. If Work is deemed incomplete by the Contract Administrator, complete outstanding items and request a reinspection.

.5 Declaration of Substantial Performance: When the Contract Administrator considers deficiencies and defects have been corrected and it appears requirements of Contract have been substantially performed, make application for

Certificate of Substantial Performance. Refer to General Conditions for specifics to application.

.6 Commencement of Lien and Warranty Periods: The date of the Owners acceptance of the submitted declaration of Substantial Performance shall be the date for commencement for the warranty period and commencement of the lien period.

.7 Declaration of Total Performance: When the Contract Administrator considers final deficiencies and defects have been corrected and it appears requirements of the Contract have been totally performed, make application for certificate of Total Performance. Refer to General Conditions for specifics to application. If Work is deemed incomplete by the Contract Administrator, complete the outstanding items and request a reinspection.

1.3 REINSPECTION

.1 Should status of work require reinspection by Contract Administrator due to failure of work to comply with Contractor's claims for inspection, Owner will deduct amount of compensation for reinspection services from payment to Contractor.

1.4 OCCUPANCY

.1 Owner reserves the right to occupy and operate portions of work whether partially or entirely completed, or whether completed on schedule or not.

.2 Partial occupancy shall not imply acceptance of work in whole or in part nor shall it imply acknowledgement that the terms of Agreement are fulfilled.

1.5 SYSTEM DEMONSTRATION

.1 Prior to Substantial Performance:

.1 Demonstrate operation of each system to Contract Administrator(s).

.2 Instruct personnel in operation, adjustment and maintenance of equipment and systems, using provided operation and maintenance data as basis for instruction.

1.6 WARRANTIES

.1 The contractor shall include a minimum one year warranty on all products, materials and workmanship. Extended warranties shall be included for various items as defined in the individual specifications.

1.7 SUBMITTALS

.1 Refer to Section 01 33 00 and Contract General Conditions for submission requirements at project completion.

1.8 FINAL CLEANING

.1 Refer to Section 01 74 11 for cleaning requirements.

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION (NOT APPLICABLE)

END OF SECTION

CLOSEOUT SUBMITTALS

PART 1 GENERAL

1.1 SECTION INCLUDES

.1 As-built, samples, and specifications.

.2 Equipment and systems.

.3 Product data, materials and finishes, and related information.

.4 Operation and maintenance data.

.5 Spare parts, special tools and maintenance materials.

.6 Warranties and bonds.

.7 Final site survey.

1.2 RELATED SECTIONS

.1 Section 01 33 00 – Submittal Procedures.

.2 Section 01 45 00- Quality Control.

.3 Section 01 71 00 – Examination and Preparation.

.4 Section 01 77 00 - Closeout Procedures.

.5 Section 01 91 13 – General Commissioning (Cx) Requirements.

1.3 SUBMISSION

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

.2 Submit one copy of completed volumes in final form 15 days prior to final inspection.

.3 Copy will be returned after final inspection, with Contract Administrator's comments.

.4 Revise content of documents as required prior to final submittal.

.5 Two weeks prior to Substantial Performance of the Work, submit to the Contract Administrator, two final copies of operating and maintenance manuals.

.6 Ensure spare parts, maintenance materials and special tools provided are new, undamaged or defective, and of same quality and manufacture as products provided in Work.

.7 If requested, furnish evidence as to type, source and quality of products provided.

.8 Defective products will be rejected, regardless of previous inspections. Replace products at own expense.

.9 Pay costs of transportation.

1.4 FORMAT

.1 Organize data in the form of an 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. 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 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. Bind in with text; fold larger drawings to size of text pages.

.9 Provide CAD files in DWG format on digital storage device. Also provide electronic files in searchable PDF format.

1.5 CONTENTS - EACH VOLUME

.1 Table of Contents: provide title of project; names, addresses, and telephone numbers of Consultant and Contractor with name of responsible parties; schedule of products and systems, indexed to content of volume.

.2 For each product or system:

.1 List names, addresses and telephone numbers of subcontractors and suppliers, including local source of supplies and replacement parts.

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

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

.5 Typewritten Text: as required to supplement product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions specified in Section 01 45 00 - Quality Control.

.6 Training: Refer to Section 01 91 13 – General Commissioning (Cx) Requirements.

1.6 AS-BUILTS AND SAMPLES

.1 In addition to requirements in General Conditions, maintain at the site for Contract Administrator one record copy of:

.1 Contract Drawings.
.2 Specifications.
.3 Addenda.
.4 Change Orders and other modifications to the Contract.
.5 Reviewed shop drawings, product data, and samples.
.6 Field test records.
.7 Inspection certificates.
.8 Manufacturer's certificates.

.2 Store record documents and samples in field office apart from documents used for construction. Provide files, racks, and secure storage.

.3 Label record documents and file in accordance with Section number listings in List of Contents of this Project Manual. Label each document "PROJECT RECORD" in neat, large, printed letters.

.4 Maintain record documents in clean, dry and legible condition. Do not use record documents for construction purposes.

.5 Keep record documents and samples available for inspection by Contract Administrator.

1.7 RECORDING ACTUAL SITE CONDITIONS

.1 Record information on set of red lined contract document, to the satisfaction of the Contract Administrator.

.2 Provide felt tip marking pens, maintaining red color pens for recording information.

.3 Record information concurrently with construction progress. Do not conceal Work until required information is recorded.

.4 Contract Drawings and shop drawings: legibly mark each item to record actual construction, including:

.1 Measured depths of elements of foundation in relation to finish first floor datum.

.2 Include UTM coordinates of all underground items, bends, corners, terminations, etc.

.3 Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.

.4 Measured locations of internal utilities and appurtenances, referenced to visible and accessible features of construction.

.5 Field changes of dimension and detail.

.6 Changes made by change orders.

.7 Details not on original Contract Drawings.

.8 References to related shop drawings and modifications.

.5 Specifications: legibly 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: submit manufacturer's certifications, inspection certifications, field test records, required by individual specifications sections.

.7 At completion of project, provide all recorded information on print drawings. Transfer recorded information to AutoCAD files in DWG format. Submit DWG files, also with electronic files in PDF format as part of the Closeout Submittals.

1.8 FINAL SURVEY

.1 Submit final site survey certificate certifying that elevations and locations of completed Work are in conformance, or non-conformance with Contract Documents.

1.9 EQUIPMENT AND SYSTEMS

.1 Each Item of Equipment and Each System: include description of unit or system, and component parts. Give function, normal operation characteristics, and limiting conditions. Include performance curves, with engineering data and tests, and complete nomenclature and commercial number of replaceable parts.

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

.3 Include installed colour coded wiring diagrams.

.4 Operating Procedures: include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter, and any special operating instructions.

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

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

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

.8 Include sequence of operation by controls manufacturer.

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

.10 Provide installed control diagrams by controls manufacturer.

.11 Provide Contractor's coordination 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

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

1.10 MATERIALS AND FINISHES

.1 Building Products, Applied Materials, and Finishes: include product data, with catalogue number, size, composition, and colour and texture designations. Provide information for re-ordering custom manufactured products.

.2 Instructions for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.

.3 Moisture-protection and Weather-exposed Products: include manufacturer's recommendations for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.

.4 Additional Requirements: as specified in individual specifications sections.

1.11 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 location as directed; place and store.

.4 Receive and catalogue all items. Submit inventory listing to Contract Administrator. Include approved listings in Maintenance Manual.

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

1.12 MAINTENANCE MATERIALS

.1 Provide maintenance and extra materials, in quantities specified in individual specification sections.

.2 Provide items of same manufacture and quality as items in Work.

.3 Deliver to site location as directed; place and store.

.4 Receive and catalogue all items. Submit inventory listing to Contract Administrator. Include approved listings in Maintenance Manual.

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

1.13 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 project site place and store.

.4 Receive and catalogue all items. Submit inventory listing to Contract Administrator. Include approved listings in Maintenance Manual.

1.14 STORAGE, HANDLING AND PROTECTION

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

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

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

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

.5 Remove and replace damaged products at own expense and to satisfaction of Contract Administrator.

CLOSEOUT SUBMITTALS

1.15 WARRANTIES AND BONDS

.1 Develop warranty management plan to contain information relevant to Warranties.

.2 Submit warranty management plan to Contract Administrator's approval.

.3 Warranty management plan to include required actions and documents to assure that Owner 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 Assemble approved information in binder and submit upon acceptance of work. Organize binder as follows:

.1 Separate each warranty or bond with index tab sheets keyed to Table of Contents listing.

.2 List subcontractor, supplier, and manufacturer, with name, address, and telephone number of responsible principal.

.3 Obtain warranties and bonds, executed in duplicate by subcontractors, suppliers, and manufacturers, within ten days after completion of the applicable item of work.

.4 Except for items put into use with Owner's permission, leave date of beginning of time of warranty until the Date of Substantial Performance is determined.

.5 Verify that documents are in proper form, contain full information, and are notarized.

.6 Co-execute submittals when required.

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

.6 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 roofs, HVAC balancing, pumps, motors, transformers, and commissioned systems such as fire protection, alarm systems, sprinkler systems, lightning protection systems, process equipment and 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 Procedure and status of tagging of equipment covered by extended warranties.

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

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

.8 Written verification will follow oral instructions. Failure to respond will be cause for the Contract Administrator to proceed with action against Contractor.

1.16 PRE-WARRANTY CONFERENCE

.1 Meet with Contract Administrator to develop understanding of requirements of this section. Schedule meeting prior to contract completion, and at time designated by Contract Administrator.

.2 Contract Administrator will establish communication procedures for:

.1 Notification of construction warranty defects.

.2 Determine priorities for type of defect.

.3 Determine reasonable time for response.

.3 Provide name, telephone number and address of licensed and bonded company that is authorized to initiate and pursue construction warranty work action

.4 Ensure contact is located within local service area of warranted construction, is continuously available, and is responsive to inquiries for warranty work.

1.17 WARRANTY TAGS

.1 Tag, at time of installation, each warranted item. Provide durable, oil and water resistant tag approved by Contract Administrator.

.2 Leave date of acceptance until project is accepted for occupancy.

.3 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 (NOT APPLICABLE)

PART 3 EXECUTION (NOT APPLICABLE)

END OF SECTION

COMMISSIONING REQUIREMENTS

PART 1 GENERAL

1.1 SUMMARY

.1 Section Includes:

.1 General requirements relating to commissioning of project's components and systems, specifying general requirements for Installation Verification and Performance Verification of components, equipment, sub-systems, systems, and integrated systems.

.2 Acronyms

.1 CxA – Commissioning Authority.
.2 Cx – Commissioning.
.3 EMCS – Energy Monitoring and Control Systems.
.4 O&M – Operation and Maintenance.
.5 PV – Performance Verification.
.6 TAB – Testing, Adjusting and Balancing.
.7 GC – General Contractor
.8 TSI – Technical Services Inspector
.9 LEED - Leadership in Energy and Environmental Design

1.2 COMMISSIONING INTENT

.1 Undertake Cx to bring the facility to a fully operational state and free of deficiencies in the most effective and timely manner available, ensuring the design intent is met by all systems. Verifying that a fully operational state has been achieved will include the successful operation of the process system, in accordance with its design requirements, for a period of 14 days, the last 7 of which shall be consecutive.

.2 Cx incorporates inspection and quality assurance activities as construction progresses, including start up, installation verification, performance verification, fine tuning, and operator training.

.3 Bear all costs associated with the required personnel and test equipment as outlined in specification sections and Contractor prepared Cx Manual and all costs with organizing and managing the activities of the applicable subtrades as identified in this section.

.4 Fully document all tests and inspections performed during the construction, at start up, installation verification and performance verification and fine tuning. Incorporate into final commissioning documentation.

.5 Provide direct training to designated staff responsible for the operation and maintenance of the building equipment and systems.

1.3 RELATED SECTIONS

.1 Section 01 45 00 - Quality Control.

.2 Section 01 77 00 - Closeout Procedures.

.3 Section 01 78 00 - Closeout Submittals.

.4 Section 01 91 33 - Commissioning (Cx) Forms.

.5 Section 01 91 41 - Commissioning (Cx) Training.

.6 Section 20 05 01 - Mechanical General Requirements

.7 Section 26 05 00 – Electrical General Requirements

.8 Section 44 00 10 – Process General Requirements

1.4 COMMISSIONING OVERVIEW

.1 Cx is a planned program of tests, procedures and checks carried out systematically on systems and integrated systems of the finished project.

.2 Cx is an intensive quality assurance process that begins at the beginning of the project and continues through to the first year of occupancy. The process focuses upon verifying and documenting that the facility and all of its systems and assemblies are planned, designed, installed, tested, operated, and maintained to meet the Owners Project Requirements.

.3 Cx activities supplement field quality and testing procedures described in relevant technical sections.

.4 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.

.5 Complete inspection and verification activities as required by the specifications and the Contractor prepared Cx Manual as construction progresses.

.6 The General Contractor shall take responsibility to:

.1 Develop the Cx manual and review with the commissioning team.

.2 Complete all items as identified in the Cx manual. This includes work by subcontractors, test agencies, equipment representatives and manufacturer agents.

.3 Review Contract Documents and inspect the Work to ensure completeness of the Work and compliance with the Contract Documents.

.4 Correct deficiencies resulting from installation and performance verifications.

.5 Test, adjust and balance equipment and systems identified in Divisions 2-44.

.6 Submit the completed manual and project record documents as specified.

.7 Update the documentation manuals prior to each project meeting.

.7 The Substantial Completion Certificate will not be issued until the commissioning process is completed and the final reports and commissioning documentation are received.

.8 The Cx Manual provides direction for the Cx process during construction, provides resolution for issues such as scheduling, roles and responsibilities, lines of communication and reporting, approvals and coordination.

1.5 COMMISSIONING TEAM

.1 The commissioning team shall consist of the Contract Administrators, including Engineer, Operator, the General Contractor, sub-contractors preselected equipment suppliers and the General Contractors Commissioning Authority, whom shall be selected and paid for by the General Contractor.

1.6 NON-CONFORMANCE TO PERFORMANCE VERIFICATION REQUIREMENTS

.1 During Cx, should equipment, system components, and associated controls be identified as incorrectly installed, malfunctioning or not performing as per specifications, the contractor shall correct deficiencies, re-verify equipment and components within the system, including related systems as deemed necessary by the Contract Administrator, to ensure effective and accurate operation.

.2 Minor deficiencies may be corrected at the time of identification. For systems requiring major repairs, the Commissioning Team shall move on to the next system to be commissioning. The Contractor shall notify the Contract Administrator when the work is complete.

.3 Costs for corrective work, additional tests, inspections, to determine acceptability and proper performance of such items to be borne by Contractor.

1.7 CONFLICTS

.1 Report conflicts between requirements of this section, other sections, and the Cx Manual to the Contract Administrator to obtain clarification prior to the start of work.

.2 Failure to report conflict and obtain clarification will result in application of most stringent requirement.

1.8 SUBMITTALS

.1 Prior to starting Cx the Contractor shall provide a set of equipment and system submittals, these should be in the form of the Operation and Maintenance Manuals described throughout the specifications. These submittals are supplemented by the installation and start-up procedures, O&M data, performance data, control drawings and any changes that may affect commissioned systems.

1.9 COMMISSIONING DOCUMENTATION

.1 Refer to Section 01 91 33 - Commissioning (Cx) Forms for examples of the forms requirements and instructions for use as well as the Cx Manual.

.2 Checklists/Forms will be provided and maintained to the Contractor by the CxA during the construction stage.

.3 Installing subcontractors are to date and initial the checklists as construction and verifications are completed.

.4 The CxA assemble and track the completed checklists for review and acceptance by the Contract Administrator.

.5 Once the CxA has all documents completed and accepted the Contract Administrator, a final commissioning document shall be submitted in electronic form (PDF) and original signed copies.

1.10 COMMISSIONING SCHEDULE

.1 Submit preliminary Cx schedule in Gantt Chart format to CxA no later than sixteen (16) weeks. The Cx Schedule is to be included in the Cx Manual.

.2 The General Contractor Shall submit final Cx schedule in Gantt Chart format to CxA for review four (4) weeks prior to performance verification.

.3 Provide adequate time for Cx activities prescribed in technical sections, commissioning sections and the Cx manual including all on site activities as well as documentation procedures. Time should be allowed for re-verification should any system be rejected upon completion of initial verification.

.4 Provide adequate time for training.

1.11 STARTING AND TESTING

.1 Contractor assumes liabilities and costs for inspections, including disassembly and re-assembly after approval, starting, testing and adjusting, and supply of testing equipment, and all associated costs of installation and performance verification.

1.12 WITNESSING OF STARTING AND TESTING

.1 Provide twenty eight (28) days' notice prior to commencement.

.2 Contract Administrator to witness start-up and testing.

.3 Contractor's CxA to be present at tests performed and documented by sub-trades, suppliers and equipment manufacturers.

1.13 MANUFACTURER'S INVOLVEMENT

.1 The Contractor shall obtain manufacturers installation, start-up and operations instructions prior to start-up of components, equipment and systems..

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

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

.2 Integrity of warranties:

.1 Use manufacturer's trained start-up personnel where specified elsewhere in other divisions or required to maintain integrity of warranty.

.2 Verify with manufacturer that testing as specified will not void warranties.

.3 Qualifications of manufacturer's personnel:

.1 Experienced in design, installation and operation of equipment and systems.

.2 Ability to interpret test results accurately.

.3 Ability 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 Performance Verification.

.2 Conduct Commissioning in following distinct phases:

.1 Included in delivery and installation:

.1 Verification of conformity to specification, approved shop drawings and completion of product information report forms.

.2 Visual inspection of quality of installation.

.2 Installation Verification: follow accepted start-up procedures.

.3 Performance Verification: document equipment performance. Include repetition of tests after correcting deficiencies.

.4 Post-substantial performance verification: to include fine-tuning.

.3 Correct deficiencies and obtain approval from Contract Administrator after distinct phases have been completed and before commencing next phase.

.4 Document required tests on checklists provided in the Cx Manual as well on any supplied Manufacturer forms.

.5 Failure to follow accepted Commissioning Processes will result in re-evaluation of equipment by an independent testing agency selected by Contract Administrator. If results reveal that equipment Commissioning Process was not in accordance with requirements, and resulted in damage to equipment, implement following:

.1 Minor equipment/systems: if evaluation report concludes that damage is minor, implement corrective measures approved by Contract Administrator.

.2 Major equipment/systems: If evaluation report concludes that major damage has occurred, Contract Administrator shall reject equipment to be removed from site and replaced with new.

.3 Subject new equipment/systems to specified Commissioning Process

1.15 COMMISSIONING DOCUMENTATION

.1 General Contractors CxA shall assemble Installation Verification documentation and submit to Contract Administrator for approval before commencement of Performance Verification.

.2 Installation Verification documentation to include:

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

.2 Inspection reports.

.3 Signed Installation Verification check lists.

.4 Start-up reports.

.5 Step-by-step description of complete start-up procedures, to permit the contractor or CxA to repeat start-up at any time.

1.16 OPERATION AND MAINTENANCE OF EQUIPMENT AND SYSTEMS

.1 After Performance Verification, operate and maintain equipment and systems as directed by equipment/system manufacturer.

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

.3 Operate and maintain systems for minimum fourteen (14) days for commissioning to be completed, the final seven (7) days of the commissioning process shall be continuous without interruption.

.4 After completion of commissioning, aid the operations group to operate and maintain systems until issuance of Substantial Completion

1.17 TEST RESULTS

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

.2 Provide personnel, resources and materials, assume all costs for re-verification.

1.18 INSTRUMENTS / EQUIPMENT

.1 CxA to prepare and submit to Contract Administrator 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 all required equipment to complete commissioning.

.3 Provide all Arc Flash Personal Protective Equipment as required. Provide commissioning personnel with the appropriate Arc Flash Protection training.

1.19 PERFORMANCE VERIFICATION

.1 Notify Commissioning Team at least twenty eight (28) days prior to start of Performance Verifications.

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

.3 Ensure all HVAC systems have been thoroughly cleaned.

.4 CxA to facilitate performance verification once identified pre-requisite activities are completed for a system and approved by the Contract Administrator.

.5 Test all building and process systems including architectural, structural, civil, mechanical and electrical components and operating procedures by challenging these systems to realistic operating conditions and train operational staff.

.6 Run systems through all sequences of operation and verify response of components.

.7 Notwithstanding all-inclusive requirements specified in this section, additional separate commissioning may be required at a later date for equipment and systems whose full operation is dependent on seasonal conditions.

.8 Carry out Cx:

.1 Under actual operating conditions, over entire operating range, in all modes.

.2 On independent systems and interacting systems.

.9 Cx procedures to be repeatable and reported results are to be verifiable.

.10 Follow equipment manufacturer's operating instructions.

.11 SCADA trending to be available as supporting documentation for performance verification.

.12 Contractor to obtain all documentation, including updated points list, controls sequences and setpoints, and submit documentation to commissioning authority for review. At completion of commissioning, scan completed manuals to electronic format on digital storage devices in PDF format as required and submit to CxA.

1.20 WITNESSING COMMISSIONING

.1 CxA along with designated representatives and Contract Administrator to witness activities and verify results.

1.21 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 If the CxA is not available to witness, the certificates of approval from the Authority Having Jurisdiction will be accepted as adequate.

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

.4 Provide copies to Contract Administrator within five (5) working days of test and with Cx report.

1.22 REPEAT VERIFICATIONS

.1 Assume costs incurred by Owner’s Commissioning representatives for second and subsequent verifications where:

.1 Verification of reported results fails to receive Contract Administrator's approval.

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

.3 Contract Administrator deems Contractor's request for second verification was premature.

1.23 DEFICIENCIES, FAULTS, DEFECTS

.1 Report problems, faults or defects affecting Cx to Contract Administrator in writing. Stop Cx until problems are rectified. Proceed with written approval from Contract Administrator.

.2 Correct deficiencies found during start-up and Cx to satisfaction of Contract Administrator.

1.24 COMPLETION OF COMMISSIONING

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

.2 Except for warranty and seasonal verification activities, complete Cx prior to application for Substantial Completion.

.3 Cx to be considered complete when all Cx deliverables have been submitted and accepted by Contract Administrator.

.4 The Contractor is to compile a Final Commissioning Report summarizing all tasks, findings and documentation of the commissioning process. The Final Commissioning Report is to incorporate all test reports by sub-contractors, manufacturer's and controlling authorities including the following list. The Contractor shall turn over all materials per this specification.

.1 Evaluation of operating condition of the systems at the time of functional test completion.

.2 Deficiencies that were discovered and measures taken to correct them.

.3 Functional test procedures and results.

.4 Documentation of all commissioning field activities as they progressed.

.5 Description and estimated schedule of required deferred testing.

.5 The Contractor to provide O&M manuals, maintenance materials, warranties and training records.

1.25 ACTIVITIES UPON COMPLETION OF COMMISSIONING

.1 When changes are made to baseline components or system settings established during Cx process notify the Commissioning Team. The Contractor will update and provide Cx forms for affected item.

1.26 TRAINING

.1 In accordance with Section 01 91 41 - Commissioning (Cx) – Training, the Cx Manual and respective technical sections.

1.27 MAINTENANCE MATERIALS, SPARE PARTS, SPECIAL TOOLS

.1 Supply, deliver, and document maintenance materials, spare parts, and special tools as specified in contract. Provide transmittal documenting all materials provided.

1.28 OCCUPANCY

.1 Cooperate fully with the Commissioning Team during stages of acceptance and occupancy of facility.

1.29 PERFORMANCE VERIFICATION TOLERANCES

.1 Application tolerances:

.1 Specified range of acceptable deviations of measured values from specified values or specified design criteria, except for special areas, to be within +/- 5 % 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 identified, recorded values to be within +/- 2 % of specified values.

1.30 OWNER'S PERFORMANCE TESTING

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

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION

3.1 SCHEDULE

.1 Provide a detailed schedule as per this section for on-site verification activities by the commissioning team based on the Cx Manual provided by the Contractor. Be responsible for resource allocation respecting the exact number and duration for personnel required to perform the tasks required.

.2 This schedule shall be submitted with the general construction schedule monthly. The level of detail shall increase as the construction progresses.

3.2 COMMISSIONING TASKS

.1 The Cx Manual will provide a list of tasks to be conducted for the commissioning process. Further specifics are provided within applicable specification sections.

END OF SECTION

EQUIPMENT INSTALLATION AND START UP

PART 1 GENERAL

1.1 INTENT

.1 This section describes general requirements for process, hoisting, mechanical, and electrical equipment relating to supply, installation, testing, and commissioning; and the verification thereof.

1.2 DEFINITIONS

.1 Manufacturer: The Manufacturer is the person, partnership, or corporation responsible for the fabrication of equipment provided to the Contractor for the completion of the Work.

.2 Manufacturer's Representative: A Manufacturer's Representative is a trained serviceman empowered by the Manufacturer to provide installation, testing, and commissioning assistance to the Contractor in his performance of these functions.

1.3 EXPERTISE AND RESPONSIBILITY

.1 The Owner recognizes the expertise of the Manufacturers.

.2 Should the Contract Administrator issue an Addendum, Field Order, Change Order, Site Instruction to change the Work which would, in the opinion of the Contractor, compromise the success or safety of the Work, then it shall be incumbent on the Contractor to promptly notify in writing the Contract Administrator and the Owner to this effect within two days.

1.4 EQUIPMENT DELIVERY

.1 The Contractor shall be responsible for receiving, unloading, and storage of all equipment.

.2 The Contractor shall ensure that he has fully informed himself of precautions to be taken in the unloading of equipment and its subsequent storage.

.3 The Contractor shall inspect the contents of any equipment delivery to satisfy himself of the contents thereof and damage which may have occurred during transport.

.4 For equipment being delivered to the site, the Contractor shall advise the Contract Administrator seven days in advance of the arrival of the equipment.

.5 Where the Contractor identifies damage or deficiencies in the equipment delivered, this damage or deficiency shall be reported to the Contract Administrator and Manufacturer prior to unloading.

1.5 IDENTIFICATION OF EQUIPMENT

.1 Provide a manufacturer's nameplate on each piece of equipment.

.2 Provide tag numbers on all valves and on each piece of equipment. Include abbreviated descriptions on each piece of equipment. Minimum size 75mm x 35mm x 2.5mm thick laminated plastic with black face and engraved white lettering. Letters to be 6mm high.

.3 Submit list to Contract Administrator for approval.

1.6 INSTALLATION ASSISTANCE

.1 Before commencing installation of equipment, the Contractor shall arrange for the attendance of the Manufacturer's Representative to provide instructions in the methods, techniques, precautions, and other information relevant to the successful installation of the equipment.

.2 The Contractor shall inform the Contract Administrator, in writing, of the attendance at the site of any Manufacturer's Representative for installation training at least fourteen days prior to arrival.

.3 When the Manufacturer's Representative is satisfied that the Contractor is aware of all installation requirements, he shall so certify by completing Form 101 attached to this specification.

.4 Installation of the equipment shall not commence until the Contract Administrator has advised that he has received the completed Form 101.

1.7 INSTALLATION

.1 If necessary, or if so directed by the Contract Administrator during the course of installation, the Contractor shall contact the Manufacturer to receive clarification of installation procedures, direction, or any other additional information necessary to continue or complete the installation in an appropriate manner.

.2 If it is found necessary, or if so directed by the Contract Administrator, the Contractor shall arrange for the Manufacturer's Representative to visit the site to provide assistance during installation, all at no cost to the Owner.

.3 Prior to completing installation, the Contractor shall inform the Manufacturer and arrange for the attendance at the site of the Manufacturer's Representative to verify successful installation.

.4 The Contractor shall advise the Contract Administrator in writing, at least seven days prior, of the Manufacturer's Representative schedule arrival.

.5 The Manufacturer's Representative shall conduct a detailed inspection of the installation including alignment, electrical connections, belt tensions, rotation

direction, running clearances, lubrication, workmanship and all other items as required to ensure successful operation of the equipment.

.6 The Manufacturer's Representative shall identify any outstanding deficiencies in the installation.

.7 In the presence of the Manufacturer's Representative, the Contractor, and the Contract Administrator, the equipment shall then be given a minimum of one hour trial run.

.8 If deficiencies noted by the Manufacturer's Representative or which become evident in the trial run prejudice the successful completion of the trial run the deficiencies will be rectified by the Contractor and the Manufacturer's Representative will be required to re-inspect the installation, at no cost to the Owner.

.9 On successful completion of the trial run in the second or subsequent attempt, the Manufacturer's Representative will certify successful installation by completing Form 102 attached to this specification.

.10 The completed Form 102 shall be delivered to the Contract Administrator prior to departure of the Manufacturer's Representative form the site.

.11 Tag the equipment with a 100mm by 200mm blue card stating "Equipment Checked". "Do Not Run" stenciled in large black letters. The Contractor shall sign and date each card.

1.8 OPERATION AND PERFORMANCE VERIFICATION

.1 Equipment will be subjected to a demonstration, running test, and performance tests after the installation has been verified and any identified deficiencies have been remedied.

.2 The Contractor shall inform the Contract Administrator at least fourteen days in advance of conducting the tests and arrange for the attendance of the Manufacturer's Representative. The tests may be concurrent with the inspection of satisfactory installation if mutually agreed by the Contractor and the Contract Administrator. The contractor shall provide the Contract Administrator with a copy of the performance test plan and list parameters to observe with the acceptable range of the parameters."

.3 The Manufacturer's Representative will conduct all necessary checks to equipment and if necessary, advise the Contractor of any further checking, flushing, cleaning, or other work needed prior to confirming the equipment is ready to run.

.4 The Contractor shall then operate the equipment for at least one hour to demonstrate to himself the operation of the equipment and any required ancillary

services. Any remedial measures required to ensure satisfactory operation shall be promptly undertaken.

.5 The Contractor shall then notify the Contract Administrator of his readiness to demonstrate the operation of the equipment. The Contract Administrator shall attend, as expeditiously as possible. The Owner's representative, also shall attend if deemed appropriate by the Owner.

.6 With the assistance of the Manufacturer's Representative, the Contractor will demonstrate that the equipment is properly installed. Alignment, piping, connections, electrical connections, etc. will be checked and if appropriate, code certifications provided.

.7 The equipment shall then be run for a minimum of one hour. Detailed equipment specifications may require longer durations than one hour – refer to detailed specifications. Local control shall be satisfactorily verified by cycling the equipment through several start-stop operations, modulating its output, or some combination. Operating parameters such as temperature, pressure, voltage, vibration, etc. will be checked to ensure that they are within the specified Manufacturer's recommended limits, whichever is more stringent.

.8 On satisfactory completion of the demonstration run, the equipment will be stopped and critical parameters, such as alignment, will be rechecked.

.9 The equipment will be restarted and run for three days, of which the last twenty-four hours shall be consecutive. During this period, as practical, conditions will be simulated which represent maximum or most severe, average, and minimum or least severe conditions. These conditions will be mutually agreed by the Contractor and Contract Administrator on the basis of the information contained in the technical specifications, as well as the methods utilized to create the simulated conditions and the time periods allotted to each.

.10 Performance tests will be conducted either concurrent with or subsequent to the running test, as practical and agreed between the Contract Administrator and the Contractor.

.11 Performance tests shall be dictated in the technical specifications for each item of equipment or as reasonably required by the Contract Administrator to prove adherence to the requirements listed in the specification.

.12 Results of the performance tests shall be documented and summarized by the Contractor in a format acceptable to the Contract Administrator.

.13 All water, chemicals (unless otherwise noted), temporary power, heating, or any other ancillary service required to complete the initial demonstration, running test and performance tests shall be the responsibility of the Owner.

.14 Should the initial demonstration, running test or performance tests reveal any defects, then these defects shall be promptly rectified and the demonstration,

running tests, and/or performance tests shall be repeated to the satisfied of the Contract Administrator. Additional costs incurred by Contractor, the Contract Administrator, or the Owner, due to repeat demonstration, running tests, and/or performance tests shall be the responsibility of the Contractor.

.15 On successful completion of the demonstration, running test, and performance tests, Form 103 attached to this specification will be signed by the Manufacturer's Representative, Contractor, and the Engineer. The contractor shall affix to form 103 the results of performance test including the data documenting the observed values or characteristics of the performance parameters.

.16 The Contractor shall affix to the tested equipment a 100mm by 200mm yellow card reading "Operable Condition" – Do not Operate without Contractors Permission" stenciled on in large black letter.

1.9 OPERATOR TRAINING

.1 For equipment specified to include training, arrange for the attendance of the Manufacturer's Representative to provide classroom training session(s).

.2 Coordinate the training session(s) with the supplier.

1.10 SECTION INCLUDES

.1 Commissioning forms to be completed for equipment, systems and integrated systems.

1.11 RELATED SECTIONS

.1 Section 01 78 00 – Closeout Submittals.

.2 Section 01 91 13 – Commissioning (Cx) Requirements.

.3 Section 01 91 41 – Commissioning (Cx) Training.

1.12 INSTALLATION VERIFICATION CHECK LISTS

.1 Prior to initiation of Performance Verification the Contractor will develop and provide the required project specific Cx Manual which will include the Installation Verification check lists, included with this specification.

.2 Completed Installation Verification Checklists to be submitted to Contract Administrator for review and approval.

.3 Include the following data:

.1 Product manufacturer's installation instructions and recommended checks.

.2 Special procedures as specified in relevant technical sections.

.3 Items considered good installation and Contract Administratoring industry practices deemed appropriate for proper and efficient operation.

.4 Equipment manufacturer's installation/start-up check lists are acceptable for use in conjunction with installation verification check lists forming part of the Cx manual. Manufacturer's check sheets used must be attached to final document submittals.

.5 Installer to sign check lists upon completion, certifying stated checks and inspections have been performed. Completed check lists to be submitted by the contractor at completion of the Commissioning Process.

.6 Use of check lists will be considered part of commissioning process.

1.13 PERFORMANCE VERIFICATION CHECK LISTS

.1 The Contractor will develop and provide to the Commissioning Team the required project specific Cx Manual including the Performance Verification check lists.

.2 Completed Performance Verification Checklists to be submitted to Contract Administrator for review and approval.

.3 Strategy for Use:

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

.2 Confirm operation as per design criteria and intent.

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

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

.5 Record analytical and substantiating data.

.6 Verify reported results.

.7 Form to bear signatures of recording technician and reviewed and signed off by General Contractor, Installing Contractor, Contract Administrator, and the Commissioning Agent.

.8 Reported results in true measured SI (metric) unit values.

.9 Maintain copy on site during start-up, testing and commissioning period.

.10 Forms to be both hard copy and electronic format.

.4 Upon completion of Performance Verification the contractor shall submit all completed checklists to the Commissioning Team and will include the checklists within the Operation and Maintenance Manuals.

.5 Final submittal shall include all Installation Verification, Performance Verification check lists, training records, maintenance materials transmittals, written warranties and a list of all Cx activities postponed due to seasonal, climatic, occupancy, or other reasons beyond the contractor's control.

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION (NOT APPLICABLE)

PART 4 COMMISSIONING FORMS

EQUIPMENT INSTALLATION AND START UP

CERTIFICATE OF READINESS TO INSTALL

FORM 101

I have familiarized the installer of the specific installation requirements related to the equipment listed below and am satisfied that he understands the required procedures.

PROJECT:

ITEM OF EQUIPMENT:

TAG NO.:

REFERENCE SPECIFICATION:

COMMENTS:

Print: Signature:

MANUFACTURE'S REPRESENTATIVE (DATE)

CERTIFICATE OF SATISFACTORY INSTALLATION

FORM 102

I have completed my check and inspection of the installation listed below and confirm that it is satisfactory and that defects have been remedied to my satisfaction except any as noted below.

PROJECT:

ITEM OF EQUIPMENT:

TAG NO.:

REFERENCE SPECIFICATION:

OUTSTANDING DEFECTS:

Print: Signature:

MANUFACTURE'S REPRESENTATIVE (DATE)

EQUIPMENT INSTALLATION AND START UP

CERTIFICATE OF EQUIPMENT SATISFACTORY PERFORMANCE

FORM 103

We certify that the equipment listed below has been operated for at least three days of which the last twenty-four hours were consecutive and that the equipment operates satisfactorily and meets its specified operating criteria. No defects in the equipment were found. The equipment is therefore classed as “conforming”.

PROJECT:

ITEM OF EQUIPMENT:

TAG NO.:

REFERENCE SPECIFICATION:

Print: Signature:
MANUFACTURE’S REPRESENTATIVE (DATE)

Print: Signature:
GENERAL CONTRACTOR’S REPRESENTATIVE (DATE)

Print: Signature:
CONTRACT ADMINISTRATOR (DATE)

END OF SECTION

COMMISSIONING FORMS

PART 1 GENERAL

1.1 SECTION INCLUDES

.1 Commissioning forms to be completed for equipment, systems and integrated systems.

1.2 RELATED SECTIONS

.1 Section 01 78 00 – Closeout Submittals.

.2 Section 01 91 13 – Commissioning (Cx) Requirements.

.3 Section 01 91 41 – Commissioning (Cx) Training.

1.3 INSTALLATION VERIFICATION CHECK LISTS

.1 Prior to initiation of Performance Verification the Contractor will develop and provide the required project specific Cx Manual which will include the Installation Verification check lists, developed in accordance with this specification.

.2 Completed Installation Verification Checklists to be submitted to Contract Administrator for review and approval.

.3 Include the following data:

.1 Product manufacturer's installation instructions and recommended checks.

.2 Special procedures as specified in relevant technical sections.

.3 Items considered good installation and engineering industry practices deemed appropriate for proper and efficient operation.

.4 Equipment manufacturer's installation/start-up check lists are acceptable for use in conjunction with installation verification check lists forming part of the Cx manual. Manufacturer’s check sheets used must be attached to final document submittals.

.5 Installer to sign check lists upon completion, certifying stated checks and inspections have been performed. Completed check lists to be submitted by the contractor at completion of the Commissioning Process.

.6 Use of check lists will be considered part of commissioning process.

1.4 PERFORMANCE VERIFICATION CHECK LISTS

.1 The Contractor will develop and provide to the Commissioning Team the required project specific Cx Manual including the Performance Verification check lists.

.2 Completed Performance Verification Checklists to be submitted to Contract Administrator for review and approval.

.3 Strategy for Use:

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

.2 Confirm operation as per design criteria and intent.

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

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

.5 Record analytical and substantiating data.

.6 Verify reported results.

.7 Form to bear signatures of recording technician and reviewed and signed off by General Contractor, Installing Contractor, Contract Administrator, and the Commissioning Agent.

.8 Reported results in true measured SI (metric) unit values.

.9 Maintain copy on site during start-up, testing and commissioning period.

.10 Forms to be both hard copy and electronic format.

.4 Upon completion of Performance Verification the contractor shall submit all completed checklists to the Commissioning Team and will include the checklists within the Operation and Maintenance Manuals.

.5 Final submittal shall include all Installation Verification, Performance Verification check lists, training records, maintenance materials transmittals, written warranties and a list of all Cx activities postponed due to seasonal, climatic, occupancy, or other reasons beyond the contractor's control.

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION (NOT APPLICABLE)

END OF SECTION

COMMISSIONING TRAINING

PART 1 GENERAL

1.1 SECTION INCLUDES:

.1 This Section specifies roles and responsibilities of Commissioning Training.

1.2 RELATED SECTIONS:

.1 Section 01 78 00 – Closeout Submittals.

.2 Section 01 91 13 – Commissioning (Cx) Requirements.

.3 Section 01 91 33 – Commissioning (Cx) Forms.

1.3 TRAINEES

.1 Trainees: personnel selected for operating and maintaining this facility including, but not limited to, Facility Manager, building operators, maintenance staff, security staff, and technical specialists as required.

.2 Trainees may be available for training during any stage of construction.

1.4 INSTRUCTORS

.1 The Cx Manual will contain:

.1 Descriptions of systems.

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

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

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

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

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

.4 Training to be completed after Installation and Performance Verification are completed.

1.5 TRAINING OBJECTIVES

.1 Training to be detailed and of sufficient duration to ensure:

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

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

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

.4 Ability to update documentation.

.5 Ability to operate equipment and systems under emergency conditions until appropriate qualified assistance arrives.

1.6 TRAINING MATERIALS

.1 Instructors to be responsible for content and quality. Provide copies for all those in attendance.

.2 Prepare a draft handout taking the form of the relevant sections of the operation and maintenance manual supplemented with any other information needed to fully explain the equipment operation.

.3 Prepare an agenda, broken into suitable time periods outlining the content of the training sessions. Allow 0.5 hours at the beginning of the first period for the Engineer to provide a summary of the design intent relating to that equipment.

.4 Training materials to include:

.1 "As-Built" Contract Documents.

.2 Operating Manual.

.3 Maintenance Manual.

.4 Testing, adjusting and balancing and performance verification reports where applicable.

.5 Contract Administrator will review training manuals.

.6 Training materials to be in a format that permits future training procedures to the same degree of detail with or without the instructor.

1.7 SCHEDULING

.1 Contractor to include in schedule time for training. Provide a detailed commissioning schedule indicating all Cx tasks and training.

.2 Deliver training during regular working hours, training sessions to be determined in Commissioning meetings.

.3 The final date for the training sessions will be established by the Contract Administrator. The date will not necessarily coincide with testing or installation visits by the Manufacturer’s Representatives.

.4 Training to be completed prior to Substantial Completion, it will be incumbent upon the Contractor to verify that the Trainee’s have confirmed that they have received adequate training to operate and maintain the facility. The training is not considered complete, nor with Substantial Completion be awarded, until the Trainee’s have verified that they have received adequate training.

COMMISSIONING TRAINING

1.8 RESPONSIBILITIES

.1 Contractor shall be responsible for:

.1 Implementation of training activities,

.2 Coordination among instructors,

.3 Quality of training, training materials,

.2 Contract Administrator will evaluate training and materials.

.3 Upon completion of training, provide written report, signed by Instructors, witnessed by Contract Administrator. Include list of those in attendance. The Cx manual will provide templates for these submittals.

1.9 TRAINING CONTENT

.1 Training to include demonstrations by Instructors using the installed equipment and systems.

.2 Content includes:

.1 Review of facility and occupancy profile.

.2 Functional requirements.

.3 System philosophy, limitations of systems and emergency procedures.

.4 Review of system layout, equipment, components and controls.

.5 Equipment and system start-up, operation, monitoring, servicing, maintenance and shut-down procedures.

.6 System operating sequences, including step-by-step directions for starting up, shut-down, operation of valves, dampers, switches, adjustment of control settings and emergency procedures.

.7 Maintenance and servicing.

.8 Trouble-shooting diagnosis.

.9 Inter-Action among systems during integrated operation.

.10 Review of O&M documentation.

.3 Provide specialized training as specified in relevant Technical Sections of the construction specifications.

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION (NOT APPLICABLE)

END OF SECTION

DIVISION 02 INDEX

TEMPORARY BY-PASS PUMPING

PART 1 GENERAL

1.1 SUMMARY

.1 Comply with Division 1 – General Requirements.

.2 Section Includes:

.1 Under this item the Contractor is required to furnish all materials, labour, equipment, power, maintenance, etc. to implement a temporary pumping system for the purpose of diverting the existing wastewater flows to the existing WPCP around the work area as required during the project. The diversions will consist of the diversion of both gravity flows and pumped flows as required.

.2 The design, installation, operation and maintenance of the temporary bypass pumping system shall be the Contractor's responsibility.

.3 The bypass system shall meet the requirements of all codes and regulatory agencies having jurisdiction.

.4 Co-ordination will be required with the plant operations staff to ensure; smooth transition between normal and temporary flows and back again; coordinated shut downs for tie-ins and removals as required; training on use of the supplied equipment for emergency situations, etc.

1.2 RELATED SECTIONS

.1 Section 01 11 00 – Summary of Work

.2 Section 01 35 43 – Environmental Protection

.3 Section 01 51 00 – Temporary Utilies

.4 Section 01 52 00 – Construction Facilities

1.3 SUBMITTALS

.1 Submit in accordance with Section 01 33 00 – Submittals.

.2 Prior to execution of the Work associated with this Section, the Contractor shall prepare and submit for approval a specific, detailed description of the proposed bypass pumping system.

.3 The Contractor shall submit to the Engineer for review shop drawings providing detailed design and descriptions outlining all provisions required and precautions to be taken by the Contractor regarding the handling of existing wastewater flows. This plan must be specific and complete, including such items as schedules, locations, elevations, flows to the pumped at each location, piping routes, capacities of equipment, materials and all other incidental items necessary and/or required to insure proper operation of the system and

protection of the facilities, including protection of the access and bypass pumping locations from damage due to the discharge flows, and compliance with the requirements specified in these Contract Documents. No construction requiring bypass pumping shall begin until all the shop drawings required illustrating all provisions and requirements of the submission have been reviewed and accepted by the Contract Administrator.

.4 The plan shall include, but not be limited to, details of the following for each temporary bypass pumping requirement/location during the project:

.5 Purpose, location and schedule for the bypass pumping requirement involved;

.6 Volume of sewage to be bypassed;

.7 Staging areas for pumps and piping;

.8 Sewer plugging method, types and locations of plugs;

.9 Number, size, material, location and method of installation of suction piping;

.10 Number, size, material, method of installation and location of installation of discharge piping and any temporary pipe supports, protection (including from freezing) and thrust anchoring required;

.11 Bypass pump sizes, capacity, number of each size to be on site and power requirements, calculations of static lift, friction losses, and flow velocity (pump curves showing pump operating range shall be submitted);

.12 Standby power generator size, location;

.13 Downstream discharge plan including method of protecting discharge structures from erosion and damage;

.14 Method of noise control for each pump and/or generator;

.15 Schedule for installation of, and maintenance of, bypass pumping equipment and lines;

.16 Method for removal of plugs and dams and removal and demobilization of temporary bypass pumping system.

.17 A contingency plan and mitigation measures for bypass pumping during high flow periods, including rain events.

1.4 PERMITS

.1 Perform work in accordance with Section 01 35 43 – Environmental Protections.

.2 No amendment to the Certificate of Approval is required to carry out temporary bypass pumping. Notification shall be given to the Ministry of the Environment, Conservation and Parks (MECP) prior to commencement of any temporary pumping.

1.5 PROTECTION AND DAMAGES

.1 Prevent damage to all existing andf proposed pipes, maintenance holes, structures, ground cover and surface features in the vicinity of the area of work. Make good any damage at no cost to the Owner.

1.6 QUALITY ASSURANCE

.1 Qualifications

.1 The Contractor shall employ the services of a vendor who can demonstrate to the Engineer that he specializes in the design and operation of temporary bypass pumping systems. The vendor shall provide at least five (5) references of projects of a similar size and complexity as this project performed by his firm within the past three years.

1.7 SYSTEM DESCRIPTION AND REQUIREMENTS

.1 Engage a professional engineer with demonstrated competence and licensed to practice in Ontario to design, and to supervise construction, operation and maintenance of the temporary bypass pumping system or systems.

.2 Coordinate with the construction of new structures, excavation and backfilling operations and with the proposed schedule of Work and required shutdowns.

.3 It is essential to the operation of the existing sewage treatment plant that there be no interruption in the flow of sewage throughout the duration of the project. A minimum flow of 8 MGD is to be maintained at all times. To this end, the Contractor shall provide, maintain and operate all temporary facilities such as dams, plugs, pumping equipment (both primary and back-up units as required), conduits, all necessary power, and all other labour, materials and equipment necessary to intercept the sewage flow before it reaches the point where it would interfere with his work, carry it past his work and return it to the existing sewer/building as required downstream of his work.

.4 The expected flows into the plant are summarized below:

.5		**m^3/d**	**L/s**
.1	Minimum Flows	2,500	30
.2	Average Day Flows (ADF)	7,500	90
.3	Maximum WWF (MDF) Recorded)	40,000	463 (Wet Weather Peak Flow

.6 The temporary bypass pumping system will be required to be maintained and operated 24 hours per day for each day it is in operation.

.7 The Contractor shall have adequate standby equipment available and ready for immediate operation and use in the event of an emergency or breakdown. One standby pump for each size pump utilized shall be installed at the bypassing locations, ready for use in the event of a primary pump failure.

.8 The design, installation and operation of the temporary bypass pumping system shall be the Contractor's responsibility. The bypass system shall meet the requirements of all codes and regulatory agencies having jurisdiction.

.9 The Contractor shall provide all necessary means to safely convey the wastewater flows past the relevant work area. The Contractor will not be permitted to stop or impede the wastewater flows at any time or under any circumstances.

.10 The Contractor shall maintain the wastewater flows around the work area in a manner that will not cause surcharging of the upstream system or damage to sewers and, that will protect public and private property from damage and flooding.

.11 The Contractor must obtain approval of the proposed locations for all bypass pumping system related equipment from the Engineer.

.12 The Contractor must coordinate all bypass pumping operations with the City of Timmins staff in advance of the initiation of any bypass pumping system operation.

.13 The Contractor shall protect water resources, wetlands and other natural resources during the temporary bypass pumping operations.

PART 2 PRODUCTS

2.1 MATERIALS

.1 All pumps used shall be fully automatic self-priming units that do not require the use of foot-valves or vacuum pumps in the priming system. The pumps may be electric or diesel powered. All pumps used must be constructed to allow dry running for long periods of time to accommodate the cyclical nature of effluent flows. All motors, pumps and generators are to be appropriately silenced to a level which will not cause disruption or annoyance to the other parts of the site or to neighboring properties (max. 85dB at 1metre distance from pumps and power generators).

.2 The Contractor shall provide the necessary stop/start controls for each pump.

.3 The Contractor shall include one stand-by pump of each size to be maintained on site. Back-up pumps shall be on-line, isolated from the primary system by a valve.

.4 Discharge Piping - In order to prevent the accidental spillage of flows all discharge systems shall be temporarily constructed of rigid pipe with positive, restrained joints. Under no circumstances will aluminum "irrigation" type piping or glued PVC pipe be allowed. Discharge hoses will only be allowed in short sections and following specific approval by the Engineer.

.5 Pumps and temporary pumping system shall be supplied by:

.1 AQUATECH
.2 ITT
.3 ATLAS

PART 3 EXECUTION

3.1 PREPARATION

.1 Contractor is responsible for locating any existing utilities in the area the Contractor selects to locate the bypass pumps and pipelines. The Contractor shall locate his bypass pipelines to minimize any disturbance to existing utilities and ongoing construction operations and, shall obtain approval of the pipeline locations from the City and the Engineer prior to installation. All costs associated with relocating existing utilities/features and obtaining all approvals shall be the responsibility of the Contractor.

.2 During all bypass pumping operations, the Contractor shall protect all existing treatment plant, inlet sewer mains, all local sewer lines and other site services/utilities from damage. The Contractor shall be responsible for all damage caused by human or mechanical failure related to the temporary bypass pumping.

.3 When working inside chambers or manholes, the Contractor shall exercise caution and comply with OSHA requirements and confined space regulations when working in the presence of sewer gases, combustible or oxygen-deficient atmospheres, and confined spaces.

.4 A meeting shall be held involving the City, the Engineer, the plant operators, the Contractor and the bypass pumping subcontractor to go over all requirements for each shut down, tie-in and other work on site which will require temporary bypass pumping and/or affect regular plant operations.

3.2 INSTALLATION AND MAINTENANCE

.1 Install, maintain, operate and remove the temporary bypass pumping systems in operation until a written authorization is given by the Engineer that the temporary systems can be shutdown.

.2 The Contractor shall make connections to the existing sewers/buildings and construct temporary bypass pumping systems only at the location approved by the Engineer and as may be required to provide an adequate suction conduit or chamber.

.3 Temporary piping is to be installed above ground where possible. No temporary piping is to be buried without prior approval from the Engineer. The proposed piping will require adequate insulation to prevent freezing during operations as necessary.

.4 Plugging or blocking of wastewater flows shall incorporate a primary and secondary plugging device. A minimum of twenty-four (24) hours notice shall be given to the Engineer prior to the plugging of any existing sewer/piping.

.5 Contractor shall inspect the bypass pumping systems every two (2) hours to ensure that the system is functioning adequately and that no leaks have developed.

.6 The Contractor shall ensure that the temporary pumping system is properly maintained and a trained, responsible operator shall be on hand at all times (ie. 24 hours per day, 7 days a week) when any pumps are operating.

.7 Spare parts for pumps and piping shall be kept on site as required, and adequate hoisting equipment for each pump and accessories shall be maintained on the site at all times during bypass pumping operations.

.8 Contractor and sub-contractor emergency contact details shall be supplied to the Contract Administrator and plant operators and displayed clearly on or near the temporary pumps.

3.3 FIELD PUMP TEST

.1 The Contractor shall perform leakage and pressure tests of the bypass pumping discharge piping using clean water prior to actual operation. Perform a field pumping test prior to any shutdowns or permanent diversions to ensure the adequacy of the bypass pumping system and to establish the rate of pumping to be used during various construction activities.

.2 The Contract Administrator shall be notified 24 hours prior to any proposed system testing.

3.4 REMOVAL OF PUMPING SYSTEM

.1 When plugging or blocking is no longer needed for performance and acceptance of work, it is to be removed in a manner that permits the sewage flow to slowly return to normal without surge, to prevent surcharging or causing other major disturbances downstream.

.2 Temporary pumping systems are to be shut down and partially removed to allow new works to be put into service. Temporary pumping systems are to be retained on site for 48 hours after removal in the event the new works are required to be shut down for emergency or deficiency repairs.

3.5 FIELD QUALITY CONTROL

.1 Top water level in all chambers and manholes (including those within the public sewer system) are to remain at, or below, the normal operating levels in place prior to initiation of the construction project at all times.

END OF SECTION

PART 1 GENERAL

1.1 SECTION INCLUDES

.1 Design, Labour, equipment and services necessary for vibration monitoring Work in accordance with Contract Documents.

1.2 RELATED SECTIONS

.1 Section 02 23 50 - Vibration Instrumentation

1.3 DEFINITIONS

.1 Accelerometer:

.1 Transducer whose electrical output responds directly to Acceleration.

.2 Due to the frequency range, Accelerometers are ideal for most types of rotating equipment, making them the most used transducer for vibration measurements.

.2 Velocity:

.1 Rate of change in position, measured in distance per unit of time.

.2 When measuring vibration signals, Velocity represents the rate of change in displacement and expressed in inches (in) or millimetres (mm) per second.

.3 Acceleration:

.1 Rate of change of Velocity depicted as g's or in mm/s2.

.2 Acceleration is not constant but varies through vibration cycle, reaching maximum levels as Velocity reaches its minimum, typically when particular mass decelerated to a stop and about to begin accelerating again.

.4 Peak Particle Velocity:

.1 Highest particle Velocity recorded during particular vibration event over 3 axes.

.2 Unit: Millimetres per second (mm/s).

.3 Symbol: PPV or Vpeak.

.5 Root Mean Square (RMS) Velocity:

.1 Square root of average of squared instantaneous vibration Velocity (V) over specified time interval or integration time (T) reported in millimetres per second (mm/s).

.2 For vibration monitoring, integration time (T) is one second.

.3 Unit: Millimetres per second (mm/s).

.4 Symbol: VRMS.

.6 Daytime:

.1 7:00 a.m. to 7:00 p.m.

.7 Evening:

.1 7:00 p.m. to 11:00 p.m.

.8 Night-time:

.1 11:00 p.m. to 7:00 a.m.

.9 Vibration Baseline Reading:

.1 Initial readings taken prior to construction to provide baseline for reference to review and alert levels.

.10 Monitoring Period:

.1 Monitoring Period refers to period of time no greater than 20 minutes. A 24-hour day will be subsequently divided in 20 minute blocks, where data will be collected and reported.

.11 Utilities:

.1 Structures including, but not limited to natural gasmains, watermains, Electrical Cables, and concrete Conduit.

.12 Vibration Review Level:

.1 Assess the necessity of altering method, rate or sequence of construction to reduce vibration levels for the value of instrumentation readings.

.2 Review levels presented in table below:

Monitored activity	Review Level
Vibration in buildings during: Daytime and Evening	PPV < 5 mm/sec for frequencies between 1 - 4 Hz. PPV < 10 mm/sec for frequencies between 4 - 10 Hz. PPV < 20 mm/sec for frequencies between > 10 Hz. For older or heritage buildings reduce limits above by 50%.
Vibration in buildings during: Night-time	PPV < 1 mm/sec for frequencies between 1 - 100 Hz.
Vibration in Utilities (as measured directly on the utility)	Modern structures: PPV < 12 mm/sec for frequencies between 1 - 100 Hz. Older structures: PPV < 5 mm/sec for frequencies between 1 - 100 Hz.

.13 Vibration Alert Level:

.1 Value of instrumentation readings at which construction operations to cease, make Site and affected properties secure, and take necessary measures to mitigate vibration and assure safety of Work and public.

Vibration Alert Level for each instrument represents maximum permissible vibration levels. For purpose of vibration monitoring and reporting alert levels are presented in the table below:

Monitored activity	Review Level
Vibration in buildings during: Daytime and Evening	PPV < 8 mm/sec for frequencies between 1 - 4 Hz. PPV < 15 mm/sec for frequencies between 4 - 10 Hz. PPV < 25 mm/sec for frequencies between > 10 Hz. For older or heritage buildings reduce limits above by 50%.
Vibration in buildings during: Night-time	PPV < 3 mm/sec for frequencies between 1 - 100 Hz.
Vibration in Utilities (as measured directly on the utility)	Modern structures: PPV < 25 mm/sec for frequencies between 1 - 100 Hz. Older structures: PPV < 10 mm/sec for frequencies between 1 - 100 Hz.

.14 Should limits in table above be exceeded and Work stopped, responsible for costs associated with Work stoppage.

1.4 SUBMITTALS

.1 Submit in accordance with Section 01 33 00 – Submittals.

.2 Documentation Submittal(s):

.1 Submit the following:

.1 Vibration Management Plan.

.2 Quality Management Plan.

.3 Calibration records and certificates.

.3 Monitoring Submittal(s):

.1 Submit the following:

.1 Baseline vibration report.

.2 Weekly vibration report.

.3 Complaint document.

.4 Closeout Submittal(s):

.1 Submit final vibration report including the following information:

.1 Summary of vibration levels collected during monitoring program.

.2 Summary of exceedance.

.3 Summary of vibration complaints.

.4 Digital copy of complete dataset collected in Excel 2010 format.

1.5 QUALITY ASSURANCE

.1 Vibration Engineer Qualifications:

.1 Professional Engineer, licensed in Province of Ontario, with minimum 10 year experience in construction vibration.

.2 Vibration Technician Qualifications:

.1 Minimum 5-year monitoring experience with construction vibration.

.2 Vibration Engineers above may also conduct vibration monitoring.

.3 Vibration Management Plan:

.1 Within 2 weeks of Notification of Award, submit Vibration Management Plan including, but not limited to the following:

.1 Identify and map construction related vibration sources and associated controls.

.2 Identify potential sensitive receptors to vibration.

.3 Identify vibration criteria.

.4 Identify and map sensitive receptors for monitoring.

.5 Detailed vibration monitoring programs.

.6 Specify vibration controls.

.7 Qualifications of vibration engineer and vibration technician.

.2 Document existing vibration assessment reports.

.1 Detailed plan of instrumentation types, numbers, locations, and layouts in conjunction with existing structures, subsurface Utilities and private property. Include identification, elevation, station, offset, and coordinates for each instrumentation location.

.2 Methods statements for installing, monitoring, reporting, maintaining, and protecting instrumentation. Assure quality with following:

.1 Schedule for report submission.

.2 Roles and responsibilities.

.3 Complaints management procedure.

.4 Record keeping procedure.

.4 Quality Management Plan:

.1 Submit within 2 weeks of Notification of Award including, but not limited to:

.1 Description of control measures to ensure calibration records of equipment (both annual calibration, and certification and Site calibration) are kept to date.

.2 Description of control measures to ensure proper maintenance of installed equipment in accordance with manufacturer's specifications.

.3 Description of control measures to reduce amount of data lost due to power failures.

.4 Description of control measures to reduce amount of data lost due to equipment failures, including mitigation actions in case of potential failures.

.5 Description of control measures in place for review and quality assurance of monthly reports sent to the Engineer.

.5 Calibration Records and Certificates:

.1 Submit calibration records and certificates 15 Days before monitoring activities, for equipment used on Site.

.2 Re-submit calibration certificates within 7 Days of issuance for equipment sent for calibration during duration of monitoring program.

.3 List of Vibration Monitoring equipment to be used, associated hardware (for example, pre-amplifiers, Accelerometers, geo-phones, calibrators) include following:

.1 Manufacturer's name.

.2 Model.

.3 Serial numbers for components (For example, unit, pre-amplifiers, Accelerometers).

.6 Baseline Vibration Report:

.1 Conduct baseline vibration monitoring minimum 3 weeks in advance of construction start.

.2 Conduct baseline vibration monitoring for minimum 24-hour period.

.3 Submit baseline vibration report within 7 Days of baseline monitoring completion and prior to construction start.

.4 Include following information:

.1 Identify and map location of monitoring.

.2 Identify and map main sources of vibration.

.3 Identify Baseline Monitoring Period, per monitoring location, include following information in tabular form:

.1 Number of Monitoring Periods recorded (20 minute blocks).

.2 Number of Monitoring Periods not recorded due to regular maintenance and download operations.

.3 Number of Monitoring Periods not recorded due to equipment failure.

.4 Number of Monitoring Periods not recorded due to power failure.

.4 For each monitoring location, provide following information for each Monitoring Period in tabular form:

.1 Peak Particle Velocity, PPV.

.2 Frequency of recorded Peak Particle Velocity, PPV.

.3 Average hourly wind speed.

.4 Precipitation.

.5 Notes on data not reported within Monitoring Period, in following decreasing order of importance:

.1 Equipment failure.

.2 Power failure.

.7 Weekly Vibration Report:

.1 Submit within 4 Business Days after end of week, including the following information:

.1 Identify and map location of monitoring.

.2 Identify and map main sources of vibrations.

.3 For each monitoring location, provide the following information for each Monitoring Period in tabular form:

.1 Peak Particle Velocity, PPV.

.2 Frequency of the recorded Peak Particle Velocity, PPV.

.3 Precipitation.

.4 Notes on data not reported within the Monitoring Period, in the following decreasing order of importance:

.1 Equipment failure.

.2 Power failure.

.5 Identify vibration sources contributing to vibration levels during that Monitoring Period and reference to either on-site observations by monitoring technician or record of Site activities by Contractor.

.4 Identify for the week, per monitoring location, and the following information in tabular form:

.1 Number of Monitoring Periods recorded (20 minute blocks).

.2 Number of Monitoring Periods not recorded due to regular maintenance and download operations.

.3 Number of Monitoring Periods not recorded due to equipment failure.

.4 Number of Monitoring Periods not recorded due to power failure.

.5 Number of Monitoring Periods exceeding the vibration review and alert levels.

.6 Number of Monitoring Periods vibration levels exceedance attributed to the Site activities.

.5 Identify mitigation actions for equipment failure or power failures.

.6 Identify complaints registered during that week and disposition of complaints.

.7 Identify mitigation measures required addressing vibration level

.8 Final Vibration Report:

.1 Submit within 30 Days of Work completion on Site, include the following information:

.1 Identify and map location of monitoring locations.

.2 For each monitoring location provide following information for each Monitoring Period in tabular form:

.1 Peak Particle Velocity, PPV.

.2 Frequency of the recorded Peak Particle Velocity, PPV.

.3 Average hourly wind speed.

.4 Precipitation.

.5 Notes on data not reported within Monitoring Period, in following decreasing order of importance:

.1 Equipment failure.

.2 Power failure.

.3 Identify, per monitoring location, the following information in tabular form:

.1 Number of Monitoring Periods recorded (20 minute blocks).

.2 Number of Monitoring Periods not recorded due to regular maintenance and download operations.

.3 Number of Monitoring Periods not recorded due to equipment failure.

.4 Number of Monitoring Periods not recorded due to power failure.

.5 Number of Monitoring Periods vibration levels exceedance.

.6 Number of Monitoring Periods vibration levels exceedance attributed to Site activities.

.4 Identify complaints registered and disposition of complaints.

.2 Supply tabular information in Excel 2010 digital format.

.9 Complaint Document Requirements:

.1 Implement, coordinate and maintain complaint system in place for entire duration of Work.

.2 Submit records of complaints received within 1 hour of reception.

.3 Prepare and submit to Engineer assessment and disposition of complaint within 48 hours of reception of complaint.

.4 If compliant formalized to Engineer, submit an assessment and disposition of the complaint within 7 Days of reception of complaint at no cost to Engineer.

.5 Assessment and disposition report to be filed by vibration engineer to include following minimum information:

.1 Records of complaint.

.2 List of Site activities during period of complaint.

.3 Disposition of complaint including, but not limited to mitigation measures to be implemented.

1.6 SITE CONDITIONS

.1 Refer to Section 02 23 50 for specific guidance on installation of equipment.

.2 When installing vibration monitoring equipment on public property, obtain appropriate permits for installation on Utilities and notify authorities of monitoring installation.

.3 Install vibration monitors prior to start of Work.

.4 Engineer reserves the right to request additional manufacturer documentation for vibration monitoring equipment used, with no extra costs to Engineer.

PART 2 PRODUCTS

2.1 VIBRATION MONITORING EQUIPMENT

.1 Comply with Section 02 23 50.

PART 3 EXECUTION

3.1 PREPARATION

.1 Obtain written permission from Engineer for instrumentation to be installed on their land or affixed to their buildings prior to installing instruments, and for access for purpose of monitoring.

.2 The monitoring program specified herein shall not relieve the Contractor of its responsibility for undertaking whatever actions are required, including installation of additional instrumentation and monitoring, to ensure that Work proceeds in a safe and secure manner, and in conformance with requirements of Contract Documents.

3.2 INSTALLATION

.1 Refer to Section 02 23 50.

.2 Provide adequate number of vibration monitoring equipment for execution of Work. Minimum number of vibration monitoring equipment for the execution of Work shall be as follows:

.1 Existing Digester – 4

.2 Existing Maintenance Garage – 2

.3 Existing Primary Clarifier #1 - 2

.3 Install vibration monitoring equipment for execution of this Section of Work.

.4 Vibration Engineer and Vibration Technician:

.1 Attend monitoring on a weekly basis for monitoring, relocation of equipment and review of Site activities.

.5 Perform maintenance and changes in location of monitoring equipment as required, at no extra cost to Engineer.

.6 Install vibration monitoring equipment on Site such that preference is given to foundation/basement floor at corner/wall closest to construction work front from buildings.

.7 Relocate vibration monitoring equipment to adequately monitor most affected building or structure.

3.3 MONITORING

.1 Supply equipment with remote data delivery capabilities.

.2 Immediately notify Engineer in case an exceedance of the Alert Level is recorded.

.3 Define and implement at no cost any mitigation measures required to comply with the Alert Levels defined in this Section.

.4 Assess any complaints (at the proposed locations or any other locations) arising from the construction activities at no cost to Engineer. Provide measurement results including an interpretation by the vibration engineer of the possible impacts such construction vibrations might have on the building or structure of the complaint.

.5 The Contractor shall monitor the vibration of all existing structures at the start of construction and to terminate until all underground Works is completed.

3.4 FIELD QUALITY CONTROL

.1 Refer to Section 02 23 50.

3.5 CLEANING

.1 Clean-up and restore area upon completion of Work in accordance with Section 02 23 50 and to the conditions prior to installation.

3.6 PROTECTION

.1 Refer to Section 02 23 50.

END OF SECTION

VIBRATION INSTRUMENTATION

PART 1 GENERAL

1.1 RELATED SECTIONS

.1 Section 02 23 40 - Vibration Monitoring

1.2 DEFINITIONS

.1 Measurement Time Interval:

.1 Time interval over which squared Instantaneous Sound Pressure is integrated to compute time averaged Sound Pressure or sound exposure (i.e., time interval data are actually measured).

.2 Accelerometer:

.1 A transducer whose electrical output responds directly to acceleration. Accelerometers typically cover much wider frequency range, allowing them to pick up signals not present with other types of transducers. Due to frequency range, Accelerometers are ideal for most types of rotating equipment, making them the most used transducer for vibration measurements.

.3 Velocity:

.1 Rate of change in position, measured in distance per unit of time. When measuring vibration signals, Velocity also represents the rate of change in displacement and is expressed in inches (in) or millimetres (mm) per second.

.4 Acceleration:

.1 Rate of change of Velocity depicted as g's or in mm/s2.

.2 Acceleration is not constant but will vary through the vibration cycle, reaching maximum levels as Velocity reaches its minimum. Typically, when a particular mass has decelerated to a stop and is about to begin accelerating again.

.5 Peak Particle Velocity:

.1 Highest particle Velocity which is recorded during a particular vibration event over the 3 axes.

.2 Unit: Millimetres per second (mm/s).

.3 Symbol: PPV.

.6 Root Mean Square (RMS) Velocity:

.1 Square root of the average of the squared instantaneous vibration

.2 For the purposes of vibration monitoring the integration time (T) is one second.

.3 Unit: Millimetres per second (mm/s).

.4 Symbol: vRMS.

.7 Valid Monitoring Data:

.1 Monitoring data recorded and downloaded complying to the following conditions:

.1 60 minutes integration time of the recording.

.2 Data do not fall within a period where Inclement Weather Conditions recorded.

.8 Inclement Weather Conditions:

.1 Hourly period atmospheric weather conditions on Site.

.2 Outside of the limits of operation of Sound Level Meter.

.3 In accordance with MOECC NPC-102 definition.

1.3 GENERAL REQUIREMENTS

.1 Be responsible for cost associated with calibration, installation, operation and maintenance of noise and vibration instrumentation.

1.4 SUBMITTALS

.1 Submit in accordance with Section 01 33 00 - Submittals.

.2 Quality Assurance Submittal(s):

.1 Submit calibration records and certificates for Workers Hearing Conservation Plan equipment.

.2 Submit calibration records and certificates for vibration monitoring equipment.

1.5 QUALITY ASSURANCE

.1 Calibration Records and Certificates for Vibration Monitoring Equipment:

.1 Submit calibration records and certificates, 15 Days before monitoring activities, for the vibration monitoring equipment to be used.

.2 List of vibration monitoring equipment, associated hardware, software (for examples, unit, pre-amplifiers, Accelerometers) and the following:

.1 Manufacturer's name.

.2 Model.

.3 Serial numbers for all components.

.3 Keep a copy of the installed equipment calibration records and certificates on Site for Engineer review.

.4 Inform in advance if any planned changes to equipment due to regular maintenance operations.

.5 Inform Engineer within 24 hours of any equipment failure, corrective actions taken, and loss of information.

PART 2 PRODUCTS

2.1 VIBRATION MONITORING EQUIPMENT

.1 Minimum equipment requirements:

.1 Capable of measuring tri-axial, in-ground, PPV in mm/s with a frequency range of 1 to 100 Hz.

.2 Direct sensor axis towards the source of vibration concern at each location.

.3 Monitors that measure building vibration and are located inside a building:

.1 Install at the foundation or basement floor at the corner or wall closest to the construction.

.2 Install at level to ensure accurate recording of vibration levels.

.4 Monitors that measure building vibration and are located outdoors:

.1 Install at ground level, or shallow-buried (150-300 mm deep) in the ground.

.2 Install at level to ensure accurate recording of vibration levels.

.5 Capable of remotely send information (as a minimum PPV and time of recording) pertaining to exceedance of the review level.

.2 Preparation:

.1 Install vibration monitors prior to start of Work.

.2 Setup monitors to continuously measure and report (time history) PPV and RMS levels in one-hour intervals.

.3 Provide monitors with outdoor weather-proof enclosures.

.4 Engineer reserves the right to request any additional manufacturer documentation for the vibration monitoring equipment used for the Contract at no extra cost to Engineer.

.3 Source quality control:

.1 Calibrate vibration monitoring instrument by manufacturer, or other authorized independent third-party calibration company, to appropriate standard as set out in the manufacturer documentation.

.2 Provide Laboratory Calibration Certificate issued in the past 12 months of calibration.

.4 Commissioning:

.1 Operational performance in general conformance with the following outline:

Area	Service Definition	Minimum Service Level
System Availability	Monitoring system is considered to be available if the application is able to collect and store data and if such information can further be downloaded and presented to Engineer upon request. Regular maintenance operations, such as calibration and data download are not considered outages as long as the duration of such operation can be completed and the equipment be placed back into service within 2 hours of the start of the maintenance period.	90%
Planned Outage	Planned outage, agreed in writing with Engineer and given 7 Days in advance and be less than 4 hours in duration.	100%
Fault Rectification	Faults with monitoring equipment, rectified within a target time of 4 Business Days from identification of the fault.	90%

.2 Be responsible for maintaining the following functional performance related to vibration monitoring equipment:

.1 Inform Engineer in writing, minimum 7 Days in advance, of planned changes in equipment due to regular maintenance or calibration required. Provide replacement unit at time of unit removal on Site at no extra cost to Engineer.

.2 Inform Engineer in writing, within 8 hours of occurrence, of damage sustained during performance of Work or un-planned maintenance of equipment that occurs. If outage is to last more than 4 hours, provide replacement unit within 48 hours at no extra cost to Engineer.

.5 Protection:

.1 Prevent traffic in proximity of monitoring equipment.

.2 Protect equipment from acts of vandalism or destruction.

.3 Protect from damage during construction and maintain exposed instrumentation components. Repair or replace instruments damaged by performance of Work, to Engineer acceptance at no extra cost.

.4 Notify Engineer of damage within 8 hours of occurrence. Submit to Engineer corrective action plan within 24 hours of occurrence.

.6 Protection:

.1 Prevent traffic in proximity of monitoring equipment.

.2 Protect equipment from acts of vandalism or destruction.

.3 Protect from damage during construction and maintain exposed instrumentation components. Repair or replace instruments damaged by performance of Work, to Engineer acceptance at no extra cost.

.4 Notify Engineer of damage within 8 hours of occurrence. Submit to Engineer corrective action plan within 24 hours of occurrence.

PART 3 EXECUTION

3.1 INSTALLATION

.1 Vibration Monitoring Equipment:

.1 Field locate positions of instrumentation in accordance with Vibration Monitoring Plan referenced in Section 02 23 40.

.2 Inform Engineer of planned changes in location prior to proceeding. Submit plan of changes for Engineer review. Update Vibration Monitoring Plan accordingly.

.3 Install access, such as temporary or mobile platforms for instrumentation installation and data collection on or in temporary Works.

.4 Provide and fabricate protection to installed vibration monitor.

.5 Install power supply for vibration monitors and for general area lighting as required by Engineer during installation of instruments and for reading of instruments installed on or within temporary Work.

.6 Supply and operate Vibration Monitors to complete Work in accordance with Section 02 23 40.

.7 Provide, monitor, and interpret data from additional instrumentation necessary to control its method of operation, ensure safety of personnel and ensure integrity of Work, at no extra cost to Engineer. Supply data from additional instrumentation in similar form in accordance with Section 02 23 40.

.8 Install instruments in accordance with manufacturer's recommendation. Install within accuracy limits specified by manufacturer.

END OF SECTION

DEMOLITION

PART 1 GENERAL

1.1 SCOPE

.1 This specification covers the requirements for demolition, salvage, removal, and in-place abandonment, either completely or partially, of those materials and structures so designated on the drawings.

.2 This Section also includes modifications of existing structures, piping, and equipment as indicated on the drawings.

1.2 RELATED SECTIONS

.1 DIV 1 – General Requirements

.2 Section 01 33 00 – Submittals

1.3 CODE AND REGULATORY REQUIREMENTS

.1 Obtain and pay for demolition permits. Give required notices.

.2 Comply with applicable requirements of CSA S350-M1980 “Code of Practice for Safety in Demolition of Structures.”

.3 Comply with applicable regulations of jurisdictional authorities governing waste management.

1.4 REFERENCES

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

.2 OHSA O.Reg. 213/91 – Occupational Health and Safety Act for Construction

.3 OPSS 510 - Removal

1.5 SUBMITTALS

.1 Complete submittals in accordance with Specification Section 01 33 00.

.2 Submit for approval drawings, diagrams or details showing sequence of disassembly work or supporting structures and underpinning. Drawings for structural elements shall bear seal and signature of professional engineer licensed to practice in Ontario.

.3 Prepare and submit a waste reduction work plan. Describe management of demolition wastes. Identify materials which can be reused, recycled, and indicate method proposed for reducing, reusing recycling wastes.

1.6 EXAMINATION

.1 Visit the site and the existing building so as to fully understand all existing conditions and extent of work required. No increase in cost or extension of performance time will be considered for failure to know conditions.

.2 Take over buildings and structures to be demolished based on their condition at time of bid submission, except where indicated otherwise.

PART 2 PRODUCTS

2.1 NOT USED

PART 3 EXECUTION

3.1 GENERAL DEMOLITION REQUIREMENTS

.1 Coordinate the work with the Engineer, Operator, and the Owner to minimize disruptions to operations of the existing plant. Include the sequence of removals in the project schedule for review by the Engineer.

.2 The removal drawings may not present all items to be demolished. The Contractor shall remove all items, components, system, cables, piping, supports and equipment within the contract limits shown on the contract drawings, except for those items specified to remain. The general area in which the demolition work is to be performed shall be left clean and free of debris at the end of each shift; access routes must always be kept clear. If required, the general area shall be graded as required to provide a uniform appearance.

.3 Schedule and organize all Demolition activities to ensure that the Security of the plant and plant operations are maintained continuously throughout the construction period.

.4 Do not begin removals except in accordance with the approved sequence of construction and until approval has been given by the Engineer in writing.

.5 At least three (3) weeks prior to commencing removal of any equipment, piping, or materials, the Contractor shall request that the Owner mark items to be salvaged. Except for items designated to be salvaged on the drawings or as indicated in the field, all removed equipment, piping, materials, fixtures, hardware, supports, etc., shall be disposed of by the Contractor.

.6 Except for items designated to be salvaged, all removed equipment, piping, materials, fixtures, hardware, supports, etc., to be disposed of by the Contractor.

.7 All equipment to be salvaged by the Contractor is to remain in good working order. Salvaged materials to be delivered and off loaded into storage anywhere within the plant boundaries.

.8 All facilities in the work area which are not to be removed must remain in continuous use during the work, unless otherwise approved by the Owner or Owner's representative.

.9 Demolition and salvage work shall create a minimum of interference with the Owner's operation and inconvenience to the Owner. Work shall be scheduled and coordinated to allow continuous, uninterrupted operation of the existing facility.

.10 Coordinate work and disposal requirements in accordance with the Designated Substance Survey (DSS) and applicable regulations.

.11 All backfilling required in the demolition area shall conform to the governing requirements of the Earthwork Section.

.12 Demolish existing work as indicated on the drawings and as required to accommodate new work.

.13 Demolish work in a safe and systematic manner, from top to bottom.

.14 Do not throw or drop demolished materials from heights. Use chutes, conveyors or hoisting equipment to lower materials.

.15 Demolish in a manner to minimize dust generation. Keep dusty materials wetted but prevent flooding or contaminated runoff.

.16 Carefully remove and lower structural framing and other heavy and large objects as needed.

.17 At all times leave work in safe condition, so that no part is in danger of uncontrolled toppling or falling.

.18 Install temporary supports as required to prevent uncontrolled collapse of structures. Design of support to be completed by Professional Engineer licensed to practice in Ontario. Submit certified drawings for review.

.19 Blasting will not be permitted.

3.2 COORDINATION

.1 Coordinate all demolition and modification work with any new work to be performed to facilitate completion. Demolition work cannot start until approved by Engineer. Coordination is required with the Engineer and the Owner's operation staff.

.2 Coordinate modification work and demolition to allow continuous, uninterrupted operation of the existing facility.

3.3 PROTECTION

.1 Prevent uncontrolled movement, any part of building being demolished; provide temporary shoring and bracing required.

.2 Take steps to positively prevent uncontrolled falling of demolished materials.

.3 Ensure that no part of existing structure is overloaded due to work carried out under this Section.

.4 Prevent debris from blocking drainage systems.

.5 Ensure the temporary guards, hoardings are provided during and upon completion of work in accordance with applicable safety regulations.

3.4 PREPARATION

.1 Ensure that affected building areas are unoccupied and discontinued in use and that required screens, partitions, hoardings are in place prior to start of demolition work.

.2 Verify that existing services in areas affected by demolition are disconnected, capped, or removed, prior to start of work. Perform scans as necessary to ensure any pipes, electrical or communication cables have been properly terminated prior to demolition.

.3 Ensure that all process equipment within demolition areas, either to be removed or retained, is appropriately protected from damage, dust, or anything else which may cause damage during the demolition works.

.4 Coordinate work and disposal requirements in accordance with the Designated Substance Survey (DSS) and applicable regulations.

3.5 CONCRETE STRUCTURES DEMOLITION

.1 Existing concrete structures, as noted, shall be removed to the limits indicated.

.2 Existing concrete to be removed shall be cut into fragments and reduced in size as required to facilitate removal and disposal.

.3 Disassembly, removal of all structural elements shall be carried out under the supervision of a professional structural engineer licensed to practice in Ontario hired by the Contractor.

3.6 PIPING AND EQUIPMENT DEMOLITION

.1 The Contractor shall be responsible for the removal of process equipment, pumps and associated motors, piping, valves, and all other appurtenances associated with the item being removed as presented on the Contract Drawings.

.2 Before piping removal, the Contractor shall completely drain the corresponding pipeline. The Contractor shall pay for all temporary pumps, piping and its operation required to drain the existing pipeline to be removed.

.3 Piping and equipment shall be disconnected, dismantled and removed as required and in such a manner as to minimize disturbance or damage to adjacent construction.

.4 At any point or location where new work is to be connected or installed, the removal of existing work shall be done so as to facilitate the new installation work to the maximum possible extent.

.5 All hazardous chemical waste shall be disposed of by a company who is licensed in Ontario and trained to handle and remove them. The hazardous chemical waste, pipe and valves shall be disposed of off-site with approval and permit.

3.7 SITE WORK DEMOLITION

.1 The demolition of existing drives, curbs, walks, dikes, and similar items shall be scheduled and performed so as to minimize inconvenience to the Owner.

.2 The demolition of existing inground services including piping and chambers shall be coordinated to ensure the continual unhindered operation of the plant, allow for efficient changeovers from existing to new inground services and to minimize inconvenience to the Owner.

3.8 REPAIR OF EXISTING CONSTRUCTION

.1 Where structures to be demolished are connected to structures to remain, remove the existing construction in a careful manner so that adjacent construction, piping, or facilities to be left in place are not cracked or otherwise damaged.

.2 The Contractor will be held responsible for any damage thereto because of their operations.

.3 Use temporary supports designed by a Professional Engineer, where and as required for the support of existing facilities.

.4 Holes and damage resulting from removal operations shall be filled, reconstructed, repaired, and finished to match and conform to adjacent surfaces and construction as determined by the Engineer.

3.9 ELECTRICAL REMOVAL

.1 The control stations, control panels, conduits, and other devices associated with the removed equipment may not be shown on the drawings.

.2 Contractor to ensure that plant operation is not affected due to loss of power to any part of the wastewater treatment process.

.3 The electrical sub-contractor shall be responsible for the following items:

.1 Disconnecting electrical power sources from all equipment and devices to be moved or removed.

.2 Removing electrical conductors from the conduits serving the equipment to be moved or removed.

.3 Removing local starters, control stations, control panels and other local control devices not an integral part of the associated equipment to be moved or removed.

.4 Disconnecting and removing abandoned motor control centres, and motor control line-ups.

.5 Removing exposed conduit connecting equipment and devices to be moved or removed and the power sources.

.6 Where abandoned conduit not indicated to be retained for future use enters a structural surface above the operating floor, it shall be undercut 25 mm with edges dovetailed and the structure tightly and neatly repaired to resemble the remaining surface.

.7 Where such a conduit enters a structural surface below the operating floor, it shall be cut flush with the floor or within 25 mm of other surfaces, and those in floors and walls filled with expanding grout to a depth of one diameter, but 50 mm minimum.

.8 On any equipment to be reapplied or abandoned in place, unused conduit openings shall be plugged and original identity nameplate shall be reversed or removed. Circuit lists and nameplates at sources of power shall be neatly corrected for changes in loads. Electrical items in motor control centres, control panels, panel boards, etc., separate from abandoned equipment shall be left as spares, unless indicated otherwise.

.9 Existing status and control panels shall be disconnected, removed, and returned to the Owner.

.4 Remove abandoned power cable, electrical control panels, and power distribution equipment as required. Coordinate this work with the Owner and the Engineer.

.5 Abandoned conduits in good condition and at least as large as indicated for new circuits may be used as part of contract installation.

.6 Salvaged items to be reinstalled or delivered to the Owner’s on-site storage shall be handled carefully.

.7 Removed electrical equipment shall first be offered to the Owner and if the Owner refuses right to Ownership, the equipment shall be disposed of off site by the Contractor.

3.10 ITEMS TO BE SALVAGED BY CONTRACTOR

.1 Removal and salvage of any item of equipment or facility includes removal and salvage of all accessories, piping, wiring, supports, associated electrical starters and devices, base plates, and frames, and all other appurtenances, unless otherwise directed.

.2 Existing materials and equipment removed, and not reused as a part of the work, shall become the Contractor's property, except for the items indicated by the Owner shall remain the Owner's property and shall be delivered to the Owner to a designated area by the Contractor in good condition.

.3 Existing materials and equipment to be removed by the Contractor and reused as a part of the work shall remain the property of the Owner.

.4 The Contractor shall carefully remove, in a manner to prevent damage, all materials and equipment specified herein or indicated to be salvaged and reused or to remain the property of the Owner.

.5 The Contractor shall store and protect salvaged items specified or indicated to be reused in the work.

.6 Any items damaged in removal, storage, or handling through carelessness or improper procedures shall be replaced by the Contractor in kind or with new items.

.7 The Contractor may, at their option, furnish and install new items in lieu of those specified or indicated to be salvaged and reused, in which case such removed items will become the Contractor's property.

.8 All other existing materials and equipment removed by the Contractor shall not be reused in the work, shall become the property of the Contractor, and shall be removed from the jobsite.

3.11 CONCRETE MODIFICATIONS

.1 Remove existing concrete where such removal is indicated on the drawings or directed by the Engineer.

.2 Remove all dust, grease, curing compounds, impregnations, waxes, foreign particles, and disintegrated material.

.3 If chipping is necessary, the edges shall be perpendicular to the surface or slightly undercut. Feather edges will not be permitted.

.4 Remove all defective existing concrete down to sound concrete where indicated on the drawings or as directed by the Engineer.

.5 Where existing concrete is to be removed, fill, repair, and finish the surfaces smooth and flush with adjacent undisturbed surfaces.

.6 All exposed cut ends of reinforcement are to be drilled out to a depth of 40mm from concrete surface, and repaired with non shrink, non-metallic grout.

.7 Unless otherwise indicated on the drawings or directed by the Engineer, clean and leave in place existing reinforcing exposed during concrete removal operations.

.8 Where indicated on the drawings, extend existing reinforcing into the new construction by mechanical connection to the existing reinforcement. Mechanical connections shall be as specified on the drawings.

.9 Any reinforcement bars the Engineer allows to be cut shall be cut off not less than 40 mm inside the finished and repaired surface. All anchor bolts, piping, and other hardware projecting from concrete surfaces after piping and equipment have been removed shall be cut 40mm inside the finished or repaired surface. Reinforcement bars and other steel construction to be removed may be flame-cut.

.10 Remove concrete bases of existing equipment that have been relocated or removed, down to the reinforcing steel of the supporting slab. Initiate removal of curb base with a concrete saw, cutting around the perimeter, taking care not to chip or spall the surface of remaining structure. After existing materials have been removed, exposed reinforcing steel and structural slab shall be cleaned and filled with new concrete, finished to match the surrounding surface.

.11 Where coring of concrete or masonry elements are necessary for installation of pipes or conduit;

- .1 Scan the floor or wall for electrical or process services prior to coring.
- .2 Coring of holes shall be at 90 degrees to the concrete surface, and made so that the cored hole is neat and clean on both sides of the element.
- .3 Core holes must be at minimum 3 hole diameters from any other opening.
- .4 Core holes must be a minimum of 150mm form any concrete edge.
- .5 Core holes should not be oversized.
- .6 Core holes must not be made in any beams, columns or lintels without prior written approval of the engineer.
- .7 Core holes must be sealed in accordance with the general mechanical and electrical specifications.

.12 Concrete materials and placement shall be in accordance with the cast-in-place concrete section. Grouting shall be in accordance with the grouting section.

.13 Provide dust control by water systems or vacuum system and tarping to limit any dust migration during any concrete demolition works.

3.12 DISPOSAL AND CLEAN-UP

.1 With the exception of items designated for salvage or reuse, all materials, rubbish and debris resulting from demolition work shall become the Contractor's property and shall be removed from site and legally disposed of unless specifically indicated otherwise.

.2 Do not allow demolished materials to accumulate on site. Promptly, as work progresses, remove and legally dispose of materials away from site.

.3 Separate and salvage materials suitable for reuse and/or recycling from general waste stream or non-salvageable items. Transport and dispose of non-salvageable items to licensed disposal facility.

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

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

.6 Collect, handle, store on-site and transport off-site, salvaged materials, salvaged for reuse and/or recycling in separate condition. Transport to authorized reuse/recycling location.

.7 Burying, burning, selling waste materials on site is prohibited.

.8 Disposal of liquid wastes into waterways, sewers is prohibited.

.9 Clean-up work, storage and waste collection areas as work progresses.

.10 Contractor shall be responsible for all cleaning of existing piping, equipment, and structures that is required to properly remove and dispose of items to be demolished.

3.13 FIELD QUALITY CONTROL

.1 Disassembly, removal of structural elements shall be carried out under the supervision of a professional engineer licensed to practice in Ontario.

END OF SECTION

DIVISION 03 INDEX

CONCRETE FORMS AND ACCESSORIES

PART 1 GENERAL

1.1 SCOPE OF WORK

.1 Work supplied under this section includes the supply and installation of concrete formwork and falsework.

1.2 RELATED SECTIONS

.1 Section 03 20 00 – Concrete Reinforcement

.2 Section 03 25 20 – Waterstops

.3 Section 03 30 00 – Cast-in-Place Concrete

1.3 SCOPE OF WORK

.1 Work supplied under this section includes the supply and installation of concrete formwork and falsework

1.4 RELATED SECTIONS

.1 Section 03 20 00 – Concrete Reinforcement

.2 Section 03 25 20 – Waterstops

.3 Section 03 30 00 – Cast-in-Place Concrete

1.5 MEASUREMENT AND PAYMENT

.1 No measurement will be made under this section. Include costs in items of work for which concrete formwork and falsework is required.

1.6 REFERENCES

.1 Canadian Standards Association (CSA):

.1 CSA A23.1-19/A23.2-19 - Concrete Materials and Methods of Concrete Construction / Test Methods and Standard Practices for Concrete

.2 CSA O86-19 - Engineering Design in Wood

.3 CSA O121-17 - Douglas Fir Plywood

.4 CSA S269.1-16 (R2021)- Falsework and formwork

.2 International Organization for Standardization

.1 ISO 16893 (2016) – Wood-Based Panels – Particleboard

1.7 SUBMITTALS

.1 Make submittals in accordance with Section 01 33 00 – Submittals.

.2 Submit formwork and falsework drawings.

.3 Submit both typical arrangements and specific configurations for each pour.

.4 Show layout and dimensions of construction joints, drop beams, pipe encasements, and all other concrete edges in the structure.

.5 Show materials and layout of panels for formwork.

.6 Show extent and layout of reglets, etc.

.7 Comply with CSA-S269.1 for falsework and formwork drawings.

.8 Show design loads, maximum allowable rate of pouring and material specifications.

.9 Contractor to retain a Professional Engineer licensed in the Province of Ontario to sign and seal all formwork and falsework design and provide inspection during construction.

PART 2 PRODUCTS

2.1 MATERIALS

.1 Formwork materials:

.1 For concrete without special architectural features, use wood and wood product formwork materials to CSA O121, CSA O86 and ISO 168693 Type P-HLB HMR.

.2 Form ties:

.1 For concrete not designated ‘Architectural’, use removable or snap-off metal ties, fixed or adjustable length, free of devices leaving holes larger than 25 mm diameter in concrete surface.

.2 All water/wastewater retaining structures ties are to have interior tie members that are cast into the structure complete with water stops and cone ends.

.3 All below grade structures ties are to have interior tie members that are cast into the structure complete with water stops and cone ends.

.3 Form panels:

.1 Plywood: high density overlay Douglas Fir to CSA O121 No.1 grade, square edge, 20 mm thick.

.4 Form liner:

.1 Zemdrain® MD, Type III “Controlled Permeability Formliner” (CPF) as produced by Dupont, Maximum uses before discard: 3.

.2 Formtex® controlled permeability formliner (CPF) as produced by Fibertex® or Zemdrain® Classic, Type II CPF by Dupont. Maximum uses before discard: 1. This requirement will be strictly enforced.

.5 Form release agent: non-toxic, biodegradable, low VOC.

.6 Preformed joint filler: Ceramar flexible foam expansion joint filler by W.R. Meadows c/w joint cap.

PART 3 EXECUTION

3.1 FABRICATION AND ERECTION

.1 Verify lines, levels and centres before proceeding with formwork/falsework and ensure dimensions agree with drawings.

.2 Locate construction joints at least 6.0 m from any corner, and to limit the largest dimension of the pour to 15.0 m.

.3 Formliner (CPF) to be used on all vertical surfaces of all liquid-retaining structures, below grade structures and additionally, in all locations noted on the drawings. Apply CPF on both faces of walls.

.4 Apply Formliner (CPF) to surface of vertical forms with anchors spaced at not more than 400 mm c/c each way, and in strict accordance with the manufacturer’s written instructions. Ensure the CPF is tight throughout as to avoid any indentations in the surface of the newly cast concrete.

.5 Fabricate and erect formwork in accordance with CAN/CSA S269.1 to produce finished concrete conforming to shape, dimensions, locations, and levels indicated within tolerances required by CAN/CSA A23.1/A23.2.

.6 Align form joints and make watertight. Keep form joints to minimum.

.7 Do not use form release agents on forms with CPF.

.8 Use 25 mm chamfer strips on external corners and/or 25 mm fillets at interior corners and joints, unless specified otherwise.

.9 Form chases, slots, openings, drips, recesses, expansion, and control joints as indicated.

.10 Build in anchors, sleeves, and other inserts required to accommodate work specified in other sections. Assure that all anchors and inserts will not protrude beyond surfaces designated to receive applied finishes, including painting.

.11 Clean formwork in accordance with CAN/CSA A23.1/A23.2, before placing concrete.

3.2 REMOVAL AND RESHORING

.1 Leave formwork in place for the following minimum periods of time after placing concrete.

.1 Seven (7) days for walls and sides of beams.

.2 Seven (7) days for beam soffits, slabs, decks and other structural members

.3 Four (4) days for columns.

.4 Two (2) days for footings and abutment.

.5 Contractor Note: Concrete requires additional curing after form removal. The ambient environmental conditions may require additional curing at the discretion of the Engineer.

.2 After removing formwork, provide shoring under beams and suspended slabs for a minimum of 21 days.

.3 Provide all necessary reshoring of members where early removal of forms may be required or where members may be subjected to additional loads during construction as required.

.4 Re-use formwork and falsework subject to requirements of CAN/CSA A23.1/A23.2.

.5 The Zemdrain® MD Type III CPF may be used a maximum of three times before it must be replaced with a new liner. If CPF becomes torn or clogged, remove and replace immediately.

.6 The Formtex® CPF or the Zemdrain® Classic CPF may only be used one time, without exception.

.7 Totally remove any sections of liner which may have become embedded in the concrete and restore the surface at these locations to the approval of the Engineer.

.8 All concrete surfaces, including those with CPF, to be finished with a sack rubbed parge coat to the satisfaction of the Engineer. Refer to Section 03 30 00 - Cast in Place Concrete for concrete finish requirements.

END OF SECTION

CONCRETE REINFORCEMENT

PART 1 GENERAL

1.1 SCOPE OF WORK

.1 Work supplied under this section includes the supply and installation of concrete reinforcement.

1.2 RELATED SECTIONS

.1 Section 03 10 00 – Concrete Forms and Accessories

.2 Section 03 30 00 – Cast-in-Place Concrete

.3 Section 04 05 19 – Masonry Anchorage and Reinforcing

1.3 MEASUREMENT AND PAYMENT

.1 No measurement will be made under this section. Include costs in items of concrete work for which reinforcement is required.

1.4 REFERENCES

.1 Canadian Standards Association (CSA):

.1 CSA A23.1-19/A23.2-19 - Concrete Materials and Methods of Concrete Construction / Test Methods and Standard Practices for Concrete

.2 CSA A23.3-19 - Design of Concrete Structures

.3 CSA G30.18-21 - Carbon Steel Bars for Concrete Reinforcement

.4 CSA G40.20-13/G40.21-13 (R2023) - General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel

.5 CSA W186-21 - Welding of Reinforcing Bars in Reinforced Concrete Construction

.2 American Concrete Institute (ACI):

.1 ACI SP-66 (04) - ACI Detailing Manual-2004

.3 Reinforcing Steel Institute of Canada (RSIC):

.1 RSIC Manual of Standard Practice 2020

.4 American Society for Testing and Materials (ASTM):

.1 ASTM A1064/A1064M-24 - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete

.2 ASTM A276/A276M-24a - Standard Specification for Stainless Steel Bars and Shapes

.3 ASTM A955/A955M-20c - Standard Specification for Deformed and Plain Stainless Steel Bars for Concrete Reinforcement

1.5 SUBMITTALS

.1 Submit shop drawings in accordance with Section 01 33 00 – Submittals.

.2 Coordinate shop drawings with construction joint locations and pour schedules. Not all construction joints are shown on the drawings.

.3 Indicate on shop drawings bar bending details, lists, quantities of reinforcement, sizes, spacing, locations of reinforcement and mechanical splices if approved by engineer, with identifying code marks to permit correct placement without reference to structural drawings. Indicate sizes, spacing and locations of chairs, spacers and hangers.

.4 Prepare reinforcement drawings in accordance with Reinforcing Steel Manual of Standard Practice – by Reinforcing Steel Institute of Canada.

.5 Detail lap lengths and bar development lengths to CAN/CSA A23.3. Provide Type B tension lap splices, unless otherwise indicated.

.6 Submit Environmental Product Declarations (EPD) showing Global Warming Potential (GWP) impact category.

PART 2 PRODUCTS

2.1 MATERIALS

.1 Substitute different size bars only if permitted in writing by Engineer.

.2 Reinforcing steel: billet steel, grade 400 and grade 400W to CSA G30.18, unless indicated otherwise.

.3 Reinforcing stainless steel: billet steel, Type 316LN grade 420 MPa, deformed bars to ASTM A955.

.4 Deformed welded steel wire fabric: to ASTM A1064/A1064M. Provide in flat sheets only.

.5 Chairs, bolsters, bar supports, spacers: continuous high chair type, Class C, D or E to CSA A23.1/A23.2.

.6 Mechanical splices: subject to approval of Engineer.

.7 Plain round bars: to CSA G40.21, Grade 300W.

2.2 FABRICATION

.1 Fabricate reinforcing steel in accordance with CSA A23.1, ACI SP-66 and Reinforcing Steel Manual of Standard Practice by the Reinforcing Steel Institute of Canada, unless indicated otherwise.

.2 Obtain Engineer's approval for locations of reinforcement splices other than those shown on placing drawings.

.3 Upon approval of Engineer, weld reinforcement in accordance with CSA W186.

.4 Ship bundles of bar reinforcement, clearly identified in accordance with bar bending details and lists.

2.3 SOURCE QUALITY CONTROL

.1 Upon request, provide Engineer with certified copy of mill test report of reinforcing steel, showing physical and chemical analysis, minimum four weeks prior to commencing reinforcing work.

.2 Upon request, inform Engineer of proposed source of material to be supplied.

PART 3 EXECUTION

3.1 FIELD BENDING

.1 Do not field bend or field weld reinforcement, except where authorized in writing by Engineer.

.2 When field bending is authorized, bend without heat, applying a slow and steady pressure.

.3 Replace bars that develop cracks or splits.

3.2 PLACING REINFORCEMENT

.1 Survey and place string lines for face of concrete prior to placement of reinforcement cage and dowels. Maintain string line for engineer's inspection of dowels.

.2 Use sufficient chairs and other supports to prevent movement of reinforcement during concrete placement.

.3 Use of hooks to lift reinforcement during a slab pour are not permitted, all reinforcement is to be tied into position prior to placement of concrete.

.4 Displacement of slab reinforcement to use as positioning bars under a slab cage is not permitted, provide continuous chairs under slabs.

.5 Use of spreader bars and chairs are required to maintain wall steel in the proper position, reduction of the clear space between inside and outside cage is to be avoided.

.6 Place reinforcing steel as indicated on the structural drawings, on reviewed placing drawings and in accordance with CSA A23.1.

.7 Use plain round bars as slip dowels in concrete. Paint portion of dowel intended to move within hardened concrete with one coat of asphalt paint. When paint is dry, apply a thick even film of mineral lubricating grease.

.8 Prior to placing concrete, provide 72 hours' notice to Engineer and facilitate access for Engineer to review reinforcement placement. Make all necessary corrections before concrete is placed and allow re-inspection by Engineer, if requested.

.9 Ensure cover to reinforcement is maintained during concrete pour.

.10 Bend tie wire away from concrete surface. Ensure a cover for tie wires, form tie bolts etc. are same as the reinforcing bars. Do not let reinforcing tie wire touch formwork or be exposed in the finished concrete structure.

END OF SECTION

WATERSTOPS

PART 1 GENERAL

1.1 SECTION INCLUDES

.1 Provision of waterstops embedded in concrete and spanning control, expansion and/or construction joints to create a continuous diaphragm to prevent fluid migration.

1.2 REFERENCES

.1 CRD-C 572-74 – Corps of Engineers Specifications for Polyvinylchloride Waterstop

.2 American Society for Testing and Materials (ASTM):

.1 ASTM D412-16 (2021) - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers - Tension

.2 ASTM D570-22 - Standard Test Method for Water Absorption of Plastics

.3 ASTM D624-00 (2020) - Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers

.4 ASTM D638- - Standard Test Method for Tensile Properties of Plastics

.5 ASTM D746-20 - Standard Test Method for Brittleness Temperature of Plastics and Elastomers by Impact

.6 ASTM D747-10 - Standard Test Method for Apparent Bending Modulus of Plastics by Means of a Cantilever Beam

.7 ASTM D792-20 - Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement

.8 ASTM D2240-15 (2021) - Standard Test Method or Rubber Property - Durometer Hardness

.3 Bureau of Reclamation - C-902

1.3 SUBMITTALS

.1 Make all submittals in accordance with Section 01 33 00 – Submittals.

.2 Submit technical data sheets for each type and profile of waterstop as well as the premanufactured joint pieces and ancillary products.

1.4 QUALITY ASSURANCE

.1 Waterstop manufacturer shall demonstrate five (5) years (minimum) continuous, successful experience in production of waterstops.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Store waterstops under tarps to protect from oil, dirt, sunlight and premature exposure to water.

PART 2 PRODUCTS

2.1 PVC WATERSTOPS FOR EXPANSION JOINTS AND CONSTRUCTION JOINTS

.1 Provide flexible PVC (polyvinyl chloride) waterstop as manufactured by Sika Greenstreak, profile style number 696, or by Durajoint Type 7BR, or approved equal, for all expansion joints.

.2 Provide flexible PVC (polyvinyl chloride) waterstop as manufactured by Sika Greenstreak, profile style number 647, or by Durajoint Type 5, or approved equal, for all construction joints where indicated on structural drawings.

.3 Provide flexible PVC (polyvinyl chloride) retrofit waterstop complete with stainless steel batten bar and anchored using epoxy adhesives as manufactured by Sika Greenstreak, profile style number 581, or by Durajoint Type 29A-RT or approved equal, for all expansion joints where indicated on structural drawings

.4 The PVC waterstop shall be extruded from an elastomeric plastic material of which the basic resin is prime virgin polyvinyl chloride. The PVC compound shall not contain any scrapped or reclaimed material or pigment whatsoever.

.5 Performance Requirements as follows:

Property	Test Method	Required Limits
Water Absorption	ASTM D570	0.15% maximum
Tear Resistance	ASTM D624	35 kN/m minimum
Ultimate Elongation	ASTM D638	350% minimum
Tensile Strength	ASTM D638	13.78 MPa minimum
Low Temperature Brittleness	ASTM D746	No Failure @ -37ºC
Stiffness in Flexure	ASTM D747	4.13 MPa minimum
Specific Gravity	ASTM D792	1.45 maximum
Hardness, Shore A	ASTM D2240	79 ± 3
Tensile Strength after accelerated extraction	CRD-C 572	11.03 MPa minimum
Elongation after accelerated extraction	CRD-C 572	300% minimum
Effect of Alkalies after seven (7) days: Weight Change Hardness Change	CRD-C 572	 between -0.10% / +0.25% ±5 points

2.2 HYDROPHILIC WATERSTOP

.1 Use hydrophilic waterstop only where specifically shown on design drawings. If no waterstop is shown, use PVC type waterstop by default.

.2 Provide hydrophilic rubber waterstop as supplied by Multiurethanes or Sika, "Hydrotite" profile style number CJ-0725, or Durajoint "Dura-Tite" DT0725 or approved equal.

.3 The waterstop shall be a combination of chloroprene rubber and chloroprene rubber modified to impart hydrophilic properties.

.4 The waterstop shall have a delay coating to inhibit initial expansion due to moisture present in fresh concrete.

.5 Performance Requirements as follows:

Chloroprene Rubber		
Property	**Test Method**	**Required Limits**
Tensile Strength	ASTM D412	9 MPa (1300 PSI) minimum
Ultimate Elongation	ASTM D412	400% minimum
Hardness (Shore A)	ASTM D2240	50 ± 5
Tear Resistance	ASTM D624	17.5 N/mm (100 lb/inch) minimum
Modified Chloroprene (Hydrophilic) Rubber		
Property	**Test Method**	**Required Limits**
Tensile Strength	ASTM D412	2.4 MPa (350 PSI) minimum
Ultimate Elongation	ASTM D412	600% minimum
Hardness (Shore A)	ASTM D2240	52 ± 5
Tear Resistance	ASTM D624	8.75 N/mm (50 lb/inch)
Expansion Ratio	Volumetric Change - Distilled Water @ 21ºC	3 to 1 minimum

2.3 ACCESSORIES

.1 PVC Waterstops:

.1 Provide factory made waterstop fabrications for all changes of direction, intersections and transitions leaving only straight butt joint splices for the field.

.2 Provide hog rings or grommets along length of waterstop to hold the waterstop firm and in place. Space rings at 300mm on centre, unless spaced differently on structural drawings.

.3 Provide Teflon coated thermostatically controlled waterstop splicing irons for field butt splices.

.2 Hydrophilic Waterstops:

.1 Provide "Sika Epoxy 7300" or approved equal to secure hydrophilic waterstop to rough, wet concrete.

.2 Provide “Leakmaster LV-Z, by Sika” single component hydrophilic sealant or approved equal to secure hydrophilic waterstop to rough, dry concrete.

.3 Provide cyanoacrylate adhesive (super glue) for all splices.

.4 Provide Leakmaster as addition to cyanoacrylate adhesive at all splices.

PART 3 EXECUTION

3.1 INSTALLATION – PVC WATERSTOP

.1 Install in all Expansion Joints and Construction Joints (unless noted otherwise):

.2 Field splices are permitted provided that they are for straight butt splices only and shall be heat fused welded using a Teflon covered thermostatically controlled waterstop splicing iron at approximately 194ºC. Follow approved manufacturer recommendations, and provide training for any worker doing this work.

.3 Lapping of waterstop, use of adhesives or solvents shall not be allowed.

.4 Centre waterstop in joint and secure waterstop in correct position using hog rings or grommets along the length of the waterstop and wire tie to adjacent reinforcing steel. See structural drawings for details.

.5 For splicing between construction joint and expansion joint waterstop where bulb is not the same size, provide manufacture cross or tee of the expansion joint waterstop and butt weld the construction waterstop only on a straight edge. Apply Leakmaster around splice location prior to concreting.

3.2 INSTALLATION - HYDROPHILIC WATERSTOP

.1 Install Hydrophillic waterstop only where specified and keep dry until concrete encased. Waterstop that has been wetted prior to the pour will have to be replaced.

.2 Cut coil ends square (or at proper angle for mitred corners) with shears or sharp blade to fit splices together without overlaps.

.3 Splices shall be sealed using cyanoacrylate adhesive (super glue) and “Leakmaster LV-Z, by Sika” or approved equal.

.4 Seal watertight any exposed cells of hydrophilic waterstop using “Leakmaster LV-Z, by Sika” or approved equal.

.5 Follow approved manufacturer recommendations.

.6 Hydrophilic waterstop must be installed on clean, dry, smooth, structurally sound concrete.

.7 Clean concrete substrate of all dust, debris and laitance.

.8 Remove the protective release tape and press the profile firmly onto the concrete substrate in the proper location. Do not reposition after initial contact with the concrete.

.9 Hydrophilic waterstop applied to vertical or overhead surfaces shall be further secured with concrete nails spaced approximately 600 mm on centers.

.10 Join lengths of the hydrophilic waterstop profile with cyanoacrylate (super glue) type adhesive. Joints to be dressed with a bead of “Leakmaster” Hydrophilic Caulk or approved equal. Intersections and changes of direction must be joined in a similar manner.

.11 Installation temperatures above 4.5ºC are preferred. Low temperature installations (below 4.5ºC) require superficial heating of the concrete substrate immediately prior to the application of the hydrophilic waterstop profile. Carefully warm and dry the concrete surface with a hot air gun or propane torch and apply the hydrophilic waterstop profile while surface is still warm. Store the hydrophilic waterstop profile in a heated location until ready to install.

.12 Adhesive performance may be affected by adverse storage conditions and time. Store in a cool, dry location and use within two (2) months of purchase.

.13 After installations, protect hydrophilic waterstops from rain or snow.

3.3 HYDROPHILIC AND PVC INTERSECTIONS

.1 Maintain continuity of waterstops at all intersections and transitions.

.2 Joinery between PVC and hydrophilic waterstop shall include a 300mm overlap of the hydrophilic onto the PVC and be sealed using “Leakmaster LV-Z” by Sika or approved equal.

.3 Follow approved manufacturer recommendations.

3.4 FIELD QUALITY CONTROL

.1 Waterstop splicing defects that are unacceptable include, but are not limited to, the following:

.1 Tensile strength less than 80 percent of parent section.

.2 Misalignment of centerbulb, ribs and bulbs greater than 5 mm.

.3 Bond failure at joint deeper than 1.5 mm or fifteen (15) percent of material thickness.

.4 Misalignment which reduces waterstop cross section more than fifteen (15) percent.

.5 Visible porosity in the weld.

.6 Bubbles or inadequate bonding.

.7 Visible signs of splice separation when cooled splice is bent by hand at a sharp angle.

.8 Charred or burnt material.

.2 Hydrophilic defects that are unacceptable include, but are not limited to, the following:

.1 If it has been allowed to be wetted and expand prior to the concrete pour.

.2 Has become dislodged and is no longer in full contact with the existing concrete.

.3 Is placed outside of a reinforcement cage.

.4 Is discontinuous.

.3 All defective waterstop must be removed and replace at no additional cost to the Owner.

END OF SECTION

PART 1 GENERAL

1.1 SCOPE OF WORK

.1 Work supplied under this section includes the supply, testing and installation of cast-in-place concrete.

1.2 RELATED SECTIONS

.1 Section 03 10 00 – Concrete Forms and Accessories

.2 Section 03 20 00 – Concrete Reinforcement

.3 Section 03 25 20 – Waterstops

.4 Section 03 36 10 – Concrete Floor Hardeners

.5 Section 03 60 00 – Grout

.6 Section 05 50 00 – Metal Fabrications

.7 Section 07 11 00 – Sheet Waterproofing Membrane

.8 Section 07 90 00 – Joint Sealants

1.3 REFERENCES (LATEST EDITION AT THE TIME OF TENDER)

.1 Ontario Building Code (OBC) 2012 with latest amendments

.2 National Building Code of Canada (NBC) 2015

.3 Canadian Standards Association (CSA):

.1 CSA A23.1-24/A23.2-24 – Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete

.2 CSA A23.3-19 – Design of Concrete Structures

.3 CAN/CSA A3000-23 - Cementitious Materials Compendium

.4 CSA A23.2-21C-24 – Test Method for Length Change of Hardened Concrete

.5 CSA S900.2-21 – Structural Design of Wastewater Treatment Plants

.4 American Concrete Institute (ACI):

.1 ACI 207.1-21 - Guide to Mass Concrete

.2 ACI 207.4-20 - Cooling and Insulating Systems for Mass Concrete

.3 ACI 212.3-16 – Report on Chemical Admixtures for Concrete

.4 ACI 214R-11 - Guide to Evaluation of Strength Test Results of Concrete

.5 ACI 237R-07 – Self Consolidating Concrete

.6 ACI 350-20 - Code Requirements for Environmental Engineering Concrete Structures and Commentary

.7 ACI 350.1-22 - Specification for Tightness Testing of Environmental Engineering Concrete Structures (SI)

.5 American Society for Testing and Materials (ASTM):

.1 ASTM C39-24 - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

.2 ASTM C157-17 - Standard Test Method for Length Change of Hardened Hydraulic-Cement Mortar and Concrete

.3 ASTM C260/C260M-10a – Specification for Air-Entraining Admixtures for Concrete

.4 ASTM C309-19 - Specification for Liquid Membrane-Forming Compounds for Curing Concrete

.5 ASTM C494/C494M-15 - Specification for Chemical Admixtures for Concrete

.6 ASTM C666/C666M-15 – Standard Test Method for Resistance of Concrete to Rapid Freezing and Thawing

.7 ASTM C1017/C1017M-13e1 - Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete

.8 ASTM C1202-22 – Standard Test Method for Electrical Indication of Concrete's Ability to Resist Chloride Ion Penetration

.9 ASTM C1611-21 – Standard Test Method for Slump Flow of Self-Consolidating Concrete

.6 BS EN 12390-8-19 – Testing hardened concrete depth of penetration of water under pressure.

.7 USA-CE CRD C48-92 – Standard Test Method for Water Permeability in Concrete

.8 Concrete Ontario – Environmental Product Declaration, Concrete Ontario Member Industry-Wide EPD for Ready-Mixed Concrete.

.9 Concrete Ontario - A Guideline for Specifying Low Carbon Ready Mixed Concrete in Ontario

.10 ISO 14025:2006 – Environmental Labels and Declarations – Type III environmental declarations – Principles and Procedures

1.4 MEASUREMENT AND PAYMENT

.1 The total volume of the Cast-in-Place concrete will not be measured and the work will be paid for at the price included in the Form of Tender for this section based on the percentage of the work completed.

.2 Heating of water and aggregates and providing cold weather protection will not be measured but considered incidental to work.

.3 Cooling of concrete and providing hot weather protection will not be measured but considered incidental to work.

.4 Coordination with other trades for the supply of hardware, pipe sleeves, and other embedded materials including the related layout drawing and installation will not be measured but considered incidental to work.

.5 Supply and installation of waterstops, construction joints, and expansion joints will not be measured but considered incidental to work.

.6 Repair of all cracks will not be measured but considered incidental to work.

.7 Repair of any deficiencies in the concrete will not be measured but be considered incidental to work.

1.5 QUALITY ASSURANCE

.1 Performance of Concrete Mixes

.1 Concrete will be tested as identified in the mix performance part of this specification which includes Section 1.6.5 “Prequalification Test Results”, Section 1.6.6 “Trial Mixes” and Section 1.6.10 “Testing of Ready Mix Concrete”.

.2 Cracking of concrete in the structure is generally considered to be detrimental to the long-term performance. All cracks resulting in any visible leakage, and cracks greater than or equal to 0.3 mm must be repaired. Even though “low shrinkage concrete” is specified, cracking will occur and must be repaired by the Contractor at no cost to the Owner.

.2 Concrete Production Facility

.1 The concrete production facility shall meet industry standard programs meeting plant and truck certifications with an ECO certification status in accordance with the RMCAO (Ready Mixed Concrete Association of Ontario).

1.6 SUBMITTALS

.1 All submittals to conform with Section 01 33 00 - Submittals.

.2 Submit a current, valid Certificate of Ready Mixed Concrete Production Facilities as issued by RMCAO for plants supplying concrete to the Contract.

.3 Submit certification that ready mix concrete manufacturer has current qualification for RMCAO Seal of Special Quality Concrete.

.4 Certification of Materials and Concrete Producer statements identifying the sources and certifying:

.1 Cement types, sources, and conformance to CSA A23.1/A23.2 and CAN/CSA-A3000

.2 Aggregates comply with CSA A23.1/A23.2 and are from M.T.O. designated sources list; submit gradations.

.3 Admixture product names and certification that they comply with CSA A23.1/A23.2 and ASTM C260, ASTM C494/C494M, or ASTM C1017/ C1017M. State type or class of admixture.

.4 Materials, plant, and equipment to be used in concrete work comply with the requirements of CSA A23.1/A23.2.

.5 Compliance with Ontario Water Resources Act with respect to toxicity.

.6 Proposed mix designs including complete details of product additives and certification that all additives are compatible with all other additives.

.5 Prequalification Test Results

.1 Submit prequalification test results to the Engineer for each Ready-Mix Concrete Mix proposed, showing adequate performance for:

.1 Compressive strength

.2 The standard deviation for the concrete compressive strength tests in conformance with ACI 214R.

.3 Linear shrinkage

.4 Air entrainment

.5 Chloride Ion Penetrability

.6 Crystalline Formation

.2 Prequalification tests must have occurred within three (3) months of the first structural concrete pour or they will not be considered valid.

.3 Submit test results from each trial mix confirming concrete strength, air-content and linear shrinkage. Submit one (1) linear shrinkage test result for each structural concrete mix for all HPC mixes. Linear shrinkage tests must be current to within three (3) months of project commencement. The tested concrete must contain all materials that will be supplied to the site and be from the batch plant that will supply the site.

.4 Adjust mixes that do not provide adequate performance, retest and resubmit the test results as noted above.

.6 Trial Mixes

.1 Prior to the start of on-site concrete construction of any structure, prepare trial mixes of each structural concrete mix design to confirm the mix-design satisfies the performance and workability requirements. The test for the workability of the mix must involve a full truckload of the proposed concrete mix, transported from the truck, placed and consolidated in an area of the Contractor’s choosing, using the proposed conveyance system. Trial mixes and related workability proof testing must have

occurred within three (3) months of the first concrete pour or they will not be considered valid.

.2 Trial mixes will be tested for slump, concrete strength, air-content, wet cast density and linear shrinkage by an independent testing agency arranged by the Owner.

.7 Submit Type III Environmental Product Declarations (EPD), verified under ISO 14025, showing Global Warming Potential (GWP) of all specified concrete materials.

.8 After review and acceptance of the mix designs, supply concrete in accordance with the reviewed mixes.

.9 Concrete Work Plan

.1 Prior to the start of on-site concrete construction, prepare a concrete work plan in accordance with the requirements in section 3.2.1.4 and 3.2.2.2, including concrete mix production, concrete placing procedures and casting sequence, and curing and protection procedures.

.2 For mass concrete placement, provide a thermal control plan following requirements of CSA A23.1 clause 7.6.3.

.3 Submit the work plan to the Consulting Engineer for approval at least 10 days prior to the pre-construction concrete meeting as outlined in clause 3.2.1.

.10 Testing of Ready-Mix Concrete

.1 Testing will be performed by an independent testing agency arranged by the Owner.

.2 Testing of Ready-Mix Concrete trucks on delivery will include:

.1 Slump

.2 Air content

.3 Concrete temperature

.4 Wet cast density

.3 Samples will be cast for laboratory testing for:

.1 Compressive strength

.2 Linear shrinkage as requested by the Engineer.

.4 Initially 3, 7, 14, and 2-28 day cylinder samples (one set) will be taken and tested. However, upon achieving acceptable results the testing will be reduced to 7 and 2-28 day tests. Where design strengths are based on 56 days, 2-56 day cylinder samples are required.

.5 A set of Concrete cylinder samples and wet cast density shall be tested once per pour or once every 100 m^3, whichever is more frequent.

.6 Concrete slump, air, and temperature shall be tested once per pour or once every 50 m^3, whichever is more frequent.

.7 Additional samples may be taken for other testing as determined by the Engineer.

.8 Copies of all concrete testing carried out by the Engineer will be made available to the Contractor upon request.

.9 The use of testing services does not relieve the Contractor of the responsibility to furnish materials and construction in compliance with the performance requirements of the contract documents.

.10 The Contractor shall take samples and carry out testing as part of their quality control procedures to verify that the concrete satisfies the performance requirements set out in these specifications. Where possible, these tests shall be carried out on the same batches as tested by the independent testing agency.

.11 Copies of the test results for all tests carried out by the Contractor must be made available to the Engineer for review and records.

.11 Pour Sequence Plan

.1 Submit pour sequence plan showing location of the proposed construction joints.

.2 Location of construction joints shall be coordinated with Section 03 20 00 – Concrete Reinforcement, to produce reinforcement shop drawings.

.12 Hydrostatic Leak Test Plan

.1 Submit hydrostatic leak test plan outlining procedures of performing a leak test for each liquid-containing tank and in accordance with ACI 350.1.

PART 2 PRODUCTS

2.1 MATERIALS FOR CONCRETE MIXES

.1 Use materials conforming to CSA A23.1/A23.2, and to the performance requirements which have been established in this section.

.2 Cement

.1 Normal Portland Cement (Type GU) blended with cementitious slag. Use Portland cement and Slag cement conforming to CSA A3000 and comply to the following conditions and requirements:

.1 For structural and architectural concrete mixes, the supplier may incorporate cementitious slag into the proposed mix design as a replacement for up to 50 percent by mass of the quantity of Type GU Portland cement.

.2 For lean concrete, slag cannot be used to replace any of the Portland cement.

.3 For mass concrete, HVSCM concrete may be used.

.3 Water

.1 Use only potable water in all concrete mixes.

.4 Additives

.1 Conform to CSA A23.1/A23.2 and ASTM C260, ASTM C494/C494M. State type or class of admixture.

.2 Use admixtures from one manufacturer and satisfy the intent and, where practical, the specific recommendations of that manufacturer.

.3 Ensure admixtures are compatible with each other and with any construction materials used that will be in contact with concrete. Ensure that the mix remains workable with the inclusion of such admixtures.

.4 Do not use calcium chloride nor admixtures containing chlorides.

.5 Shrinkage Reducing Admixture (not covered by CSA or ASTM standards).

.1 A shrinkage reducing admixture shall be used in all topping mixes and in elements with thickness of 125 mm or less.

.2 A shrinkage compensating admixture may be used where appropriate or as necessary to meet linear shrinkage testing requirements specified herein.

.6 Integral Crystalline Waterproofing Admixture: Permeability-reducing admixture for hydrostatic conditions (PRAH) as defined by ACI 212.3 Chapter 15; Provide as a powdered waterproofing admixture for use in ready-mix concrete.

.1 Permeability:

.1 When tested to BS EN 12390-8 at 0.5 MPa (72.5 psi) for 72 hours, permeability of treated concrete will be reduced by 70% over untreated concrete. When tested to BS EN 12390-8 at 0.5 MPa (72.5 psi) for 72 hours, permeability of treated concrete will be reduced by 70% over untreated concrete.

.2 When using the Taywood / Valenta method of testing to modified BS EN 12390-8 at 1 Mpa (150 psi) for 96 hours and then measuring and calculating the coefficient of permeability, the permeability of treated concrete will be reduced by a minimum of 70% over untreated concrete.

.3 When tested to USACE CRD C48, no passage of water through treated samples when exposed to a vertical water head equal to 200 psi (460 foot head pressure) for 14 days.

.2 Compressive Strength: Treated concrete must have compressive strength equal or higher than plain concrete when tested to ASTM C39/C39M at 28 days.

.3 Drying Shrinkage: Minimum 20% reduced drying shrinkage for treated concrete when tested to ASTM C157.

.4 Self-Sealing: Autogenous crack sealing of treated concrete for cracks with width of 0.4mm or greater; verified by independent testing.

.5 Chemical Resistance: The waterproofing admixture shall improve sulphuric acid resistance of cement-based materials by blocking capillary pores to reduce acid penetration.

.6 Corrosion of Reinforcing Steel: The waterproofing admixture shall provide enhanced corrosion resistance to embedded steel such that no noticeable signs of corrosion shall be evident after 10 years exposure to corrosive environment.

.7 Acceptable products: Krysol Internal Membrane, Concentrate C500 by Xypex Chemical Corporation., Penetron Admix SB by Penetron, or Agency Approved Equal.

.5 Aggregate

.1 Starter grout wall mixes to be placed at the bottom all large wall pours to have no large aggregate.

.2 All mixes for concrete elements with thicknesses of 125 mm or less shall contain 14 mm aggregate.

.3 Mixes for mass concrete may contain aggregate sizes up to 40 mm.

.4 Use 20 mm aggregate in the remainder of the mixes, unless approved or otherwise specified by the Engineer.

2.2 CONCRETE MIXES

.1 Supply concrete to meet the project performance requirements. Structural Concrete specified herein is required to be “High Performance Concrete” for increased durability and watertightness, and reduced shrinkage and cracking, compared to regular structural concrete.

.2 The high performance concrete mix shall be manufactured under the requirements of Clause 8.8 “Low Shrinkage Concrete” of CSA A23.1/A23.2 which include a shrinkage limit of 0.04% based on modified CSA A23.2-21C.

.3 This is considered to be a Performance Specification in accordance with CSA A23.1/A23.2 - Table 5 Alternative Methods for Specifying Concrete.

.4 Lightweight concrete mix shall be manufactured in accordance with ACI 523.1R.

.5 Meet or exceed the requirements in the following tables:

CAST-IN-PLACE CONCRETE

Mix Number	1	2	3	4
Mix Description	HPC Raft slabs, walls, and columns	Starter grout for structural walls & columns	HPC Toppings, screeds, benching for tankage, int./ext. floors or roofs & thin concrete sections	HPC Suspended Slabs and Beams
Special Performance	Low Shrinkage		Low Shrinkage	Low Shrinkage
Min. Specified Strength, 28 days	30 MPa	30 MPa	30 MPa	30 MPa
Min. Specified Strength, 56 days	35 MPa	35 MPa	35 MPa	35 MPa
Max. Aggregate Size	20mm	N/A	14mm	20mm
Slump Range (see 2.2.7)	120-180	120-180	-	120-180
SCM	Max. 50% slag	Max. 50% slag	Max. 50% slag	Max. 50% slag
Max. W/C Ratio	0.40	0.45	0.40	0.40
CSA Exposure Class	A-1	A-2	A-1	A-1
Plastic Air Range (%)	5-8	-	5-8	-
Additives	Super plasticizer admixture and shrinkage reducing admixture	Super plasticizer admixture	Super plasticizer admixture, and shrinkage reducing admixture	Super plasticizer admixture

Mix Number	5	6	7	8
Mix Description	HPC Wall with crystalline admixture	HPC Mass Concrete	Mud slabs, & fill concrete	U-Fill for pipe bedding and backfilling
Special Performance	Low Shrinkage Watertight Low permeability	Low Shrinkage Low Heat of Hydration	-	-
Min. Specified Strength @ 28 days	30 MPa	30 MPa	20 MPa	0.4MPa max. as per OPSS. MUNI 1359
Min. Specified Strength, 56 days	35 MPa	35 MPa	-	-
Max. Aggregate Size	20mm	40mm	14mm	-
Slump Range	120-180	120-180		Min 150 mm
SCM	Max. 50% slag	Max. 75% slag	-	-
Max. W/C Ratio	0.40	0.40	0.5	-

Mix Number	5	6	7	8
Mix Description	HPC Wall with crystalline admixture	HPC Mass Concrete	Mud slabs, & fill concrete	U-Fill for pipe bedding and backfilling
CSA Exposure Class	A-1	A-1	N	-
Plastic Air Range (%)	5-8	4-7	-	-
Additives	Super plasticizer admixture, shrinkage reducing and crystalline admixture	Super plasticizer admixture, set retarder and shrinkage reducing admixture	-	-

.6 HPC herein means high performance concrete with reduced shrinkage, reduced cracking and increased durability.

.7 Final selection of slump for each mix is the responsibility of the contractor to suit specific site needs for workability and finishing.

.8 Super plasticizer admixture to be added to the mix at the batching plant. Additional superplasticizer may be added on site to meet the workability requirements of the Contractor placing the concrete in accordance with the manufacturers published recommendations.

.9 For mass concrete, proportion mix to reduce the heat of hydration. When HVSCM concrete is used, follow the requirements of this specification and CSA A23.1/A23.2, whichever is more stringent.

.10 Utilize the same mix proportions throughout the project.

.11 Where the performance of a mix deteriorates to values below the Contract requirements, cease supply of the mix. Re-evaluate the mix, propose revised proportions to meet the performance requirements for the mix, submit trial mix results, and after review, utilize the revised mix.

2.3 MATERIALS FOR CRACK INJECTIONS

.1 Epoxy Grout Injection

.1 Acceptable products include:

.1 Sikadur 35 Hi-Mod LV

.2 Sikadur 52

.3 MasterInject 1500, by BASF Master Builders Solutions

.4 or an approved equal

.2 Flexible Polyurethane Grout Injection

.1 Acceptable products include:
- .1 Sika Fix PU LV
- .2 Sika Fix PU
- .3 MasterInject 1210 IUG, by BASF Master Builders Solutions
- .4 or an approved equal

.2 Polyurethane Sealant
- .1 Sikaflex 2C NS, NSF/ANSI 61 approved
- .2 MasterSeal NP2, by BASF Master Builders Solutions
- .3 or an approved equal

.3 No crack injections shall be carried out without the approval of the Engineer.

2.4 POLYETHYLENE SHEETS

.1 Polyethylene Slip Sheet – 15 mil polyethylene sheet satisfying ASTM E1745 CLASS 'A'.

.2 Curing Membrane – 6 mil polyethylene sheet

.3 Curing Compounds - The curing compound, if permitted by the engineer, shall conform to the requirements of ASTM C309.

2.5 MISCELLAENOUS MATERIALS FOR JOINTS

.1 Preformed Joint Fillers – See Section 03 10 00 – Concrete Forms and Accessories.

.2 Bond Breakers - 810-07 Non-Fibered Asphalt Roof and Foundation Coating by Henry Company Canada Inc.

.3 Expansion joint sealant – SikaFlex 2C NS or approved equivalent.

.4 Bonding Agent - SikaTop Armatec110 EpoCem or approved equivalent.

.5 For sealants on saw cut joints, refer to Section 07 90 00 – Joint Sealants.

2.6 TEMPERATURE MONITORING EQUIPMENT

.1 Temperature monitoring equipment shall provide continuous temperature monitoring.

.2 Real-time monitoring data shall be made available to consultant and contractor.

.3 Monitoring temperatures shall be directly recorded and sent to the monitoring manufacturer program where reports are being generated.

.4 User-friendly mobile app or computer interface shall be provided with location of sensors clearly identified at the interface.

.5 Data logs shall be available for downloading as PDFs for record keeping.

PART 3 EXECUTION

3.1 STANDARD OF WORKMANSHIP

.1 Comply with CSA A23.1/A23.2.

.2 Undertake all aspects of the Work to meet watertight requirements.

3.2 PREPARATION

.1 Preconstruction Concrete Meeting

.1 Prior to concrete construction, hold a meeting to discuss all design requirements and any potential production or construction issues to avoid delays during the implementation of the works.

.2 Have representatives of every party involved in the concrete work attend the meeting, including but not limited to the following:

.1 Contractor’s superintendent

.2 Concrete subcontractor’s Foreman and Cement Finisher

.3 Ready-mix concrete producer

.4 Admixture manufacturer(s)

.5 Laboratory responsible for the concrete design mixes and trial mixes

.6 Concrete pumping subcontractor, if applicable

.3 The representative of the Owner, the Engineer and the Independent Laboratory responsible for field quality control will also attend the meeting. Coordinate with the Engineer at least 10 days prior to the scheduled date of the meeting.

.4 Provide a description of the intended procedures and Quality Assurance for:

.1 Concrete mix production, delivery and discharge

.2 Concrete trial mix testing and results submissions

.3 Concrete mix testing including storage facilities provided by the Contractor and procedures

.4 Formwork construction and alignment

.5 Installation of Formliners and waterstops

.6 Concrete handling, pumping, and placement

.7 Concrete finishing

.8 Curing procedures

.9 Concrete protection in hot, cold or windy weather

.10 Watertightness

.11 Mass concrete procedures

.5 Ensure that each party's interests are discussed, and procedures refined to provide optimum concreting practices for this project.

.6 Distribute minutes of the meeting to all parties present and with related individuals within five (5) days of the meeting.

.7 Ensure that procedures established and agreed at this meeting are carried out during construction.

.8 If additional procedures are required, meet again, discuss, develop, submit and follow the revised procedures.

.2 Pre-planning Requirements

.1 Two weeks (14 calendar days) prior to placing of concrete, obtain Engineer's approval of the proposed method for the protection of the concrete during placing and curing.

.2 Submit the proposed sequence of casting for review by the Engineer including the location of the proposed construction joints. Where possible sequence the casting schedule so that walls are cast as soon as possible after their supporting footings or slabs are cast.

.3 Complete and submit the Concrete Pour Release Form prior to placing any concrete.

.4 Provide three (3) working days' notice of the proposed time of commencing of concrete placement. The Contractor will be responsible for the Engineer's testing companies standby time costs in the event a concrete pour does not commence within 90 minutes of the proposed time indicated in the three (3) day notice.

.5 Ensure reinforcement and inserts are not disturbed during concrete placement.

.6 Coordinate with the concrete supplier with respect to the workability requirements for the concrete. Do not add water to the concrete after the initial batching unless approved by the Engineer, and the concrete supplier. If approval is granted, a record of the amount of water added must be kept and a copy submitted to the Engineer within three (3) days for their records.

.7 Establish and maintain accurate records of poured concrete items to indicate date, location and size of pour, air temperature, concrete temperature, previously placed concrete temperature, batch ticket and test samples taken.

.8 Do not place load upon new concrete until authorized by the Engineer.

3.3 SUMMER CONCRETING

.1 Between June 1st and September 30th, except when the air temperature is below 3ºC and winter concrete requirements dictate, the Contractor must prepare and submit their procedures for curing the concrete based on and to suit the ambient

conditions anticipated during the curing period. Most cracking is a result of excessive water content in the concrete, rapid drying and thermal effects that including thermal shock during or shortly after the removal of the formwork, ambient conditions or shape considerations. The requirements are designed to minimize those effects and, thereby, to minimize the cracking of the concrete.

.2 The maximum temperature of the concrete delivered to the site must be maintained at or below 26ºC. This may require the addition of ice to the mix at the Ready Mix Concrete Plant. An amount of water, equivalent to the volume of the ice, must be removed from the mixing water.

.3 For each pour exceeding 20 m^3 provide and install temperature probes to measure the temperature of the concrete. The probes must be installed to measure the temperature of the concrete, 150 mm below the surface, at two (2) locations for each day of placement or type of concrete, locations to be established by the Engineer. These probes shall be used to measure the temperature of the concrete prior to the removal of the forms. In addition, the probes shall be maintained to establish the temperature of that concrete when new concrete is placed against it. The probes must be of a type that will record the temperature continuously and will allow for the downloading of that data.

.4 For formed structures: The forms for walls, columns and related structures and for suspended slabs shall remain in place for a minimum period of seven (7) days after placing the concrete. If the temperature differential between the concrete and the ambient air is greater than 10ºC, the forms shall remain in place until the temperature differential is less than 10ºC. Immediately after the removal of a form, the concrete shall be thoroughly wetted down and be covered with a 6 mil polyethylene sheet or equivalent and this sheet shall remain in place for a minimum of seven (7) days.

.5 For slabs: Slabs must be misted during the placing and finishing work. After the finishing has been completed, the slab must be flooded and be covered completely with tarpaulins for seven (7) days. When temperatures are above 30ºC the slab must be covered for a total of 14 days.

.6 The surface of slabs, against which new concrete is to be placed, shall be cooled using intermittent wetting techniques and the temperature shall not be more than 5ºC greater than the new concrete at the time of placing the new concrete.

.7 The use of curing compounds is not to be considered normal practice and the use will be at the discretion of the Engineer. Curing compound shall be applied immediately after the removal of the forms for walls and similar structures. In addition, its use may be considered for slabs after the initial seven (7) day curing period has been completed.

3.4 WINTER CONCRETING

.1 Between October 1st and May 31st of the following year, and at any time when the air temperature is below 3ºC, or when, in the opinion of the Engineer, there is a

probability of its falling to that limit during the placing period, place concrete in accordance with the requirements of CSA A23.1/A23.2, "Cold Weather Requirements".

.2 The temperature of the concrete, when deposited, shall not be less than 10ºC and not more than 25ºC. To accomplish this, the mixing water and, if necessary, the aggregates, shall be heated. Aggregates shall not be heated above 85ºC.

.3 For each pour exceeding 20m^3 provide and install temperature probes to measure the temperature of the concrete. The probes must be installed to measure the temperature of the concrete 150 mm below the surface at two (2) locations per day of placement and type of concrete, locations to be established by the Engineer. These probes shall be used to measure the temperature of the concrete prior to the removal of the forms. In addition, the probes shall be maintained to establish the temperature of that concrete when new concrete is placed against it. The probes must be of a type that will record the temperature continuously and will allow for the downloading of that data by the Engineer.

.4 The temperature difference between concrete being placed and the concrete against which it is placed is of primary importance during winter concreting. The temperature of the base concrete, measured 150 mm below the contact surface, must be within 5ºC of the concrete being placed against it, but no lower than 5ºC. The Contractor, to satisfy this requirement, must provide a 5000 mm wide underslab heating system. This system must:

.1 Be continuous along the full length of the wall.

.2 Heat the slab from bottom up.

.3 Include insulated tarpaulin placed on the slab over the area which is to be heated.

.4 Meet the above temperature requirements before the new concrete is placed.

.5 Be left in operation for at least 72 hours after the new concrete has been placed.

.6 Include the insulated tarpaulins being left in place over the heated area until the forms are removed.

.5 If uninsulated metal forms are to be used or if the temperature within the form falls below -5ºC prior to placing the concrete, an insulated cover must be provided over the formwork and heat must be provided to raise the temperature to +5ºC before pouring the concrete. All snow or ice must be removed from the form prior to placing the concrete. Insulated cover and heat must remain in place for the cure period.

.6 The forms for walls, columns and suspended slabs shall remain in place for a minimum for seven (7) days after placing the concrete. Additional protection is to be provided as per 3.4.7.

.7 The temperature of the concrete shall be monitored and when the form is to be removed, the temperature differential between the concrete and the ambient conditions shall be recorded and:

.1 If the temperature differential is less than 10ºC and the winds is less than 20 km/h, the forms must be left on for seven (7) days and when they are removed, the concrete must be covered tightly with a 10 mil polyethylene sheet or suitable new tarpaulin. The covering must remain in place for a minimum of seven (7) days.

.2 If the temperature differential is 10ºC or greater, the forms cannot be removed. Once the temperature differential is less than 10ºC follow clause 3.4.7.1.

.8 If an enclosure is required to meet the requirements of clauses 3.4.1 through 3.4.7, provide an enclosure.

.1 The enclosure shall be kept between 10ºC and 18ºC for a minimum period of seven (7) days after placing the concrete. The temperature shall be gradually reduced at the end of the period of protection at a rate not greater than 10ºC per day until the outside ambient temperature is reached.

.2 Combustion type heaters may be used but they shall be constructed and placed so that their combustion gases are not directed toward the surfaces of the “green” concrete.

.9 Slip forming: curing and form removal in accordance with CSA A23.1/A23.2 for curing type 2.

3.5 MASS CONCRETE:

.1 Permissible concrete temperature at placement shall follow the limits indicated in Table 14 of CSA A23.1.

.2 In summer months, the concrete temperature at placement shall not be less than 10ºC and not more than 15ºC.

.3 Provide and install two (2) temperature probes to measure the temperature of the concrete per pour for base slabs. One probe to be located at 75 mm from the surface and the other to be located at the mid-depth of the concrete thickness at locations established by the Engineer. These probes shall be used to measure the temperature differential between the concrete core and the near surface and limit the maximum differential following CSA A23.1 clause 7.6.3.2. Provide additional pairs of temperature probes such that the spacing does not exceed more than 10.0 m each way. For walls, provide three (3) temperature probes at each location (inside face, outside face and mid-depth).

.4 The installed temperature probes shall also be used to measure the temperature of the concrete prior to the removal of the forms. In addition, the probes shall be maintained to establish the temperature of that concrete when new concrete is

placed against it. The probes must be of a type that will record the temperature continuously and will allow for the downloading of that data by the Engineer.

.5 Once surface is finished, provide and install insulated tarpaulins to completely cover and seal the mass concrete pour. Maintain moisture on surface with a soaker hose and burlap under the insulated tarpaulins.

.6 Insulated tarpaulins are to remain in place for a minimum of seven (7) days after placing the concrete. If the temperature differential between the concrete, taken from the probes, and the atmospheric air temperature is greater than 5ºC, the forms and insulated tarps shall remain in place until the temperature differential is less than 5ºC.

3.6 CONSTRUCTION

.1 Do cast-in-place concrete work in accordance with CSA A23.1/A23.2.

.2 At construction joints, all loose debris/items must be removed/cleaned and laitance must be mechanically removed from the face of concrete from previous castings and the joint shall be saturated surface dry before adjacent concrete is placed.

3.7 CONCRETE PLACEMENT

.1 Concrete be deposited in the forms in manner that prevents segregation and, in a location, as close as practicable to its final position.

.2 Concrete is not to be moved laterally with the use of vibrators.

.3 Maximum free drop of concrete into forms is 1.5m. Use of smooth pipe or 6” elephant trunk may be required in some narrow walls, or use of form windows may be needed to get access to place and vibrate the concrete.

.4 The rate of placing shall be such that each successive lift can be vibrated into the previous lift for proper bonding, without cold joints, but time between lifts is not to exceed 2 hours unless set retarders are used.

.5 Total depth of plastic concrete shall never exceed that limited by the formwork design.

3.8 VIBRATORS

.1 The use of mechanical vibrators is required for all structural concrete.

.2 A sufficient number of vibrators shall be employed so complete compaction is ensured.

.3 At least one (1) extra gasoline powered vibrator shall be on hand for emergency use.

.4 Vibration shall not be continued to the extent that water forms on the surface.

.5 Avoid any disturbance to concrete that has become too stiff to regain plasticity when vibrated.

.6 Vibration shall not be applied directly to steel which extends into partially hardened concrete.

3.9 SLEEVES AND INSERTS:

.1 No sleeves, ducts, pipes, or other openings shall pass through joists, beams, column capitals or columns, except where indicated or approved by the Engineer.

.2 Where approved by the Engineer, set sleeves, ties, pipe hangers, and other inserts and openings as indicated or specified elsewhere. Sleeves and openings greater than 100 mm x 100 mm not indicated, must be approved by the Engineer.

.3 Do not eliminate or displace reinforcement to accommodate hardware. If inserts cannot be located as specified, obtain approval of modifications from the Engineer before placing of concrete.

.4 Check locations and sizes of sleeves and openings shown on drawings.

.5 Sleeves and openings shall be placed at a minimum of three sleeve diameters centre to centre unless noted otherwise.

.6 Box out for penetrations are not permitted, unless agreed to in writing from the Engineer. If requested by the contractor, additional reinforcement and waterstops will be required to compensate for the construction of the box out. Supply and install of these additional reinforcements and waterstops shall be at no additional cost to the Owner.

.7 Anchor Rods:

.1 Set anchor rods to templates under supervision of appropriate trade prior to placing concrete.

.2 Protect anchor rod holes from water accumulations, snow, and ice build-ups.

.3 When using proprietary anchor systems set rods and fill holes with epoxy grout, in accordance with the manufacturer’s requirements. All proprietary anchors must be approved by the Engineer.

.4 Locate anchor rods used in connection with expansion shoes, rollers, and rockers with due regard to ambient temperature at time of erection.

.5 Under special circumstances, with approval of the Engineer, grouted anchor rods may be installed into preformed holes or holes drilled after

concrete has set. Formed holes or sleeves to be minimum 100 mm diameter and be deformed.

.8 Drainage Holes and Weep Holes:

.1 Form weep holes and drainage holes in accordance with Section 03 10 00 – Concrete Forms and Accessories. If wood forms are used, remove them after concrete has set.

.2 Install weep hole tubes and drains as indicated.

3.10 COORDINATION:

.1 Adjust the work to suit final shop drawings of the equipment being supplied. Verify all sizes with the trade supplying and installing the equipment. Obtain, utilize and submit data on relevant sizes to suit any change in equipment. Confirm the adjustments with the Engineer.

3.11 GROUTING:

.1 Grout to be placed in accordance with grout specification Section 03 60 00 - Grout. Grout under base plates and/or machinery using procedures in accordance with manufacturer's recommendations that result in 100 percent contact over grouted area. Install bleed holes in base plates to ensure full coverage of grout.

3.12 SLIP-SHEET:

.1 Install polyethylene slip-sheet under mud-slab for all the concrete slabs cast against grade as indicated on the drawings.

.2 Lap slip-sheet a minimum of 300 mm at joints and seal.

.3 Seal punctures in slip sheet before placing concrete. Use patching material at least 300 mm larger than puncture and seal.

3.13 CURING COMPOUNDS:

.1 Curing compounds are not be used in structural concrete without prior written approval by the Engineer.

3.14 STARTER WALLS:

.1 A grout starter layer of concrete, 100 mm must be provided at the base of all walls.

3.15 FINISHES

.1 Formed finishes specified herein shall be finished as defined by CSA A23.1/A23.2.

.1 The surfaces exposed to view shall be given a smooth form finish with sack-rubbed finish.

.2 Interior surfaces of tanks including the portion of those structures above the high water level to the top of the structure, shall be given a smooth form finish with a “sack-rubbed” finish.

.3 All buried surfaces shall be given a rough form finish. All buried surfaces that receive waterproofing to have all voids and bugholes filled.

.4 For exposure type A-1 concrete, all bugholes shall be filled.

.5 All exposed and non-exposed corners shall be rubbed with a carborundum stone to remove any loose concrete fins and edges and to create a smooth and rounded profile.

.2 Unformed surfaces shall be finished as defined by CSA A23.1/A23.2.

.1 The floor surface of occupied spaces shall be “floated” and “trowelled” to create a Class A Floor finish as defined by Table 21 in CSA A23.1/A23.2.

.2 The floor surface of exterior or interior walkways and tankage or chambers, shall be “swirl trowelled” to create a non-slip surface.

.3 All tops of buried structures and foundations shall be finished by steel float to a sealed smooth surface.

.4 All surfaces to receive waterproofing membrane shall be finished as per manufacturers recommendations.

.5 All surfaces to receive coatings shall be prepared as per coating manufacturer’s recommendation.

3.16 EXAMINATION OF COMPLETED STRUCTURES

.1 Undertake, with the Engineer, review of concrete surfaces for defects and finishes.

.2 Undertake, with the Engineer, assessments and measurements of the concrete structures for cracking.

.3 Provide a written summary of defects noted complete with a plan showing locations of each defect.

.4 Submit a plan for repair of each defect in accordance with these specifications.

.5 Undertake, with the Engineer, to test all liquid containing structures for watertightness in accordance with applicable standards.

.6 Test for water tightness in accordance with ACI 350.1. All chambers, channels, and tanks to be tested separately as open containment structures classified as “Other types”.

.7 Leak test duration requirements shall be based on part 1 and 2 of the test, refer to ACI 350.1 Section 1 and Section 2 for more information.

.8 Completed concrete tank may be leak tested when the specified compressive strength has been reached and/or when the age of the last concrete pour is minimum 14 days old, whichever is the longest.

3.17 PATCHING OR REPAIRS

.1 No patching or repairing shall be carried out without the approval of the Engineer.

.2 All preparation for repairs is to be reviewed by the engineer.

.3 All patches, bug holes, and suspected honeycomb are to be reviewed by the engineer prior to patching.

.4 All repairs shall be colour matched to the parent concrete.

.5 Surface defects such as honeycombing, sand streaking, lift lines, variations in colour, soft areas, and large surface voids in the finished concrete walls shall be considered defective and shall be repaired by the contractor at no additional cost to the Owner, regardless of structural or water retaining characteristics of the wall. Provide a methodology to repair all visible pour lines, for submission and approval by the Consultant.

.6 All bug holes to be filled for concrete mixes with exposure classes of A-1 at no additional cost to the Owner.

.7 All honeycombing shall be chipped out to sound concrete. The edge around the perimeter of the area shall be sawcut to a depth of 20 mm minimum to eliminate all “feather” edges. All repairs of honeycomb shall be a proprietary repair material. If honeycombing extends to the depth of the reinforcement, the chipping shall be continued to a depth of 1.4 times the diameter of the largest reinforcing bar and 40 mm minimum beyond the layer of reinforcement.

.8 The patch shall be continuously covered with a 6 mil polyethylene sheet and heated to above 15ºC for 14 days.

.9 Chips and edge breaks in the concrete shall be repaired as noted above.

.10 All visible cracks in liquid retaining structures shall be repaired. Submit a detailed plan and details for review by Engineer before beginning any repair or injection. As the standard repair methodology, unless otherwise approved by the Engineer, cracks shall be injected with epoxy or polyurethane, depending on the application. Clean face of concrete after injection is complete.

.11 Prior to the leak test all visible cracks are to be repaired by epoxy injection.

.12 During the leak test, minor visibly leaking cracks may be repaired with polyurethane grout upon approval of the Engineer.

.13 In the event that injection cannot seal the leak, with the approval of the Engineer, the crack shall:

.1 be routed out square to a depth and width of 20 mm

.2 be thoroughly cleaned

.3 have a bond breaker placed in the bottom of the routed slot

.4 be primed in accordance with the manufacturers recommendations

.5 be sealed with a polyurethane sealant such as Sikaflex 2C NS EZ Mix by Sika Canada, or approved equal.

.6 Sealant shall be allowed to cure in accordance with the manufacturers written procedures.

.14 During the leak test, repair leaking cracks or joints in concrete containing waterproofing admixture. Follow waterproofing admixture manufacturer's written instructions and as follows:

.1 Chase the length of joints and cracks to a minimum depth of 40 mm. Provide rectangular-shaped chase that is deeper than wide.

.2 Use waterproofing admixture manufacturer's recommended waterstop plug to stop water leakage.

.3 Use waterproofing admixture manufacturer's recommended repair grout to completely fill the chase flush with adjacent surfaces.

.15 Rock Pockets, Honeycombing or other defective concrete: All areas of poor concrete consolidation (honeycomb or rock pockets) shall be repaired. Infill concrete with specialized repair mortar as required by the manufacturer or ready-mixed concrete dosed with waterproofing admixture as required by the manufacturer.

3.18 SITE TOLERANCES

.1 Concrete tolerance in accordance with CSA A23.1/A23.2.

.2 The Contractor shall survey the site and shall provide a drawing layout of the concrete work to be included in the "as built" drawings.

END OF SECTION

CONCRETE FLOOR HARDENERS

PART 1 GENERAL

1.1 SCOPE OF WORK

.1 Work supplied under this section includes the supply and application of concrete floor hardeners.

1.2 RELATED SECTIONS

.1 Section 01 33 00 – Submittals

.2 Section 03 30 00 – Cast-in-Place Concrete

1.3 REFERENCES

.1 Canadian Standards Association (CSA):

.1 CAN/CSA A23.1-19/A23.2-19 - Concrete Materials and Methods of Concrete Construction/Methods of Test for Concrete

1.4 PRODUCT DATA

.1 Submit the technical product data in accordance with Section 01 33 00 – Submittals.

.2 Include application instructions for concrete, hardener, curing compound and slip resistant coating.

.3 Submit Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Health and Safety Act.

1.5 ENVIRONMENTAL REQUIREMENTS

.1 Temporary lighting:

.1 Minimum 1200W light source, placed 2.5 m above floor surface, for each 40 m^2 of floor being finished.

.2 Electrical power:

.1 Sufficient electrical power to operate equipment normally used during construction.

.3 Work area:

.1 Watertight protection against rain and detrimental weather conditions.

.4 Temperature:

.1 Maintain ambient temperature of not less than 10ºC from seven (7) days before installation to at least 48 hours after completion of work and maintain relative humidity not higher than 40 percent during same period.

.2 Maintain substrate temperature at 10ºC minimum.

.3 Refer to manufacturer's recommendation for optimum application temperatures.

.5 Moisture:

.1 Ensure concrete substrate is within moisture limits prescribed by manufacturer.

.6 Safety:

.1 Comply with requirements of WHMIS regarding use, handling, storage and disposal of hazardous materials.

.7 Ventilation:

.1 Contractor to provide adequate ventilation during the application and curing of flooring compounds.

.2 Provide continuous ventilation during and after coating application.

PART 2 PRODUCTS

2.1 FLOOR HARDENER

.1 Liquid concrete floor hardeners.

.2 Acceptable suppliers:

.1 Sika Canada: Sikafloor 3S

.2 W. R. Meadows: Liqui-Hard

.3 CureCrete: Ashford Formula

PART 3 EXECUTION

3.1 EXAMINATION

.1 Verify that surfaces are clean and ready to receive work. Concrete must be a minimum of 28 days old and must be fully cured.

3.2 HARDENING

.1 Apply three (3) coats of liquid concrete surface hardener to manufacturer's specifications.

.2 Apply hardener evenly over the floor surface in one direction and scrub into the floor as per the manufacturer's instructions.

.3 Rinse the floor and remove any excess material as per the manufacturer's instructions.

.4 Comply with manufacturer's printed instructions for installation and curing.

3.3 PROTECTION

.1 Protect finished installation until floor treatment has completely cured.

END OF SECTION

STRUCTURAL PRECAST/PRE-STRESSED CONCRETE

PART 1 GENERAL

1.1 SCOPE OF WORK

.1 Design, supply, delivery and installation of:

.1 Pre-stressed hollow core slab units and pre-stressed double tee slab units, and precast stairs.

.2 This section includes product design, manufacture, anchorage, bearing pads, inserts and similar accessories required for work under this contract.

.3 Take delivery and cast into precast work boxes/inserts/openings required and supplied by other trades prior to casting.

.2 Supply information required for the installation of bracing, supports, inserts and similar accessories required for the work under this Contract supplied and to be installed by others.

1.2 RELATED SECTIONS

.1 Section 01 33 00 – Submittals

.2 Section 03 30 00 – Cast-in-Place Concrete

.3 Section 03 40 00 – Precast Concrete Wall Panels

.4 Section 05 50 00 – Metal Fabrications

.5 Section 07 72 00 – Roof Hatches

.6 Section 07 52 10 – Modified Bitumen Membrane (MBM) – Torch Applied Roofing

1.3 REFERENCE STANDARDS

.1 Canadian Standards Association (CSA):

.1 CSA A23.1-19/A23.2-19 - Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete

.2 CAN/CSA A23.3-19 - Design of Concrete Structures

.3 CSA A23.4-16 (R2021) - Precast Concrete-Materials and Construction

.4 CSA A283-19 - Qualification Code for Concrete Testing Laboratories

.5 CAN/CSA G30.18-09 (R2019) - Carbon Steel Bars for Concrete Reinforcement

.6 CSA G40.20-13/G40.21-13 (R2018) - General Requirements for Rolled or Welded Structural Quality Steel / Structural Quality Steel

.7 CSA W186-M1990 (R2016) - Welding of Reinforcing Bars in Reinforced Concrete Construction

.8 CSA W47.1-09 (R2019) - Certification of Companies for Fusion Epoxy-Coated Reinforcing Steel Bars

.9 CSA W59-18 – Welded Steel Construction (metal arc welding)

.2 American Society for Testing and Materials (ASTM):

.1 ASTM A123/A123M-13 – Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

.2 ASTM A185/A185M-07 – Specification for Carbon-Steel Welded Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete

.3 ASTM A276/A276M-16a - Standard Specification for Stainless Steel Bars and Shapes

.4 ASTM A416/A416M-18 - Standard Specification for Low-Relaxation, Seven-Wire Steel Strand for Prestressed Concrete

.5 ASTM A421/A421M-15 – Stress-Relieved Steel Wire for Prestressed Concrete.

.6 ASTM A775/A775M-07b(2014) - Specification for Epoxy Coated Reinforcing Steel Bars

.7 ASTM C494/C494M-13 - Specification for Chemical Admixtures for Concrete

.8 ASTM C1017/C1017M-13e1 - Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete

.9 ASTM D412-06a(2013) - Test Method for Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers – Tension

.10 ASTM D2240-05(2010) - Test Method for Rubber Property – Durometer Hardness

.11 ASTM F593-17 – Standard Specification for Stainless Steel bolts, Hex Cap Screws, and Studs.

.3 Master Painters Institute (MPI):

.1 MPI #18 – Primer, Zinc Rich, Organic

.2 MPI #79 – Primer, Alkyd, Anti-Corrosive for Metal

.4 Underwriters' Laboratories of Canada (ULC):

.1 CAN/ULC-S701-11 – Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering

.5 Precast/Prestressed Concrete Institute (PCI):

.1 PCI Journal V. 28, No. 1 (1983) – Fabrication and Shipment Cracks in Prestressed Hollow-Core Slabs and Double Tees

.2 PCI Manual for Design of Hollowcore Slabs

.3 PCI MNL 116 Manual for Quality Control for Plants and Production of Precast and Prestressed Concrete Products

.4 PCI MNL-124 – Design for Fire Resistance of Precast/Prestressed Concrete, 3rd Edition.

.5 PCI MNL-135 – Tolerance Manual for Precast and Prestressed Concrete Construction, 1st Edition.

.6 Canadian Precast/Prestressed Concrete Institute (CPCI):

.1 CPCI Design Manual 5th Edition

.7 Ontario Building Code 2012 with Latest Amendments

1.4 QUALIFICATIONS OF MANUFACTURER

.1 Fabricator:

.1 Precast concrete manufacturers to be certified to Canadian Precast Concrete Quality Assurance (CPCQA) Certification Program in Commercial Precast and Prestressed Concrete Products (Structural) Category C2 prior to the time of bid.

.2 Precast fabrication to meet the requirements of CSA-A23.4, including Annexes A and B, together with PCI MNL-116 and 117 and CPCQA certification requirements.

.3 Only precast elements fabricated under the CPCQA plant certification program to be acceptable, and plant certification is to be maintained for the duration of fabrication, erection, and until warranty expires.

.2 Fabricate precast/prestressed concrete elements certified by the Canadian Standards Association in the appropriate categories according to CSA A23.4. The precast concrete manufacturer shall be certified in accordance with the CSA Certification program for Structural Precast/Prestressed Concrete prior to submitting a tender and must specifically verify as part of the tender that the company is currently certified in the appropriate categories:

.1 Precast Concrete Products – Structural: (I) Non-Prestressed or (II) Prestressed.

.2 Precast Concrete Products – Specialty: (I) Non-Prestressed or (II) Prestressed.

.3 Only precast concrete elements fabricated by certified manufacturers are acceptable to the Owner. Certification must be maintained for the duration of the fabrication and erection for the project. Fabricate precast concrete elements in accordance with Ontario Building Code requirements.

.3 The structural precast/pre-stressed concrete manufacturer shall have a proven record and satisfactory 10-year experience in the design, manufacture and erection of structural units specified. The company shall have adequate financing, equipment, plant and skilled personnel to detail, fabricate and erect the work of this section as required by the specification and drawings. The size of the plant shall be adequate to maintain the required delivery schedule.

1.5 BYLAWS AND CODES

.1 Conform to applicable requirements of the Ontario Building Code, National Building Code and local authorities having jurisdiction.

.2 Design and provide reinforcement, anchors and support as required by codes and to Consultant's approval. Submit relevant design data prepared by a Professional Engineer registered in the Province of Ontario for approval, if so requested by the Consultant.

1.6 ALLOWABLE TOLERANCES

.1 Conform to the requirements of CSA A23.4 - Clause 12.

.2 Refer to related sections of this specification and fabricate work to accommodate specified tolerances.

1.7 SOURCE QUALITY CONTROL

.1 Make available copies of quality control tests related to this project as specified in CSA A23.4.

.2 Inspect pre-stressed concrete tendons in accordance with CSA A23.4.

.3 Make available records from in-house quality control program based upon plant certification requirements for inspection and review.

.4 Make available certified copy of mill test reports of steel reinforcement supplied, showing physical and chemical analysis.

.5 In addition to quality control, an independent inspection and testing company may be appointed by the Owner to verify compliance with this specification.

.6 Cooperate with inspector to facilitate the work.

.7 Cost of an independent inspection is to be paid by the Owner.

1.8 SUBMITTALS

.1 Submit in accordance with Section 01 33 00 - Submittals.

.2 Prepare and submit certified shop drawings, stamped by a professional Engineer licensed in the Province of Ontario, of precast/prestressed concrete elements in accordance with general conditions of the contract, CSA A23.4 and CSA A23.3, and as specified below.

.3 Submit fully detailed and dimensional drawings showing and including, but not limited to the following:

.1 Design calculations for items designed by manufacturer.

.2 Typical details of prestressed members, reinforcement and connections, including all welds.

.3 Prestressing tendon arrangement profiles.

.4 Estimated camber.

.5 Finishing schedules.

.6 Indicate clearly on the shop drawings if the precast elements are designed to rely on the concrete topping for composite action.

.7 Methods of handling and erection.

.8 Openings, sleeves, inserts and related reinforcement.

.9 Hanger saddles and angles to accommodate openings.

.4 Show the exact location of inserts and anchors required to be cast into precast/pre-stressed units for interface elements.

.5 Show the system of identifying units for erection purposes on shop drawings and apply a similar mark on all units at the time of manufacture.

.6 Provide the shop drawings to obtain approvals from the authorities having jurisdiction prior to fabrication of structural precast/prestressed units.

.7 Provide drawings of all precast members.

.8 Include all loading supported by the precast element based on approved shop drawings. Contractor to coordinate location of equipment and supply all loads to precast engineer for final design.

.9 Provide manufacturer's special installation requirements, including special procedures, crane and truck access locations, and perimeter conditions requiring special attention.

.10 Submit grout material technical data sheet.

.11 Submit Environmental Product Declarations (EPD) showing Global Warming Potential (GWP) impact category.

1.9 WARRANTY

.1 Provide standard CPCI warranty with a duration of one (1) year in accordance with the General Conditions. Warranty shall be in writing and shall warrant work under this section to be free from defects for the period stipulated.

1.10 DELIVERY, STORAGE AND PROTECTION

.1 Accept full responsibility for delivery, handling and storage of units.

.2 Deliver, handle and store precast/prestressed structural units using methods approved by the manufacturer. Do not permit units to contact earth or staining influences or to rest on corners.

.3 Blocking and Lateral Support during Transport and Storage: Clean, non-staining spacers, that do not cause harm to exposed surfaces, shall be placed between each unit. Temporary lateral supports should be provided to prevent bowing and warping.

.4 Protect precast concrete components to prevent staining, chipping, or spalling of concrete. Protect holes and reglets from water and ice during freezing weather.

.5 Mark precast concrete components with identification tag in accordance with CPCQA requirements

1.11 DESIGN AND PERFORMANCE REQUIREMENTS

.1 Design components and connections of precast/pre-stressed structural concrete elements, brackets and anchorage devices:

.1 Design precast concrete components to withstand specified loads including superimposed dead loads, live loads, snow, wind, thermal loads and all other loads specified on the drawings.

.2 Precast panel connections shall be designed to resist 50% of the diaphragm forces shown on the drawings.

.3 Design structural precast products to resist handling, transportation, and erection stresses.

.4 Design system to accommodate construction tolerances, deflection of other building structural members and clearances of intended openings, as specified in CSA A23.4 and PCI MNL-135.

.5 Maximum deflection of span/360 due to live loads or snow loads.

.6 Maximum deflection of span/240 due to superimposed total loads.

.7 Design loads shall be as specified on the contract drawings, and in accordance with the Ontario Building Code. The structure is considered to be a “post disaster” building.

.8 Design precast concrete elements at all stages of construction, including un-topped conditions. Minimum 1.0 kPa construction live loads shall be considered in addition to the wet concrete topping, but shall not exceed 2.4 kPa. Coordinate with concrete placing contractor to determine minimum uniformly distributed loads and concentrated loads during the concrete topping placement stage.

.9 Design all units to provide at least 50 mm of concrete cover to prestressed strands or main reinforcing, and 40 mm cover to all ties and stirrups.

.10 Design all elements to limit stresses exposed to a corrosive environment.

.11 Design and fabricate structural precast products, brackets and anchorage devices to tolerances as specified in CSA-A23.4 and PCI MNL-135

PART 2 PRODUCTS

2.1 MATERIALS

.1 Reinforcing steel: to CSA G30.18 Grade 400 MPa, deformed bars.

.2 Prestressing tendons: to ASTM A416 Grade 1720 MPa, prestressing strands.

.3 Forms: to CSA A23.4.

.4 Hardware and miscellaneous materials: to CSA A23.1/A23.2.

.5 Welding materials: to CSA W47.1.

.6 Air entrainment admixture: to ASTM C1017/C1017M.

.7 Bearing pads: neoprene, 70 durometer hardness to ASTM D2240 and 17 MPa minimum tensile strength to ASTM D412, moulded to size or cut from moulded sheet. (Random oriented fibre-reinforced neoprene.)

.8 Shims: plastic

.9 Hanger saddles and angles: to ASTM A276, Type 316L.

.10 Stainless steel plate: to ASTM A276, Type 316L

.11 Stainless steel bolts and nuts: to ASTM F593, Type 316L

.12 Cement Grout: minimum 25MPa at 28 days.

2.2 CONCRETE MIXES

.1 Unless otherwise noted or specified, use concrete mix designed to produce a minimum of 35 MPa compressive cylinder strength at 28 days, with a maximum water/cement ratio to CSA A23.4.

.2 Use cement and supplementary cementing materials that conform to CSA A23.1/A23.2.

.3 Air Entrainment of Concrete Mix: refer to CSA A23.1/A23.2.

.4 Use of calcium chloride is not permitted.

.5 Exposure Class: A-1 in accordance to CSA A23.1/A23.2.

2.3 REINFORCEMENT AND ANCHORS

.1 Anchors: All connection hardware shall be fabricated from 316L stainless steel.

2.4 FABRICATION

.1 Fabricate precast/pre-stressed concrete units to CSA A23.4.

.2 Mark each precast/pre-stressed unit to correspond to identification mark on shop drawings for location.

.3 Mark each precast unit with the date cast.

.4 Cast members in accurate rigid moulds designed to withstand high frequency vibration. Set reinforcing anchors and auxiliary items to detail. Cast in anchors, blocking and inserts supplied by other sections as required to accommodate their work. Vibrate concrete during casting until full thickness is reached. Provide necessary holes and sinkages for flashings, anchors, cramps, etc. as indicated. Separately and accurately batch cement and aggregates uniformly by weight to ensure maintenance of even and uniform appearance.

.5 Anchors, lifting hooks, shear bars, spacers and other inserts or fittings required shall be as recommended and/or designed by manufacturer for a complete and rigid installation. Each shall conform to requirements of local building bylaws. Lift hooks shall be adequately sized to safely handle panels according to member dimension and weight. Anchors/inserts shall be concealed where practical.

.6 Openings: Opening locations shall be coordinated and verified by the Contractor and provide information to the manufacturer. Manufacturer shall provide openings 300 mm square or larger and shown on the architectural and structural drawings. Small openings (less than 300 mm square) shall be drilled or cut by the respective trades after plank is grouted. Prior to field cutting, openings must be approved by the manufacturer.

.7 Burn off lift cables paint and fill in recesses.

2.5 FINISH

.1 Finish units to Finish Grade B to CSA A23.4, Clause 26.

2.6 GENERAL REQUIREMENTS

.1 Furnish units free of voids or honeycombs.

.2 Provide rough bonding surface on slabs for topping where specified.

.3 Reinforce units to resist transportation and erection stresses.

.4 Include stainless steel cast-in weld plates.

.5 Coordinate with other trades for installation of cast-in items. Coordinate specifically with roofing supplier and general contractor to ensure that hardware used for connections does not interfere with roofing or connections and are adequately protected.

.6 Ensure that the underside of all units is free of staining, discoloration, or dirt. Clean all units to a consistent appearance. If staining is permanent, replace double tee unit at no cost to the Contract.

.7 If a precast unit has a defect or damage deemed to be potentially structural in nature, as determined by Section 33.3.2 of CSA A23.4, repair the unit in accordance with Section 33.3.3 of CSA A23 at no cost to the Contract. All repair methods and materials shall be submitted to the engineer for review, including any requirements for load testing. Load test the units if requested by the engineer.

.8 Patch cosmetically damaged or chipped components as determined by the Engineer using a methodology approved by the Engineer.

2.7 HOLLOWCORE UNITS

.1 Precast/pre-stressed roof/floor units shall be as shown on the drawings with prestressed reinforcement as required by design.

.2 The finish of the underside of the slabs shall be a standard steel form finish.

.3 Finish on the top side shall be raked to promote adhesion to concrete topping.

2.8 DOUBLE TEE UNITS

.1 Precast Double Tee roof units of depth shown on the drawings.

.2 Finish on the top side shall be raked to promote adhesion to concrete topping.

.3 Coordinate opening sizes of access hatches with Section 07 72 00 – Roof Hatches and with mechanical openings Division 15 – Plumbing and HVAC.

2.9 STAIR UNITS

.1 Precast/pre-stressed stairs for the width and cross section shown on the drawings.

.2 Rise and run dimensions to satisfy requirements of Ontario Building Code 2012 with latest amendments.

.3 Provide anti-slip troweled grooves on treads with bullnose nosing.

.4 Coordinate the required support profile and formed recess on cast-in place landings with Division 3 – Concrete.

.5 Coordinate guardrail assembly and connection requirements with metal fabricator in Section 05 50 00 – Metal Fabrications.

PART 3 EXECUTION

3.1 GENERAL

.1 Erect precast/pre-stressed work in accordance with CSA A23.4.

.2 Contractor to verify site conditions and supporting materials are ready to receive work and field measurements are as indicated on the Shop Drawings.

.3 Supply stainless steel anchors or plates for precast units required to be cast into cast-in place concrete frame to Contractor for installation.

.4 Provide such items in ample time to meet construction program. Supply layout drawings locating accurately the position of all cast-in items to be installed by other sections.

.5 Provide minimum 50 thick insulation plugs at the ends of each hollow core location.

.6 Supply and install deformed welded wire fabric mesh in topping as indicated on the Contract drawings.

3.2 INSTALLATION

.1 Set precast/pre-stressed concrete units, straight, level and square.

.2 Do welding in accordance with CSA W59, for welding to steel structures and CSA W186, for welding of reinforcement.

.3 Non-cumulative erection tolerances to be in accordance with CSA A23.4, Clause 12.

.4 Set elevations and alignment between units to within allowable tolerances before connecting units.

.5 Grout joints of precast units with 25 MPa concrete grout and “feather”. Ensure there are no rough areas, projections or abrupt changes in roof elevation.

.6 Secure with bolts using tack-weld nut to bolt.

.7 Do not weld or secure bearing plates at sliding joints.

.8 Use grout to align elevations at surface of joints in situations where allowable tolerances have been exceeded or as noted on Engineer’s drawings in critical splatter.

.9 Caulk joints between hollowcore panels/double tees at ceiling, complete with backer rod. Use Sika 2CNS or approved equal.

3.3 HANDLING AND ERECTION

.1 Precast/prestressed components shall be handled and erected in accordance with CSA Standard A23.4 and as per the manufacturer's instructions.

.2 Precast/prestressed components shall be delivered and handled in such a manner as to avoid warpage.

.3 Holes and reglets shall be protected from forming of ice during freezing weather.

.4 Lifting devices shall be protected from rusting at all times.

.5 All precast/prestressed components shall be erected by experienced workmen under the supervision of a qualified superintendent with a minimum of five (5) years of experience.

.6 Welding of precast units shall be performed by certified welders in accordance with CSA Standard A23.4, Clause 32.7.

.7 Units shall be set plumb and true with joints parallel and uniform.

.8 All necessary precautions shall be taken to prevent weld burn or splatter onto exposed surfaces. Clean areas effected by burns or splatter to the satisfaction of the Engineer.

3.4 REPAIRS

.1 Patch cosmetically damaged or chipped components as determined by the Engineer using a methodology approved by the Engineer.

.2 Repair all cracks in accordance with PCI Journal – Fabrication and Shipment Cracks in Prestressed Hollowcore Slabs and Double Tees.

.3 If defect or damage is deemed to be potentially structural in nature, as determined by Section 33.3.2 of CSA A23.4, repair the unit in accordance with Section 33.3.3 of CSA A23.4 at no cost to the contract. All repair methods and materials shall be submitted to the engineer for review, including any requirements for load testing. Load test the units if requested by the Engineer.

.4 Provide a top surface suitable for the installation of the membrane roofing specified under Section 07 52 10 – Modified Bitumen Membrane.

3.5 CLEANING

.1 Connections for precast concrete components should be clean and unobstructed prior to erection. Any cleaning of the precast after the installation and acceptance of work is the responsibility of the Contractor.

.2 Clean weld marks, dirt, or blemishes from surface of exposed precast concrete components, caused by erection work

.3 Clean field welds with wire brush.

.4 Upon completion of the work in this Section, all surplus materials and debris shall be removed from this site.

.5 If required, clean exposed face of work by washing and brushing only, as precast is erected. Use approved masonry cleaner if washing and brushing fails to achieve required finish. Remove immediately materials that may set up or harden.

END OF SECTION

PRECAST CONCRETE

PART 1 GENERAL

1.1 SCOPE OF WORK

.1 Work supplied under this section describes the procurement and installation requirements for uninsulated non-loadbearing architectural precast panels.

.2 Design, supply, delivery and installation of:

.1 Precast concrete architectural wall panels.

.2 Field sealing and sealant of all precast concrete joints, surrounding penetrations, doors, louvers and windows.

.3 Take delivery and cast into precast work inserts required by other trades.

.4 Design and supply hardware for precast connections to the structure.

1.2 RELATED WORK

.1 In addition to the general project requirements in Division 1, the following sections are referenced in this section:

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

.2 Section 05 50 00 - Metal Fabrications

.3 Section 07 90 00 - Joint Sealants

.4 Section 08 11 00 - Metal Doors and Frames

.5 Section 08 20 00 – FRP Doors and Windows

.6 Section 08 33 00 – Coiling Metal Doors

.7 Section 08 52 00 – Aluminum Windows

.8 Division 15, 22, 23 , 26, 40 and 46

1.3 REFERENCE STANDARDS

.1 Canadian Standards Association (CSA):

.1 CSA A23.1-19/A23.2-19 - Concrete Materials and Methods of Concrete Construction /Methods of Test for Concrete

.2 CAN/CSA A23.3-19 - Design of Concrete Structures

.3 CSA A23.4-16 (R2021) – Precast Concrete-Materials and Construction

.4 CSA A283-19 - Qualification Code for Concrete Testing Laboratories

.5 CSA-A3000-18 - Cementitious Materials Compendium.

.6 CSA G30.18-09 (R2019) – Carbon Steel Bars for Concrete Reinforcement

.7 CSA G40.20-13/G40.21-13 (R2018) General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel

.8 CSA W47.1-09 (R2019) - Certification of Companies for Fusion Welding of Steel Structures

.9 CSA-W59-18 (R2023) - Welded Steel Construction (Metal Arc Welding).

.10 CSA W186-M1990 (R2016) - Welding of Reinforcing Bars in Reinforced Concrete Construction.

.2 American Society for Testing and Materials (ASTM):

.1 ASTM A123M-17 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

.2 ASTM A153/A153M-16a - Zinc (Hot-Dip) on Iron and Steel Hardware.

.3 ASTM A307-14e1 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60000 PSI Tensile Strength.

.4 ASTM A416/A416M-18 – Standard Specification for Low-Relaxation, Seven-Wire Steel Strand for Prestressed Concrete.

.5 ASTM A555/A555M-16 - General Requirements for Stainless Steel and Wire Rods.

.6 ASTM A666-15 - Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.

.7 ASTM A775/A775M-17 - Epoxy-Coated Reinforcing Steel Bars.

.8 ASTM A1064/A1064M-24 - Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.

.9 ASTM C260/C260M-10a – Air-Entraining Admixtures for Concrete

.10 ASTM C494/C494M-17 - Chemical Admixtures for Concrete.

.11 ASTM C881/C881M-15 - Epoxy-Resin-Base Bonding Systems for Concrete.

.12 ASTM D2240-15e1 - Test Method for Rubber Property - Durometer Hardness.

.13 ASTM F3125/F3125M-15a - High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 ksi (830 MPa) and 150 ksi (1040 MPa) Minimum Tensile Strength, Inch and Metric Dimensions.

1.4 CANADIAN PRECAST/PRESTRESSED CONCRETE INSTITUTE (CPCI):

.1 CPCI - Architectural Precast Concrete Colour and Texture - Selection Guide.

.2 CPCI - Architectural Precast Concrete Technical Guide.

.3 CPCI Design Manual – 5th Edition.

.4 CPCI – Architectural Precast Concrete Walls: Best Practice Guide.

1.5 MASTER PAINTERS INSTITUTE (MPI):

.1 MPI #18 – Primer, Zinc Rich, Organic

.2 MPI #79 – Primer, Alkyd, Anti-Corrosive for Metal

1.6 COORDINATION

.1 Work described by this section shall be coordinated as follows:

.1 Supply embedded items for other concrete placed under section 03 30 00 – Cast-in place Concrete.

.2 Receive and incorporate embedded items for pipe and equipment supports and other appurtenances.

.3 Coordinate requirements for box-outs of concrete walls for installation of precast panels.

.4 Coordinate with relevant trades and installers for all items that will be required to be supported by the precast wall panels.

.5 Coordinate and final size and location of openings with equipment supplied under Divisions 40 and 46.

.6 Coordinate equipment loads supported by the precast with Divisions 26, 40 and 26.

1.7 QUALITY ASSURANCE

.1 Perform work in accordance with CSA-A23.1/A23.2, and CSA-A23.3, and CPCI Architectural Precast Concrete Walls: Best Practice Guide

.2 Welding: CSA-W59 and CSA-W186.

.3 Welders: Certified to CSA-W47.1.

.4 Qualifications of Manufacturer

.1 Precast concrete manufacturers to be certified to Canadian Precast Concrete Quality Assurance (CPCQA) Certification Program in Architectural Precast Concrete Products, A1, Subcategory AT prior to submitting a Tender.

.2 Precast fabrication to meet the requirements of CSA-A23.4, including Annexes A and B, together with PCI MNL-116 and 117 and CPCQA certification requirements.

.3 Only precast concrete elements fabricated under CPCQA plant certification program are acceptable to the Owner. Certification must be maintained for the duration of the fabrication, erection and until warranty expires.

.4 The precast concrete manufacturer shall have a proven record and satisfactory experience in the design, manufacture and erection of precast concrete facing units of the type specified. The company shall have adequate financing, equipment, plant and skilled personnel to detail, fabricate and erect the work of this section as required by the specification and drawings. The size of the plant shall be adequate to maintain the required delivery schedule.

.5 Design precast concrete members under direct supervision of a Professional Engineer experienced in design of this Work and licensed in the Province of Ontario.

.5 Quality Control

.1 Panels as delivered to site shall have matching colour, texture, and be in an un-cracked and unchipped state. Defects mentioned above can be grounds for rejection of panel.

.2 An independent inspection and testing company may be appointed by the Owner to verify compliance with this specification.

.3 Cooperate with inspector to facilitate the work.

1.8 SUBMITTALS

.1 Submit in accordance with Section 01 33 00 – Submittals.

.2 Shop Drawings

.1 Prepare and submit shop drawings in accordance with the General Conditions of the Contract, CSA-A23.4 and CSA-A23.3.

.2 Submit fully detailed and dimensioned drawings showing method of fastening and sealing and provisions made to receive work of other sections. Indicate type of finish and other pertinent information on each shop drawing. Submit layout of cast-in hardware.

.3 All panels shall be labeled on shop drawings for ease of identification.

.4 Consult reviewed shop drawings relating to interface elements and show exact location of inserts and anchors to be cast in precast units for interface elements.

.5 Show system of identifying units for erection purposes on shop drawings and apply similar mark on units at time of manufacture.

.6 Provide shop drawings to and obtain approvals from the authorities having jurisdiction prior to fabrication of the precast panels.

.7 Each drawing submitted shall bear stamp and signature of a Professional Engineer licensed in the Province of Ontario.

.8 Installation Data: Manufacturer's special installation requirements, indicating special procedures, crane and truck access locations, perimeter conditions requiring special attention, and laydown areas.

.9 Maintenance Data: Indicate surface cleaning, inspection frequency, and joint sealant repair instructions.

.10 Submit welder’s certificates.

.3 Samples

.1 Provide samples of pre-cast finish for approval. Unless otherwise noted, minimum size 300 mm x 300 mm section of each exposed finish face as described under “finishes” elsewhere in this section. Make samples until

final unconditional Consultant's approval is obtained. All work shall match approved production run samples.

.2 Samples to remain on site to establish a minimum quality of material finish for final installation of precast panel.

.4 Submit Environmental Product Declarations (EPD) showing Global Warming Potential (GWP) impact category.

1.9 DELIVERY, STORAGE AND PROTECTION

.1 Accept full responsibility for delivery, handling and storage of units.

.2 Deliver, handle and store precast components in method approved by manufacturer and position, consistent with their shape and design. Handle precast units in a near vertical plane at all times. Do not permit components to contact earth or staining influences or to rest on corners. Do not stockpile defective components but remove from site. Lift and support only from support points.

.3 Blocking and Lateral Support during Transport and Storage: Clean, non-staining, spacers between each unit, that do not cause harm to exposed surfaces. Provide temporary lateral support to prevent bowing and warping. If wood is used it shall be wrapped with polyethylene.

.4 Protect components to prevent staining, chipping, or spalling of concrete. Protect holes and reglets from water and ice during freezing weather.

.5 Mark components with date of production in location not visible to view when in final position in structure.

1.10 WARRANTY

.1 Provide standard warranty with a duration of two (2) years in accordance with General Conditions. Warranty shall be in writing and shall warrant work under this section to be free from defects for the period stipulated.

1.11 DESIGN PERFORMANCE REQUIREMENTS

.1 Calculate structural properties of components in accordance with CSA-A23.3 and CSA-A23.4.

.2 Conform to applicable requirements of National Building Code of Canada and Ontario Building Code.

.3 Design and provide reinforcement, anchors and supports as required by codes. Submit relevant design data prepared by a professional engineer licensed to practice in the province of Ontario for Consultant's review.

.4 Design components to withstand specified loads such as superimposed dead loads, equipment loads, live loads, wind, and thermal loads. Environmental loads and climatic data shall be based on NBCC 2020.

.5 Seismic Loads: Design and size components and connections to withstand specified seismic loads and sway displacements.

.6 Design precast components based on Post-Disaster building importance category.

.7 Design connection of structural concrete to accommodate for structural back up wall to be out of plumb by 50 mm, and out of straight by +/- 50 mm.

.8 Design precast components to limit stresses exposed to a corrosive environment.

.9 Design wall panels to span the full height of walls. No intermediate connections are allowed that will require intermediate box-out openings on the concrete walls.

.10 Design and fabricate panels, brackets and anchorage devices so that when installed they will:

.1 Compensate for unevenness and dimensional differences in structure to which they are secured.

.2 Tolerate structural deflection of span/360 due to live load and distortion of structure, under design criteria conditions, without imposing load on panel assembly.

.3 Adequately sustain precast loads and superimposed wind, snow and rain loads, and seismic loads, without exceeding deflection of 1/500.

.4 Permit no water infiltration into the building under design loads.

.11 Allowable Tolerances

.1 Conform with requirements of CSA A23.4-Section 10, except as noted herein.

.2 Refer to related sections of this specification and fabricate work to accommodate specified tolerances.

PART 2 PRODUCTS

2.1 MATERIALS

.1 Portland Cement: CSA-A3000, Concrete Materials: CSA A23.4 and CSA A23.1/A23.2.

.2 Forms: to CSA A23.4.

.3 Exposed aggregate and special facing materials: to match existing finish.

.4 Surface Finish Aggregate as required to produce the desired finish from single source throughout.

.5 Use same brand and source of cement and aggregate for entire project to ensure uniformity of coloration and other mix characteristics.

.6 Reinforcing steel: CSA-G30.18, deformed steel Grade 400, unfinished, strength and size commensurate with precast unit design.

.7 Welded Steel Wire Fabric: ASTM A1064/A1064M, welded steel wire fabric, in hot dip galvanized.

.8 Tensioning Steel Strands: ASTM A416/A416M Grade 250 ksi.

2.2 CONNECTION SUPPORTS

.1 Connecting and Supporting Devices: ASTM A666 stainless steel plates, angles, items connected to steel framing members, and inserts; fasteners to ASTM F3125.

.2 Miscellaneous Plates, Angles, Inserts: CSA-A23.1/A23.2.

.3 Bolts, Nuts, and Washers: Type 316L Stainless Steel.

.4 Welding materials: to CSA W47.1 and CSA W186.

.5 All anchors and supports shall be Type 316L Stainless Steel.

2.3 ACCESSORIES

.1 Sealants – Section 07 90 00 – Joint Sealants

.2 Shims: Type 316L Stainless Steel.

.3 Recessed Reglets: Type 316L Stainless Steel. shaped and flanged to remain in place once cast, foam plastic filled to eliminate wet concrete intrusion.

.4 Bearing Pads: Neoprene (Chloroprene), to ASTM D2240, Shore A Durometer 60, smooth both sides.

.5 Surface retardant: to ASTM C494/C494M.

2.4 CONCRETE MIXES

.1 Concrete designed to CSA A23.4 Clause 16.2. Cure in accordance with CSA-A23.4.

.2 Unless otherwise noted or specified, use concrete mix design to produce a minimum of 35 MPa compressive cylinder strength at 28 days, with a maximum water/cement ratio to CSA A23.4.

.3 Use white or grey cement in facing matrix.

.4 Minimum Class A-1 Concrete as per CSA-A23.1.

.5 Air Entrainment Admixture: CSA-A23.4

.6 Use of calcium chloride is not permitted.

2.5 FABRICATION

.1 Fabricate architectural precast concrete units to CSA A23.4.

.2 Mark each precast unit to correspond to identification mark on shop drawings for location.

.3 Mark each precast unit with the date cast.

.4 Ensure that surfaces to receive sealant are smooth and free of laitance to provide a suitable base for adhesion. Ensure that release agents do not deleteriously affect the sealing of the joints.

.5 Cast panels face down in accurate rigid moulds designed to withstand high frequency vibration. Set reinforcing anchors and auxiliary items to detail. Cast in anchors, blocking and inserts supplied by other sections as required to accommodate their work. Where possible, permanently attach anchors and inserts to the reinforcing. Vibrate concrete continuously during casting until full thickness is reached. Provide necessary holes and sinkages for flashings, anchors, cramps, etc. as indicated and/or required. Separately and accurately batch cement and aggregates uniformly by weight to ensure maintenance of even and uniform appearance.

.6 Design and locate hoisting devices so that they can be concealed when the structure is in service. These devices shall be treated so they will not corrode in service.

.7 Cure components to develop concrete quality, and to minimize appearance blemishes such as non-uniformity, staining, or surface cracking. Cure according to CSA-A23.4.

.8 Anchors, lifting hooks, shear bars, spacers and other inserts or fittings required shall be as recommended and/or designed by manufacturer for a complete and rigid installation. Each shall conform to requirements of local building bylaws and be of type satisfactory to Consultant. Lift hooks shall be adequately sized to safely handle panels according to panel dimension and weight. Anchors/inserts shall be concealed where practical.

.9 Burn off lift cables paint and fill in where required if unit is damaged due to burn off.

2.6 FINISH

.1 Precast Concrete Surface Finish: Confirm to approved range samples as shown on Contract drawings.

.2 Unexposed faces to be float finish, exposed backs of panels to be steel trowel finish.

.3 Connecting Supporting Steel Devices: Stainless Steel Grade 316L.

PART 3 EXECUTION

3.1 GENERAL

.1 Erect precast work in accordance with CSA A23.4.

.2 General Contractor to verify that site conditions and supporting materials are ready to receive work and field measurements are as indicated on Contract drawings.

.3 Supply anchors and hardware to cast-in place concrete sub-contractor for inclusion in their work. Ship and provide anchors to the site in accordance with the construction schedule. General contractor and precast supplier to coordinate installation of cast in place anchors and hardware to meet construction schedule. Supply layout drawings locating accurately the position of all cast-in items to be installed by other sections.

3.2 PREPARATION

.1 Provide and install sufficient temporary bracing to brace precast components adequately, at all stages of construction, so that precast components will safely withstand loads to which they may be subjected. This temporary bracing shall remain in position until required connections have been completed. Any bracing required to the structural frame supporting the architectural precast concrete is to be provided by the General Contractor.

3.3 INSTALLATION

.1 Erect components without damage to shape or finish. Replace or repair damaged panels.

.2 Set precast concrete units, straight, level and square within allowable tolerances.

.3 Align and maintain uniform horizontal and vertical joints, as erection progresses.

.4 Non-cumulative Erection Tolerances

.1 Joint dimension: nominal 15 mm; to vary not more than +/- 6 mm.

.2 Joint taper: unit edges at joint not out of parallel over 0.6 mm in 300 mm but not more than 2.9 mm total.

.3 Edge alignment: alignment of panel edges not to exceed 6 mm.

.4 Offset faces of adjacent panels to be not more than 3 mm.

.5 Bowed panels, within allowable bowing tolerances, arranged so offset between adjacent panels does not exceed 6 mm.

.5 Fasten and Weld component securely in place. Perform welding in accordance with CSA-W59 for welding to steel structures and CSA-W186, for welding of reinforcement. Protect work from damage by weld splatter.

.6 Where bolts are used for installation, tighten with equal torque. Secure bolts by damaging threads, with lock washers, jam nuts, or tack-weld nut to bolt.

.7 Provide temporary erection anchorage for welded anchorage system.

.8 Clean field welds with wire brush and touch-up with zinc rich primer.

.9 Place vent weepholes at top and bottom of all precast concrete wall panel vertical joints, including head and sills of openings and as shown on drawings.

.10 Set vertical components dry, without grout, attaining joint dimension with spacers. Grout to base of unit if required.

.11 The concrete walls will be in place prior to the erection of the precast panels and all connections will be installed to prevent damage to the vapour barrier and the building waterproofing system.

.12 Remove shims and spacers from joints between non-load bearing panels after fastening but before sealant is applied.

.13 Clean and prime joints and apply sealant and joint backing to exterior and interior joints to provide a complete weather-tight installation in accordance with Section 07 90 00 – Joint Sealants.

.14 Apply sealant ensuring full bond with joint sides and no bond with backing material. Tool the joint to be a full bead, smooth, free from ridges, sags, air pockets and other defects.

.15 Completed Work: Free of blemishes, discoloration, surface voids, unnatural mould marks, and matching sample installation.

3.4 APPLYING ORNAMENTAL CONCRETE STAIN

.1 Preparation: Free concrete surfaces of dirt, dust, grease, efflorescence, and other foreign materials in accordance with mould manufacturer's recommendations. Do not sandblast.

.2 Apply stain to concrete surfaces that has been cured for minimum 30 days.

3.5 CLEANING

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

.2 Progress Cleaning: Perform cleanup as work progresses

.3 Leave work area clean at end of each day.

.4 Final cleaning:

.1 Upon completion, remove surplus materials, rubbish, tools, and equipment

.2 Clean exposed face of work by washing and brushing only, as precast is erected, if required. Use approved masonry cleaner if washing and brushing fail to achieve required finish. Remove immediately materials that set up or harden.

.5 Waste Management:

.1 Collect recyclable waste and dispose of or recycle field generated construction waste created during construction or final cleaning related to work of this Section.

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

END OF SECTION

GROUT

PART 1 GENERAL

1.1 SCOPE

.1 This section covers procurement and installation of grout beneath column base plates, grouting of pump, motor and equipment base plates or bedplates, and other structural uses of grout as indicated on the drawings. Unless otherwise specified, only non-shrinking grout shall be furnished.

.2 Epoxy grouting of anchor bolts, threaded rod anchors and reinforcing bars are covered in the Anchorage in Concrete and Masonry section. Grouting of masonry is covered in the Building Masonry section.

1.2 RELATED SECTIONS

.1 Section 01 33 00 – Submittals

.2 Section 03 41 00 – Structural Precast Prestressed Concrete

.3 Section 04 05 13 – Masonry Mortar and Grout

.4 Section 05 55 50 – Anchorage in Concrete and Masonry

1.3 SUBMITTALS

.1 Submit shop drawings in accordance with the Section 01 33 00 – Submittals.

.2 Include technical data sheet for each product and clearly indicate location and the intended use of each type.

.3 Letter of certifications from grout manufacturer and equipment supplier indicating the type of grout to be supplied is appropriate for the intended use.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Materials shall be handled, transported and delivered in a manner that will prevent damage of any kind. Materials shall be protected from moisture.

PART 2 PRODUCTS

2.1 MATERIALS

.1 Non-shrinking Grout: cementitious grout with demonstrated non-shrinking properties.

.2 Water: Clean and free from deleterious substances.

.3 Min 28 Day Compressive Strength: 50 MPa

.4 Aggregate: where required due to the thickness of the grout extends with aggregate in accordance with the manufacturers written recommendations.

.5 Non-shrinking grout shall be furnished factory pre-mixed so that only water is added at the job site.

2.2 ACCEPTABLE PRODUCTS

.1 For use in classified space:

.1 Sika “SikaGrout-928”
.2 Sika “SikaGrout-885”
.3 Or approved equivalent.

.2 For general use

.1 Sika “SikaGrout-212”
.2 Sauereisen “F-100 Level Fill Grout”
.3 Five Star Products “Five Star Grout”
.4 Or approved equivalent.

PART 3 EXECUTION

3.1 PREPARATION

.1 Mechanically roughen the surface as per manufacturers written instructions

.2 The concrete foundation to receive non-shrinking grout shall be saturated with water for at least 12 hours preceding grouting unless additional time is required by the grout manufacturer.

.3 Remove all standing water prior to application of grout.

3.2 INSTALLATION

.1 Mixing

.1 Mix materials in accordance with manufacturer’s instructions.
.2 Grout shall be mixed in a mechanical mixer. No more water shall be used than is necessary to produce a flowable grout.
.3 Do not mix more grout than can be placed in approximately 30 minutes.
.4 Do not retemper grout by adding water and remixing after it stiffens.

.2 Placement

.1 Unless otherwise specified or indicated on the drawings, grout under base plates shall be 38 mm thick. Grout shall be placed in strict

accordance with the directions of the manufacturer so that all spaces and cavities below the base plates are completely filled without voids. Forms shall be provided where structural components of base plates will not confine the grout.

.3 Edge Finishing

.1 In all locations where the edge of the grout will be exposed to view, the grout shall be finished smooth after it has reached its initial set. The edges of grout shall be cut off flush at the base plate except where shown to be finished on a slope.

.4 Curing

.1 Cure grout in accordance with manufacturer's instructions.

.2 Non-shrinking grout shall be protected against rapid loss of moisture by covering with wet cloths or polyethylene sheets. After edge finishing is completed, the grout shall be wet cured for at least three (3) days and then an acceptable membrane curing compound shall be applied.

.5 Protection

.1 Protect grout from temperatures at and below 0 degrees C until grout has attained compressive strength of 21 MPa.

.2 Protect completed grout from damage during construction.

END OF SECTION

DIVISION 05 INDEX

METAL FABRICATIONS

PART 1 GENERAL

1.1 SCOPE OF WORK

.1 Design, supply and install the following items including bolts, nuts, washers, anchors, hardware,

.1 Lintels, concrete protection angles, embedded grating supports
.2 Checkered plate covers and supports.
.3 Platform framing.
.4 Handrail and guardrail complete with kick plates.
.5 Removable guardrails with sockets.
.6 Masonry top lateral supports.
.7 All other miscellaneous metal items shown on the drawings.

1.2 RELATED SECTIONS

.1 Section 01 33 00 - Submittals

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

.3 Section 04 05 00 - Masonry Procedures

.4 Section 04 05 19 - Masonry Anchorage and Reinforcing

.5 Section 05 51 00 - Metal Stairs and Ladders

.6 Section 05 53 00 - Grating

.7 Section 09 90 00 – Paint

1.3 REFERENCES

.1 All products shall conform to the following standards and regulations:

.2 ASTM International (ASTM).

.1 ASTM A53/A53-20 - Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
.2 ASTM A123/A123M-17 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
.3 ASTM A276/A276M-17 - Standard Specification for Stainless Steel Bars and Shapes
.4 ASTM A307-14e1 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60000 psi Tensile Strength

.5 ASTM A780/A780M-20 Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings

.6 ASTM D1187/D1187M-20 - Standard Specification for Asphalt-Base Emulsions for Use as Protective Coatings for Metal

.7 ASTM D5360-15 – Standard Practice for Design and Construction of Bituminous Surface Treatment

.8 ASTM D6511/D6511M-18 - Standard Test Methods for Solvent Bearing Bituminous Compounds

.9 ASTM F1554-20 – Standard Specifications for Anchor Bolts

.10 ASTM F3125-15 – Standard Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 830 MPa and 1040 MPa Minimum Tensile Strength

.11 ASTM F593-17 – Standard Specification for Stainless Steel bolts, Hex Cap Screws, and Studs.

.3 Canadian Standards Association (CSA):

.1 CSA G40.20-13/G40.21-13 (R2018) - General Requirements for Rolled or Welded Structural Quality Steel / Structural Quality Steel

.2 CAN/CSA S16-19 - Design of Steel Structures

.3 CAN/CSA S157-17/S157.1-17 - Strength Design in Aluminum / Commentary on CSA S157-05, Strength Design in Aluminum

.4 CSA W47.2-11 (R2020) – Certification of Companies for Fusion Welding of Aluminum

.5 CSA W48-18 - Filler Metals and Allied Materials for Metal-Arc Welding

.6 CSA W59.2-M1991 (R2018) - Welded Aluminum Construction

.7 CSA W59-18 - Welded Steel Construction (Metal-Arc Welding)

.4 American Institute of Steel Construction (AISC):

.1 AISC 370-21 Specifications for Structural Stainless Steel Buildings

.5 American Welding Society (AWS)

.1 AWS D1.6/D1.6M-17 – Structural Welding Code – Stainless Steel

.6 The National Association of Architectural Metal Manufactures (NAAMM):

.1 NAAMM-AMP 521-01(R2012) – Pipe Railing System Manual (Fourth Edition)

1.4 SUBMITTALS

.1 Submit shop drawings in accordance with Section 01 33 00 – Submittals.

.2 Indicate materials, core thicknesses, finishes, connections, joints, method of anchorage, number of anchors, supports, reinforcement, details and accessories.

.3 Design loads and general arrangement shall be clearly identified on the shop drawings.

.4 In preparing shop drawings, the fabricator shall verify that all component parts and assembly of each item will support the superimposed loads without deflection detrimental to function, appearance or safety.

.5 Provide signed and sealed shop drawings certified by a Professional Engineer licensed in the Province of Ontario.

.6 Upon request, submit design calculations signed and sealed by a Professional Engineer licensed in the Province of Ontario.

.7 Submit Environmental Product Declarations (EPD) showing Global Warming Potential (GWP) impact category.

1.5 PROTECTION

.1 Cover exposed stainless steel surfaces with pressure sensitive heavy protection paper or apply strippable plastic coating, before shipping to job site.

.2 Leave protective covering in place until final cleaning of building. Provide instructions for removal of protective covering.

.3 Prevent metals from collecting standing water and protect from staining.

PART 2 PRODUCTS

2.1 MATERIALS

.1 Structural steel columns and beams: to CSA G40.20/G40.21, Grade 350W.

.2 Steel angles, channels and plates: to CSA G40.20/G40.21, Grade 300W.

.3 Hollow Structural Sections (HSS): conform to CAN/CSA G40.21, Grade 350W, Class H.

.4 Welding materials:

.1 to CSA W59 for Steel.
.2 to CSA W59.2 for Aluminum.
.3 to AWS D1.6 for Stainless Steel

.5 Welding electrodes: to CSA W48 Series.

.6 Anchor Rods: to ASTM F1554.

.7 High Strength Bolts and Nuts: to ASTM F3125

.8 Aluminum shall conform to the following alloy designations of the Aluminum Association:

.1 Extruded Shapes – Structural: 6061-T6.

.2 Smooth Plates: 5083-H34.

.3 Rivets and Bolts: 6061-T6.

.4 Checkered or Tread Plate: 6061-T6.

.9 Stainless steel shapes: to ASTM A276, Type 316L

.10 Stainless steel plate: to ASTM A276, Type 316L

.11 Stainless steel bolts and nuts: to ASTM F593, Type 316L

.12 Grout: non-shrink, non-metallic, flowable, 24h, 15 MPa at 24 hours, pull-out strength 7.9 MPa.

2.2 FABRICATION

.1 Fabricate work square, true, straight and accurate to required size, with joints closely fitted and properly secured.

.2 Use self-tapping shake-proof screws on items requiring assembly by screws or as indicated.

.3 Where possible, fit and shop assemble work, ready for erection.

.4 Ensure exposed welds are continuous for length of each joint. File or grind exposed welds smooth and flush.

2.3 FINISHES

.1 Galvanizing: hot-dipped galvanizing with zinc coating 610 g/m^2 to ASTM A123M.

.2 Zinc primer: zinc rich, ready mix in accordance with Section 09900 Paint.

.3 Bituminous Paint: quick-drying asphalt utility enamel.

.4 Aluminum to be anodized.

2.4 ISOLATION COATING

.1 Isolate aluminum from following components, by means of bituminous paint:

.1 Dissimilar metals except stainless steel, zinc or white bronze of small area.

.2 Concrete, mortar and masonry.

.3 Wood.

2.5 SHOP PAINTING

.1 Apply one (1) coat of primer to metal items, with exception of galvanized or concrete encased items.

.2 Use primer unadulterated, as prepared by manufacturer. Paint on dry surfaces, free from rust, scale, grease. Do not paint when temperature is lower than 7ºC.

.3 Clean surfaces to be field welded. Do not paint.

2.6 PLATFORM FRAMING

.1 All angles, channels, beams and related connection hardware as indicated.

.2 Material type shall be as indicated on the drawings.

.3 Design framing to resist concentrated load of 1.0 kN at mid span or 4.8 kPa uniform live loading on platform unless noted otherwise on the drawings.

.4 Limit live load deflection of beams to 1/360th of the span or 6mm, whichever is smaller.

.5 For outdoor platforms, wind load to follow OBC with post-disaster category and limit wind drift to H/200.

.6 Design platforms to account for fall-arrest ultimate load of 22 kN where applicable.

.7 Design base post connections and anchorage to concrete or precast concrete.

2.7 CHECKERED PLATES AND FRAMES

.1 All angles, channels, beams and related connection hardware as indicated.

.2 Material type shall be as indicated on the drawings.

.3 Plates shall be provided with welded ribs as required to limit deflection of any plate to 1/360th of the span under a concentrated load of 1.0 kN at the centre or 4.8 kPa uniform live loading unless noted otherwise on the drawings.

.4 All free edges of the panel are to be stiffened to limit deflection and tripping hazard between adjacent plates.

.5 All checkered plates shall be approved ‘raised’ patterns and the edges of all plates shall be planed to a straight edge. The minimum thickness of plates shall be 6 mm.

.6 Checkered plates, when not detailed, shall be designed, subdivided and fastened as to be readily removable. Where cut, abutting edges shall have continuity of pattern.

.7 The angle frames and border bars shall have mitred corners neatly fitted and welded. Border bars shall be fastened to angle frames by welding.

.8 Checkered plates shall be fabricated in panels that can be easily handled by plant personnel. Unless otherwise indicated on the drawings, the weight of individual panels shall not exceed 35 kg.

.9 Panels shall be within 6 mm of authorized length and 6 mm of authorized width, and shall have a maximum difference in length of opposite diagonals of 6 mm.

.10 After installation, there shall be not more than 6 mm clearance between panels.

.11 Provide minimum of two recessed handles per panel or as indicated on the drawings. Handles to be max 300 mm from edge of panel.

2.8 PIPE "GRAB" BARS

.1 Stainless steel or aluminum pipe: 50 mm nominal outside diameter, formed to shapes and sizes as indicated on drawings.

2.9 GUARDRAIL AND HANDRAIL

.1 Materials and sizes as indicated on drawings.

.2 All transitions to be welded and smooth.

.3 Gaps in guards around equipment, or between individual guard pieces, to be no more than 200mm.

.4 Provide expansion joint sleeves as indicated on drawings.

2.10 REMOVABLE GUARDRAILS

.1 Materials and sizes as indicated on drawings.

.2 Removable guardrail sections are required as noted on the drawings.

.3 Gaps between individual guard piece shall not be more than 200 mm.

2.11 SAFETY GATES

.1 Gates in guardrail are to be of the same material as the guardrail.

.2 Gates to be complete with a lockable latch, and to swing shut automatically.

.3 Gate to be installed as to close in the direction of the hazard.

.4 Clapper plate to be of the same material as the gate and be installed on the gate as per vendor design.

.5 Spring-loaded hinge mechanism to be corrosion resistant material, all other hardware to be of stainless-steel Type 316.

.6 Gates to be designed for guard loading as per OBC, and to be engineered and stamped by vendor.

.7 Gate top rail to match the top rail elevation of adjacent guardrails.

2.12 SLAB CORNER GUARDS

.1 Cast-in Stainless steel angles Type 316L complete with welded studs as indicated on drawings.

2.13 EMBEDDED SUPPORT FRAMES FOR FLOOR PLATE, PRECAST STAIR LANDING AND GRATING

.1 Embedded angle support frames which are to be embedded in concrete shall be stainless steel, A276, AISI Type 316, unless indicated otherwise in the Contract Documents.

.2 Welded stainless steel Type 316 stud anchors for stainless steel support frames.

2.14 MISCELLANEOUS LINTEL ANGLES

.1 Miscellaneous lintel angles as indicated on the design drawings. Galvanized for face masonry supports.

2.15 SAFETY D-RING ANCHORS

.1 Supply CSA certified safety D-rings complete with fasteners/anchors to concrete or precast concrete.

.2 All materials to be stainless steel Type 316.

.3 Ultimate Design load = 22 kN at any direction.

2.16 MISCELLANEOUS ITEMS

.1 Review all drawings and include all other metal fabrications not included in the above noted list.

PART 3 EXECUTION

3.1 ERECTION

.1 Do welding work in accordance with CSA W59, unless specified otherwise.

.2 Erect metal work square, plumb, straight and true, accurately fitted with tight joints and intersections.

.3 Provide suitable means of anchorage acceptable to engineer such as dowels, anchor clips, bar anchors, expansion bolts and shields, chemically anchored bolts and toggles.

.4 Exposed fastening devices to match finish and be compatible with material through which they pass.

.5 Provide components for building by other sections in accordance with shop drawings and schedule.

.6 Make field connections with bolts to CAN/CSA S16 or weld.

.7 Hand items over for casting into concrete or building into masonry to appropriate trades together with setting templates.

.8 Touch-up rivets, field welds, bolts and burnt or scratched surfaces after completion of erection with primer.

.9 Touch-up galvanized surfaces with zinc rich primer where burned by field welding.

END OF SECTION

METAL STAIRS AND LADDERS

PART 1 GENERAL

1.1 SCOPE OF WORK

.1 Supply, fabricate and install metal stair and ladder assemblies in accordance with the requirements set forth in this section.

1.2 RELATED SECTIONS

.1 Section 01 33 00 – Submittals

.2 Section 03 30 00 – Cast-in-Place Concrete

.3 Section 04 05 00 – Masonry Procedures

.4 Section 05 50 00 – Metal Fabrications

1.3 REFERENCES

.1 American Society for Testing and Materials (ASTM):

.1 ASTM A123/A123M-17 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

.2 ASTM A276/A276M-17 - Standard Specification for Stainless Steel Bars and Shapes

.3 ASTM A307-14e1 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60000 psi Tensile Strength

.4 ASTM A53/A53M-20 - Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless

.5 ASTM F1554-20 - Standard Specifications for Anchor Bolts

.6 ASTM F3125-15 – Standard Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 830 MPa and 1040 MPa Minimum Tensile Strength

.7 ASTM F593-17 – Standard Specification for Stainless Steel bolts, Hex Cap Screws, and Studs.

.2 American Institute of Steel Construction (AISC):

.1 AISC 370-21 Specifications for Structural Stainless Steel Buildings

.3 American Welding Society (AWS)

.1 AWS D1.6/D1.6M-17 – Structural Welding Code – Stainless Steel

.4 The National Association of Architectural Metal Manufactures (NAAMM):

.1 NAAMM AMP 510-92 - Metal Stair Manual (Fifth Edition)

.5 American National Standards Institute (ANSI):

.1 ANSI/NAAMM AMP 521-01 (R2012) – Pipe Railing Systems Manual (Fourth Edition)

.2 ANSI/NAAMM MBG 531-17 - Metal Bar Grating Manual

.6 Canadian Standards Association (CSA):

.1 CSA G40.20-13/G40.21-13 (R2018)- General Requirements for Rolled or Welded Structural Quality Steel / Structural Quality Steel

.2 CSA S16-19 - Design of Steel Structures

.3 CAN/CSA S157-17/S157.1-17 - Strength Design in Aluminum / Commentary on CSA S157-05, Strength Design in Aluminum

.4 CSA W59-18 - Welded Steel Construction (Metal-Arc Welding)

.5 CSA W59.2-M1991 (R2018) - Welded Aluminum Construction

.7 Ontario Building Code (OBC) 2012 with Latest Amendments

1.4 QUALITY ASSURANCE

.1 In addition to the requirements of 01 45 00 – Quality Control, the following measures are required:

.2 Fabricator Qualifications

.1 Work of this section shall be carried out by a fabricator specialized in the type of work specified herein.

.2 Fabricator must have been producing stair systems for at least ten (10) years.

.3 Installer Qualifications

.1 Work of this section shall be carried out by a firm specialized in the type of work specified herein. Use competent installers, experienced, trained and approved by fabricator for application of materials being used. Installers shall have a minimum five (5) years of experience in installation and provide documentation of examples minimum of (5) five previous projects completed more than (1) year since construction closeout upon request by engineer.

1.5 SUBMITTALS

.1 Complete submittals in accordance with Section 01 33 00 - Submittals.

.2 Shop Drawings

.1 Submit engineered and certified shop drawings in accordance with Section 01 33 00 – Submittals.

.2 Indicate construction details, sizes of aluminum and/or stainless steel sections and thickness of aluminum and/or stainless steel sheets.

.3 Show sections and plans of stairs, dimensions and assembly of components.

.1 Stringers
.2 Treads
.3 Nosings
.4 Risers
.5 Headers
.6 Newels
.7 Platforms
.8 Struts, columns and hangers
.9 Railings
.10 Handrails
.11 Brackets
.12 Reinforcements
.13 Anchors
.14 Welded and bolted connections

.4 Comply with NAAMM minimum standards for construction, proportions and dimensions of fixed metal stairs.

.5 Indicate NAAMM stair classification

.6 Show all field connections.

.7 Provide setting diagrams for installation of anchors, location of pockets, weld plates for attachment of stairs and rails to structure, and blocking for attachment of wall rail.

.8 Specify adequate back-up support for anchoring handrail bracket.

.9 Indicate all required field measurements.

.10 Indicate all design loadings.

.11 Provide shop drawings certified by a Professional engineer licensed in the Province of Ontario.

.3 Submit Environmental Product Declarations (EPD) showing Global Warming Potential (GWP) impact category.

1.6 DELIVERY STORAGE AND HANDLING

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

.2 Deliver materials to the job site in good condition and properly protected against damage to finished surfaces.

.3 Storage On Site

.1 Store material in a location and in a manner to avoid damage. Stacking shall be done in a way, which will prevent bending and damage to factory finishes.

.2 Store aluminum and stainless steel components and materials in clean, dry location, away from uncured concrete and masonry. Cover with waterproof paper, tarpaulin or polyethylene sheeting in a manner that will permit circulation of air inside the covering.

.3 Keep handling on-site to a minimum. Exercise particular care to avoid damage to finishes of materials.

.4 Replace defective or damaged materials with new.

PART 2 PRODUCTS

2.1 DESIGN REQUIREMENTS

.1 Detail and fabricate stairs to NAAMM Metal Stairs Manual.

.1 Stair classification in accordance with NAAMM to be the following:

.1 All stair shall be Industrial class stair

.2 Design metal stair, posts and landing construction and connections to support a uniform live load of 4.8 kPa with deflection of stringer or landing framing not to exceed 1/360 of span or 6mm whichever is less.

.3 Detail and fabricate handrails and guardrail finishes to NAAMM Pipe Railing Systems Manual.

.4 Design handrails to resist lateral force obtained from the nonconcurrent application of:

.1 A concentrated load not less than 0.9kN applied at any point and in any direction for all handrails and,

.2 A uniform load not less than 0.7kN/m applied in any direction to handrails.

.5 Design Guardrail to resist lateral force obtained from the nonconcurrent application of:

.1 A concentrated load not less than 1.0kN applied horizontally at any point, at the minimum required height, and

.2 A uniform load of 0.75kN/m applied horizontally at any point, at the minimum required height, and

.3 A uniform load not less than 1.5kN/m applied vertically on the top rail.

.6 Detail and Design ladders and anchorage in accordance with Ontario Building Code MMAH Supplementary Standard SB-8 requirements.

.1 Factor of safety for designing components – 4:1

.2 Factor of safety for designing components with fall arrest systems – 10:1

2.2 MATERIALS

.1 Metal bar grating: to ANSI/NAAMM MBG 531, aluminum or stainless-steel Type 316, Type P-19, with abrasive nosings.

.2 Welding materials: to CSA W59.

.3 Anchor Rods: to ASTM F1554.

.4 High Strength Bolts and Nuts: to ASTM F3125.

.5 Aluminum shall conform to the following allowable designations of the Aluminum Association:

Extruded Shapes – Structural	6061-T6
Smooth Plates	5083-H34
Rivets and Bolts	6061-T6
Grating	6061-T6
Checkered or Tread Plate	6061-T6
Castings	356-T2
Hand Railing (clear anodized)	6351-T6

.6 All stainless steel to ASTM A276, Type 316.

2.3 FABRICATION

.1 Fabricate to NAAMM, Metal Stair Manual.

.2 Weld connections where possible, otherwise bolt connections. Countersink exposed fastenings, cut off bolts flush with nuts. Make exposed connections of same material, colour and finish as base material on which they occur.

.3 Accurately form connections with exposed faces flush, mitres and joints tight. Make risers of equal height.

.4 Grind or file exposed welds and steel sections smooth.

.5 Shop to fabricate stairs in sections as large and complete as practicable.

2.4 METAL GRATE STAIRS

.1 Material type shall be as indicated on the drawings.

.2 Treads shall have a permanently attached or integral non-skid nosing.

.3 Form grating, treads and landings, as indicated on drawing, from metal bar grating to profile indicated and secure to stringers and supports, as indicated. Form landings of grating and reinforce as required.

.4 Form stringers minimum 300 deep or equivalent aluminum section, as indicated.

2.5 GUARDRAIL AND HANDRAIL SYSTEM

.1 Fabricate to NAAMM Pipe Railing Systems Manual.

.2 Construct posts and handrails from aluminum tubing, as indicated.

.3 Form rail-to-end post connections and all changes in rail direction by radius bends or miltered joints.

.4 Remove burrs from all exposed cut edges.

.5 Form elbow bends and wall returns to uniform radius, free from buckles and twists, with smooth finished surfaces, or use prefabricated bends.

.6 Locate intermediate rails equally spaced per OBC requirements between top rail and finish floor or nosing line of tread.

.7 Close exposed ends of pipe and tubing by welding metal closure in place or by use of prefabricated fittings.

.8 Terminate at abutting wall with end flange.

.9 For posts set in concrete, furnish matching sleeves or inserts not less than 125mm.

.10 On posts set on stair stringers, weld posts directly to stringer or weld plate to bottom of post for bolting. Specify stiffener plate as required for strength at base of post.

.11 Welding:

.1 Accurately miter and cope intersections of posts and rails and weld all around.

.2 Weld joint to match Type 2 as described in page 7 of NAAM AMP 521.

.12 Provide vent/drain holes at ends of all closed sections of pipe for railing systems.

.13 Fabricate joints which will be exposed to the weather so as to exclude water, or provide weep holes where water may accumulate.

.14 Provide kick plate to extend no less than 125mm above the walking surface.

.15 If the expected discoloration, due to welding, of anodized aluminum and the resulting color discrepancies are not acceptable, they shall be touched up using an acceptable lacquer.

.16 All welded areas on stainless steel railing systems shall be ground and finished to blend with adjacent areas.

.17 Top-rail outside diameter, formed to shapes and sizes as indicated on drawings.

2.6 LADDERS

.1 Ladder rails, rungs and related hardware as shown on the drawings.

.2 Material type shall be as shown on the ladder schedule in the drawings.

.3 Coordinate final top of elevation with roof hatch frames and access hatch curbs.

2.7 LADDER EXTENSION BRACKET

.1 All materials shall be stainless steel type 316L.

.2 Design based on clause 2.1.6.

.3 Coordinate final location with the swing gate and guardrail post locations.

2.8 FALL-ARREST SYSTEM

.1 Ladders noted with safety mid-rail system shall be furnished with the Miller GlideLoc Vertical Rail System by Honeywell. Each ladder shall be equipped with a complete system including vertical rail, rung clamps and exit/entry gates at top and bottom of each ladder. Vertical rail shall span the entire length of each ladder. Vertical rails and rung clamps to be aluminum.

2.9 FINISHES

.1 Aluminum shall be clear anodized, unless noted otherwise on the drawings.

PART 3 EXECUTION

3.1 INSTALLATION OF STAIRS

.1 Prior to installation, field check and verify structural framing, ensure enclosures, weld plates, blocking, size and location of pockets are as called for on drawings.

.2 Install in accordance with NAAMM, Metal Stair Manual.

.3 Install plumb and true in exact locations, using welded connections wherever possible to provide rigid structure. Provide anchor bolts, bolts and plates for connecting stairs to structure.

.4 Hand items over for casting into concrete or building into masonry to appropriate trades, together with setting templates.

.5 Do welding work in accordance with CSA W59, unless specified otherwise.

.6 Touch-up shop primer to bolts, welds and burned or scratched surfaces at completion of erection.

.7 Install reinforcing mesh in tread and landing pans that are to receive concrete fill. Position and securely fasten mesh midway in depth of concrete. Size mesh to cover entire area of tread or landing. Prepare surface to receive tile finish.

3.2 INSTALLATION OF HANDRAIL SYSTEMS

.1 Install in accordance with NAAMM, Pipe Railing Systems Manual.

.2 Provide holes, pre-set sleeves, or inserts of sufficient depth in concrete to develop required post strength. Make hole diameter at least 19mm larger than O.D. of post.

.3 Ends of aluminum posts to be in direct contact with grout, concrete or masonry shall be coated with bituminous paint.

.4 Setting posts:

.1 Clean dust and foreign matter from sleeves.
.2 Moisten interior of holes and surrounding surfaces.
.3 Prepare and use grout in accordance with manufacturer's directions.
.4 Place posts in position and brace until grout sets.
.5 Pour mixture into annular space until it overflows the hole.
.6 Wipe off excess and leave 3mm build-up, sloped away from post.

.5 Set posts plumb and aligned to within 1:576.

.6 Set rails horizontal or parallel to rake of steps or ramp to within 1:576.

.7 Assemble connections end to end and splice joints by using internal sleeves, bonded by adhesive or mechanical connectors, or by field welding.

.8 Support wall handrails on brackets to withstand design loads as required but not more than 1.50 m on centers.

3.3 CLEANING

.1 As installation is completed, was thoroughly using clean water and soap, rinse with clean water.

.2 Do not use acid solution, steel wool or other harsh abrasives.

.3 If stain remains after washing, remove finish and restore in accordance with fabricator's recommendations.

.4 Protective wrappings shall not be removed until items are no longer subject to subsequent construction damage, at which time any necessary cleaning shall be performed.

END OF SECTION

GRATING

PART 1 GENERAL

1.1 SCOPE

.1 This section covers the supply, fabrication and installation of metal grating.

1.2 RELATED SECTIONS

.1 Section 05 50 00 – Metal Fabrications

.2 Section 05 51 00 – Metal Stairs and Ladders

1.3 REFERENCES

.1 American National Standards Institute (ANSI):

.1 ANSI/NAAMM MBG 531-09 - Metal Bar Grating Manual

.2 American Society for Testing and Materials (ASTM):

.1 ASTM B221-14 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.

.2 ASTM A666-15 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.

1.4 SUBMITTALS

.1 Make submittals in accordance with Section 01 33 00 – Submittals.

.2 Drawings shall indicate locations of grating supports, profiles, thicknesses, markings of panels and fastening methods.

.3 Provide drawings signed and sealed by a Professional Engineer licensed in the Province of Ontario.

.4 Submit Environmental Product Declarations (EPD) showing Global Warming Potential (GWP) impact category.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Materials shall be handled, transported and delivered in a manner that will prevent bends, dents, scratches or damage of any kind. Damaged materials shall be promptly replaced. Materials shall be stored off the ground.

PART 2 PRODUCTS

2.1 PERFORMANCE AND DESIGN REQUIREMENTS

.1 Design Criteria: Except as modified herein, the manufacture and fabrication of metal grating shall comply with recommendations in the "Metal Bar Grating Manual" of the National Association of Architectural Metal Manufacturers (NAAMM). Minimum grating depth shall be as indicated on the drawings.

.2 Design for distributed loads of 4.8 kPa and 1.3 kN point load or as indicated on the drawings, whichever is greater.

.3 Deflections shall be limited to L/360 or 6mm whichever is smaller.

.4 Grating: grating shall be pressure locked type, with cross bars deformed or swaged to prevent turning. Bearing bars shall be at least 5 mm thick flat stock or equivalent I-bars, with centre-to-centre spacing of 30 mm. Cross bar centre-to-centre spacing shall be 100 mm maximum. Grating shall be a mill finish.

2.2 MATERIALS

.1 Aluminum Grating: NAAMM MBG 531, ASTM B221, 6063-T6 or 6061-T6 alloy, pressure or swage locked, mill finish.

.2 Stainless Steel Grating: ASTM A666 Type 316, pressure locked.

.3 Grating Stair Treads: Grating stair treads shall match the material and finish of grating in adjacent platforms and floors. Treads shall have a permanently attached or integral non-skid nosing.

.4 Grating Fasteners: Manufacturer's standard, AISI Type 316 stainless steel.

.5 Clips, Bolts, Nuts, Washers: Manufacturer's standard, AISI Type 316 stainless steel.

.6 Welded Threaded Steel Studs: ASTM A108 fully threaded studs automatically welded with compatible nuts and washers; TRW Nelson Type CFL or acceptable equal.

.7 Stepped Locking Fasteners: Non-penetrating, non-welded mechanical fasteners, with stainless steel clips and bolts, galvanized cast iron body, Lindaptor "Grate-Fast" or Grating Specialty Co. "G-Clip".

2.3 FABRICATION

.1 Grating shall be fabricated in panels that can be easily handled by plant personnel. Unless otherwise indicated on the drawings, the weight of individual panels shall not exceed 35 kg.

.2 Panels shall be within 6 mm of authorized length and 6 mm of authorized width, and shall have a maximum difference in length of opposite diagonals of 6 mm. The spacing of bearing bars shall be within 1 mm of authorized spacing. Cross bars and edge bars of adjacent panels shall align.

.3 After installation, there shall be not more than 6 mm clearance between panels. All bearing bars shall be parallel. Bands and toe plates shall align within 3 mm tolerance, vertical and horizontal.

.4 All cuts in grating shall be sawed or sheared and banded.

.5 Grating panels shall be arranged so that openings are centred on a joint between panels. Toe plates extending the full depth of the grating and 125 mm above the top shall be provided around openings. Toe plates shall be welded to each bearing bar. The ends of bearing bars shall be banded. Bands shall be welded to the first, the last and every fourth intermediate bar. Bands and toe plates shall be 5 mm thick. Crossbars shall be cut off flush with the outside face of side bars.

.6 Metal frames anchored to or cast in concrete to support grating shall be stainless steel as indicated in drawing.

2.4 SHOP COATING

.1 Aluminum: All surfaces of aluminum that will be in contact with concrete, mortar or dissimilar metals shall be given a coat of bituminous coating on the contact surfaces.

PART 3 EXECUTION

3.1 GENERAL

.1 All grating shall lie flat, with no tendency to rock when installed. Poorly fitting or damaged grating shall be rejected.

.2 Grating openings may be field cut with the approval of Engineer, provided that no more than four (4) adjacent bearing bars are cut. If the grating is cut or modified in the field, affected surfaces shall be repaired or sealed to assure restoration of the corrosion resistance of the grating. Field cut openings must be spaced so that there are at least as many continuous bars between each opening as there are cut bars at the opening.

.3 After installation of grating panels, gap between grating panels shall not exceed 6mm.

3.2 ATTACHMENTS TO SUPPORTING STRUCTURE

.1 All grating shall have adequate bearing as per the manufacturers printed recommendations, but not less than 50mm.

.2 All grating supported aluminum structures shall be attached. Grating shall be attached to the supporting structure in accordance with the grating manufacturer's recommendations and submittals.

.3 Single span grating over flumes, manholes, pits or other openings in concrete floors may rest unattached in recesses constructed for that purpose.

.4 To preclude excessive accumulation of tolerances, an extra-long panel shall be provided for each unanchored grating cover that exceeds 6 m in length. The panel shall be cut to the required dimension after the remainder of the grating panels have been installed.

.5 Framing Supports: Unless indicated otherwise on the drawings, clip or flange block fasteners or stepped locking fasteners shall be used to attach grating to stainless steel or aluminum supports. Fasteners shall be secured to the supporting structure with stainless steel through bolts in drilled holes. Welded fasteners shall not be used.

3.3 FINISH TOUCH-UP

.1 After erection, all grating shall be cleaned. Damaged coatings shall be touched-up in accordance with the grating manufacturer's recommendations to fully restore the corrosion resistance of the grating. Cut ends shall be sealed with sealant of equal or superior corrosion resistance to the grating itself or repaired in accordance with the manufacturer's recommendations to assure full undamaged performance.

END OF SECTION

ANCHORAGE IN CONCRETE AND MASONRY

PART 1 GENERAL

1.1 SCOPE

.1 This section covers the procurement and installation of anchors in concrete and masonry. It includes cast-in-place anchor bolts, adhesive anchors, expansion anchors and epoxy grouted anchor bolts and reinforcing steel to be installed in concrete and masonry.

1.2 RELATED SECTIONS

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

.2 Section 04 20 00 - Concrete Masonry Unit

.3 Section 05 50 00 - Metal Fabrications

.4 Section 05 51 00 - Metal Stairs and Ladders

1.3 GENERAL

.1 Unless otherwise specified or indicated on the drawings, all anchors and anchor bolts shall be cast-in-place anchor bolts with forged heads or embedded nuts and washers. Unless otherwise indicated, bolts in concrete shall have a diameter of at least 20 mm and bolts in grouted masonry shall have a diameter of at least 13 mm.

.2 Unless otherwise indicated on the drawings, anchors and anchor bolts used in the following locations and applications shall be of the indicated materials. Other anchors and anchor bolts shall be as indicated on the drawings. Where stainless steel is indicated, use type 316 stainless steel.

.1 Cast-in-Place Anchor Bolts: Carbon Steel
.2 Submerged locations: Stainless steel
.3 Locations subject to splashing: Stainless steel
.4 Buried locations: Stainless steel
.5 Anchorage of structural steel columns: Galvanized steel
.6 Other exterior locations: Galvanized steel
.7 Other interior locations: Carbon steel

.3 Threaded Rod and Expansion Anchors:

.1 Submerged locations: Stainless steel, no mechanical anchors permitted
.2 Locations subject to splashing: Stainless steel, no mechanical anchors permitted
.3 Buried locations: Stainless steel

.4 Anchorage of structural steel columns: Stainless steel, no mechanical anchors permitted UNO.

.5 Other exterior locations: Stainless steel, no mechanical anchors permitted

.6 Other interior locations: Carbon steel

.4 Adhesive anchors and expansion anchors may be used instead of cast-in-place anchors where with the specific acceptance by the Engineer.

1.4 SUBMITTALS

.1 Submit in accordance with Section 01 33 00 – Submittal.

.2 Letters of certification indicating the manufacturer and types of adhesive anchors, expansion anchors and epoxy grouts to be supplied.

.3 A current ICC-ES Evaluation Service Report shall be submitted for all anchors that will be considered for use on this project.

.4 Product Data: Manufacturer's data sheets on each product to be used.

.5 Manufacturer’s Published Installation Instructions (MPII)

.6 Installation Training Records:

.1 Provide a list of names of all installers who are trained by the Manufacturer’s Field Representative on this jobsite prior to installation of products. Record must include the installer name, date of training, products included in the training and trainer name and contact information

.2 Provide a copy of the current ACI-CRSI or equivalent “Adhesive Anchor Installer” certification cards for all installers who will be installing adhesive anchors in the horizontal to vertically overhead orientation.

1.5 REFERENCES

.1 Canadian Standards Association (CSA):

.1 CAN/CSA-G30.18-09 (2019) - Carbon Steel Bars for Concrete Reinforcement

.2 American Society for Testing and Materials (ASTM):

.1 ASTM A307-14e1 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60000 psi Tensile Strength

.2 ASTM F593-17 - Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs

.3 ASTM F594-09 (2020) - Standard Specification for Stainless Steel Nuts

.4 ASTM A153/A153M-16a - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware

.5 ASTM A385/A385M-20 - Standard Practice for Providing High-Quality Zinc Coatings (Hot-Dip)

.3 American National Standards Institute (ANSI):

.1 ANSI/ASME B18.22M-1981 (R2010) - Metric Plain Washers

.4 American Concrete Institute (ACI):

.1 ACI 355.2-19 – Qualifications of Post-installed Mechanical Anchors in Concrete

.2 ACI 355.4-19 - Qualification of Post-Installed Adhesive Anchors in Concrete and Commentary

.5 ICC Evaluation Services (ICC-ES):

.1 ICC-ES AC193 – Mechanical Anchors in Concrete Elements

.2 ICC-ES AC308 – Post-Installed Adhesive Anchors in Concrete elements.

.3 ICC-ES ACC446 – Headed Cast-in Specialty Inserts in Concrete

1.6 DELIVERY, STORAGE AND HANDLING

.1 Materials shall be handled, transported and delivered in a manner that will prevent damage or corrosion. Damaged materials shall be promptly replaced.

.2 Keep anchors, rod materials, nuts and washers in original manufacturer's packaging with label intact until needed for use.

.3 Keep anchors free of dirt and debris.

.4 Protect anchors from corrosion and deterioration.

.5 Store all anchoring products in strict accordance with manufacturer's recommendations. For adhesive anchors, consider temperature, exposure to sunlight, and shelf life.

1.7 QUALITY ASSURANCE

.1 All post-installed anchors in concrete shall have current published ICC-ES Evaluation Report indicating the anchor is approved for installation in cracked concrete and shall have seismic qualification to meet the project requirements.

.2 Special inspection, where required by code, shall be in accordance with a current published ICC-ES Evaluation Reports.

.3 Where material or equipment must be supported from the structure, the installer of that material or equipment support shall be responsible for supplying the anchors and meeting the requirements of this specification unless specifically noted otherwise on the Drawings.

PART 2 PRODUCTS

2.1 MATERIALS

.1 Materials shall be as indicated below:

.1 Expansion Anchors: Hilti “Kwik-Bolt”; Red Head “Trubolt Wedge Anchor”; Dewalt “Power-Stud Anchor”.

.2 Reinforcing Bars: CAN/CSA G30.18 grade 400.

.3 Anchor Bolts and Nuts:

.1 Carbon Steel: ASTM A307 or grade 300 rod, with compatible nuts.

.2 Stainless Steel: Bolts, ASTM F593, Alloy Group 2 (316 SS); nuts, ASTM F594, Alloy Group 2.

.3 Galvanized Steel: Carbon steel bolts and nuts; hot-dipped galvanized, ASTM A153/A153M and ASTM A385/A385M.

.4 Flat Washers: ANSI/ASME B18.22M; of same material as anchor bolts and nuts.

.4 Threaded Rod Anchors and Nuts:

.1 Carbon Steel: Grade 300W rod, with compatible nuts.

.2 Stainless Steel: Rods, ASTM F593, Alloy Group 2 (316 SS); nuts, ASTM F594, Alloy Group 2.

.3 Galvanized Steel: Carbon steel rods and nuts; hot-dipped galvanized, ASTM A153/A153M and ASTM A385/A385M.

.5 Adhesive Anchors for Concrete and Grout Filled Masonry:

.1 Threaded Rods and Nuts: As specified for Threaded Rod Anchors and Nuts and as recommended by the adhesive manufacturer.

.2 Adhesive: Hilti “HIT HY 200 v3”, “HIT RE500”, Dewalt “AC200+”.

.6 Epoxy Grout for Reinforcing Bars, Threaded Rod Anchors and Anchor Bolts:

.1 Adhesive for Floors and Horizontal Surfaces: Sika “Sikadur 35, Hi-Mod LV”; BASF “MasterEmaco ADH 326”; Sika “Sikadur 32 Hi-Mod”, Hilti “HIT RE-500 v3”, Dewalt “Pure220+”.

.2 Adhesive for Vertical Surfaces and Overhead Applications: Sika “Sikadur 31 Hi-Mod Gel”.

.3 Aggregate: As recommended by the epoxy grout manufacturer.

.4 Water: Clean and free from deleterious substances.

.7 Adhesive Anchors for Hollow Masonry System:

.1 Threaded Rod Anchors and Nuts: As specified for Threaded Rod Anchors and Nuts and as recommended by the adhesive manufacturer.

.2 Adhesive: Hilti “HIT HY 270” System; Redhead “Epcon Ceramic 6” System.

.3 Screen Tubes: As recommended by the manufacturer.

.8 Undercut Anchors:

.1 Hilti HDA Undercut Anchor.

.2 USP Structural Connectors; DUC Undercut Anchor.

.9 Heavy Duty Sleeve Anchors:

.1 Hilti HSL3-R Heavy Duty Sleeve Stainless Steel Anchor.

.2 ITW Construction Products; Ramset/Red Head; Dynabolt Hex Nut Sleeve Anchor.

2.2 ANCHORS

.1 Cast-in-Place Anchor Bolts: Cast-in-place anchor bolts shall be delivered in time to permit setting before the structural concrete is placed. Anchors bolts shall be provided with sufficient threads to permit a nut to be installed on the concrete side of the concrete form or the supporting template. Two (2) nuts, a jam nut and a washer shall be furnished for cast-in-place anchor bolts indicated on the drawings to have locknuts; two (2) nuts and a washer shall be furnished for cast-in-place anchor bolts without locknuts. Installation of anchor bolts is covered in the cast-in-place concrete section.

.2 Adhesive and Expansion Anchors: When adhesive or expansion anchors are indicated on the drawings, only acceptable systems shall be used. Acceptable systems shall include only those systems and products specified or specifically indicated by product name on the drawings. The proposed alternate anchor shall belong to the same anchor category and inspection level as the specified anchor, in accordance with ACI 355.2 for mechanical anchors or ACI 355.4 for chemical anchors. All substitutions must be submitted for approval prior to installation. Alternative anchoring systems may be used only when specifically accepted by Engineer. An acceptable adhesive anchor system may be used as an alternative in locations where epoxy grouted anchor bolts and epoxy grouted threaded rod anchors are specified or indicated.

.1 Threaded rod anchors in adhesive anchor systems shall be furnished with a sufficient length to provide an embedment depth of at least 15 rod diameters and free of coatings that would weaken the bond with the adhesive. Unless otherwise required, single nut and washer shall be furnished for threaded rod anchors, adhesive anchors and expansion anchors. Anchor bolts and threaded rod anchors that are to be epoxy grouted shall be clean and free of coatings that would weaken the bond with the epoxy.

.2 Adhesive anchors in hollow masonry shall utilize screen tubes as recommended by the manufacturer.

.3 Epoxy Grouted Anchor Bolts and Reinforcing: Epoxy grout for installing reinforcing steel dowels and anchor bolts not indicated to be adhesive anchors shall consist of a two-component liquid epoxy adhesive of viscosity appropriate to the location and application and an inert aggregate filler component, if

recommended by the adhesive manufacturer. Components shall be packaged separately at the factory and mixed immediately before use.

.1 Anchor bolts and reinforcing steel shall be as indicated on the drawings.

PART 3 EXECUTION

3.1 GENERAL

.1 Anchor bolts shall be installed at the locations indicated on the drawings.

.2 Identify location of embedded items such as reinforcing steel, stressing tendons, conduit, heating tubes, etc. prior to drilling holes. Coordinate with respective trades if any apparent conflict exists. Exercise care in coring and drilling to avoid damaging any existing embedded items. If embedded items are encountered, stop drilling and contact Engineer immediately for direction. Any offsets or relocations of anchors must be approved by Engineer.

.3 Drill holes of proper diameter and depth in accordance with manufacturer's published design information for that specific anchor. Use only equipment approved by anchor manufacturer. All holes shall be perpendicular to the concrete surface unless shown otherwise on structural plans and/or details.

.4 Do not drill holes until base material has achieved full design strength.

.5 Installation of all post-installed anchor products shall be conducted in strict accordance with the Manufacturer's Published Installation Instructions (MPII). Use hammer drills for adhesive anchors (unless noted otherwise).

.6 Anti-seize thread lubricant shall be liberally applied to projecting, threaded portions of stainless steel anchors immediately before final installation and tightening of the nuts.

.7 Anchors shall be located at least 100 mm away from conduits, sleeves and drains bodies at their largest point measured on top of the slab above the anchor, and the like, embedded in the concrete.

.8 Anchors shall be installed in drilled holes with a minimum depth and diameter specified by the manufacturer unless noted otherwise.

.9 Anchors shall be assumed, for determining required anchor size, to be installed in an unreinforced concrete mass.

.10 Clean out holes, properly prepare substrate, and install anchors in accordance with manufacturer's instructions and current ICC-ES ESR. Proper tools must be on job site.

.11 If, when drilling the holes for the anchors, reinforcement is encountered and the hole must be shifted to clear the reinforcement, the abandoned hole shall be patched with non-shrink grout of similar properties as the base concrete.

3.2 CAST-IN-PLACE ANCHORS AND ANCHOR BOLTS

.1 Cast-in-place anchors and anchor bolts shall be carefully positioned with templates and secured in the forms prior to placing concrete. Contractor shall verify that anchorage devices are positioned in accordance with the design drawings and with applicable equipment submittal drawings. Anchors and bolts shall be positioned sufficiently in advance of the concrete placement so that an on-site representative of Engineer or Owner will have sufficient time to inspect the bolts prior to placing concrete. If special inspection of the anchor bolts is required by the local building code, anchorage shall be placed in sufficient time and with sufficient notification so that such inspection can take place without delaying progress of the work.

.2 Threads, bolts and nuts spattered with concrete during placement shall be cleaned prior to final installation of the bolts and nuts.

3.3 EPOXY GROUT

.1 Epoxy grout components shall be packaged separately at the factory and shall be mixed immediately before use. Proportioning and mixing of the components shall be done in accordance with the manufacturer's recommendations.

.2 An acceptable adhesive anchoring system may be used where epoxy grouted threaded rod anchors are indicated on the drawings.

.3 Preparation: Where indicated on the drawings, anchor bolts, threaded rod anchors and reinforcing bars shall be epoxy grouted in holes drilled into hardened concrete. Diameters of holes shall be as follows:

ITEM	DIAMETER OF HOLE
REINFORCING BARS AND THREADED ROD ANCHORS	3 MM LARGER THAN THE OUTSIDE DIAMETER OF THE BAR OR THE ROD
HEADED ANCHOR BOLTS	BOLT DIAMETER PLUS 50 MM AND SUFFICIENT TO CLEAR THE BOLT HEAD.

.4 The embedment depth for epoxy grouted anchor bolts, threaded rod anchors and reinforcing bars shall be at least 15 bolt, rod or bar diameters, unless otherwise indicated on the drawings.

.5 Holes shall be prepared for grouting as recommended by the epoxy grout manufacturer.

.6 Installation: Anchor bolts, threaded rod anchors and reinforcing bars shall be clean, dry and free of grease and other foreign matter when installed. The bolts,

rods and bars shall be set and positioned and the epoxy grout shall be placed and finished in accordance with the recommendations of the grout manufacturer. Care shall be taken to ensure that all spaces and cavities are filled with epoxy grout, without voids.

3.4 ADHESIVE ANCHORS

.1 When adhesive anchors are indicated on the drawings, only an acceptable system shall be used. Alternative anchoring systems may be used only when acceptable to Engineer. An acceptable adhesive anchor system may be used as an alternative in locations where epoxy grouted anchor bolts and threaded rod anchors are specified or indicated. The embedment depth for adhesive anchors shall be at least 15 rod diameters unless a greater depth is indicated on the drawings or as required by the product manufacturer.

.2 Adhesive for adhesive anchors shall be statically mixed in the field during application. All proportioning and mixing of the components shall be in accordance with the manufacturer's recommendations.

.3 Anchors shall be installed in holes drilled into hardened concrete or grout filled masonry. Diameter of holes shall be 3 mm larger than the outside diameter of the rod unless recommended otherwise by the anchor system manufacturer. Holes shall be prepared for insertion of the anchors by removing all dust and debris using procedures recommended by the adhesive manufacturer.

.4 Adhesive anchors and holes shall be clean, dry and free of grease and other foreign matter at the time of installation. The adhesive shall be placed, the rods shall be set and positioned and the adhesive shall be finished, all in accordance with the recommendations of the material manufacturer. Care shall be taken to ensure that all spaces and cavities are filled with adhesive, without voids and remain filled with adhesive until completion of the curing period. Adhesive shall be cured in accordance with the recommendations of the adhesive manufacturer.

3.5 EXPANSION ANCHORS

.1 When expansion anchors are indicated on the drawings, only an acceptable expansion anchor shall be used. Alternative systems may be used only when acceptable to Engineer. Expansion anchors shall be installed in accordance with the drawings, but in no case shall the depth of the hole be less than six (6) bolt diameters. The minimum distance between the centre of any expansion anchor and an edge or exterior corner of concrete shall be at least six (6) times the diameter of the bolt. Unless otherwise indicated on the drawings, the minimum distance between the centres of expansion anchors shall be at least 12 times the diameter of the bolt.

3.6 QUALITY CONTROL

.1 Implement a system of quality control to ensure that the minimum standards specified herein are attained.

.2 All post-installed anchors shall be installed by an installer trained for that specific product by a manufacturer's field representative. All training must be conducted on the jobsite prior to the installation of any products. A record of training must be submitted to the Engineer per the submittal instructions.

.3 All adhesive anchor installations in the horizontal to vertically overhead orientation shall be conducted by a certified Adhesive Anchor Installer(AAI) as certified by ACI-CRSI Adhesive Anchor Installer Certification program or approved equivalent. Current AAI Certificate must be submitted to the Engineer for approval prior to commencement of any adhesive anchor installations.

.4 Bring to the attention of the Consultant any defects in the work or departures from the contract documents that may occur during construction. The Consultant will decide upon corrective action and give his recommendations in writing.

.5 The Consultant's general review during construction and inspection and testing by independent inspection and testing agencies reporting to the Consultant are both undertaken to inform the Owner of the Contractor's performance and shall in no way augment the Contractor's quality control or relieve the Contractor of contractual responsibility.

3.7 NOTIFICATION

.1 Prior to commencing significant segments of the work, give the Consultant and independent inspection and testing agencies appropriate notification, so as to afford them reasonable opportunity to review the work. Failure to meet this requirement may be cause for the Consultant to classify the work as defective.

3.8 INSPECTION AND TESTING

.1 Appointment of Independent Inspection and Testing Companies:

.1 The Owner will appoint the independent inspection and testing companies to make inspections or perform tests as the Consultant directs. The independent inspection and testing companies shall be responsible only to the Consultant and shall make only such inspections or tests as the Consultant may direct.

.2 When defects are revealed, the Owner may request, at the Contractor's expense, additional inspection or testing to ascertain the full extent of the defect.

.2 Tests on Installed Anchors/rebar:

.1 Anchors/rebar: The independent inspection and testing company may test up to 10 percent of some of the installed anchors to the manufacturer's specified working load. Should defective anchors/rebar or under-capacity installations be found a higher percentage will be tested at the Contractor's expense.

3.9 DEFECTIVE MATERIALS AND WORK

.1 Where evidence exists that defective work has occurred or that work has been carried out incorporating defective materials, the Consultant may have tests, inspections or surveys performed, analytical calculations of structural strength made and the like in order to help determine whether the work must be repaired or replaced. Tests, inspections or surveys or calculations carried out under these circumstances will be made at the Contractor's expense, regardless of their results, which may be such that, in the Consultant's opinion, the work may be acceptable.

.2 All testing shall be conducted in accordance with the requirements of the Ontario Building Code, except where this would in the Consultant's opinion cause undue delay or give results not representative of the rejected material in place. In this case, the tests shall be conducted in accordance with the standards given by the Consultant.

.3 Materials or work which fails to meet specified requirements may be rejected by the Consultant whenever found at any time prior to final acceptance of the work regardless of previous inspection. If rejected, defective materials or work shall be promptly removed and replaced or repaired to the satisfaction of the Consultant, at no expense to the Owner.

END OF SECTION

DIVISION 06 INDEX

PART 1 GENERAL

1.1 INTENT

.1 This section describes the materials and procedures for the installation of rough carpentry including but not limited to miscellaneous interior carpentry, blocking, rough in framing and equipment mounting panels.

1.2 RELATED SPECIFICATION SECTIONS

.1 In addition to the general project requirements in Division 1, the following sections are referenced in this section:

.1 Section 05 51 00 – Metal Stairs and Ladders
.2 Section 05 55 00 - Metal Fabrications
.3 Section 05 55 50 – Anchorage in Concrete and Masonry
.4 Section 07 52 10 – Torch Applied Roofing
.5 Section 07 62 00 – Sheet Metal Flashing and Trim
.6 Section 07 72 00 – Roof Hatches
.7 Section 07 90 00 – Joint Sealants

1.3 REFERENCES

.1 National Building Code of Canada (NBCC)

.2 Canadian Standards Association (CSA):

.1 CSA O121-17 - Douglas Fir Plywood
.2 CSA O141-05 (R2014) - Softwood Lumber
.3 CSA O151-17 - Canadian Softwood Plywood
.4 CAN/CSA-O80 SERIES-15 CONSOLIDATED - Wood Preservation
.5 CAN/ULC-S102-18 - Standard Method of Test for Surface Burning Characteristics of Building Material Assemblies.

.3 American Society for Testing and Materials (ASTM):

.1 ASTM A123/A123M-17 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
.2 ASTM F1667-20 - Standard Specification for Driven Fasteners: Nails, Spikes, and Staples

.4 National Lumber Grades Authority (NLGA):

.1 Standard Grading Rules for Canadian Lumber (2014 Edition)

1.4 QUALITY ASSURANCE

.1 Lumber identification: by Grade Stamp of an agency certified by Canadian Lumber Standards Accreditation Board.

.2 Plywood identification: by grade mark in accordance with applicable CSA standards.

.3 "Treated" and "fire treated" identification: by grade mark in accordance with the Canadian Wood Preservers Bureau.

1.5 DELIVERY STORAGE AND HANDLING

.1 Store lumber in a dry place and protect from dampness and damage

.2 Store lumber flat with spacers between each bundle to provide air circulation. Provide for air circulation around stacks and under coverings.

PART 2 PRODUCTS

2.1 LUMBER MATERIAL

.1 Lumber: unless specified otherwise, softwood, SPF 1/2, moisture content 19 percent or less, in accordance with the following standards:

- .1 CSA O141
- .2 NLGA Standard Grading Rules for Canadian Lumber.
  - .1 Light Framing: Species Group D, Standard Grade.
  - .2 Studding: Species Group D, Stud Grade.
  - .3 Structural Light Framing: Species Group D, No. 1 Grade.
  - .4 Appearance Lumber: Species Group B, Appearance Grade.
  - .5 Hardwood Lumber: Of grade conforming to grading rules of U.S. National hardwood Lumber Association, solid Yellow Birch, select or better
  - .6 Concealed Framing Lumber: No. 2 White Pine, No. 2 Red Pine, or No. 1 Construction Eastern Spruce, Balsam Fir or Jack Pine, kiln dried, free from sap, shakes, splits, knots and other defects.
  - .7 Grounds, Nailing Strips, Blocking Furring, rough bucks, cants, curbs, fascia backing and sleepers: No 2 White Pine, No. 2 Red Pine, or No. 1 Construction Eastern Spruce, kiln dried, free from sap, shakes, splits, knots and other defects.
- .3 Glue: Waterproof
- .4 Field Applied Wood Preservative: For field cut ends, supply "Wolman End Cut" by Koppers Company Inc. or same CCA preservative as used for shop impregnation.
- .5 "Treated" Wood and Plywood (Decay and Termite Resistant):

.1 Koppers Company Inc., Womanized, Distributed by Hickson Building Products Limited.

.2 Timber Specialties K-33

.3 Provide vacuum/pressure impregnated lumber treated in accordance with CSA O80.

.4 Retention/Penetration Standards: Conform to CSA O80.

.5 Provide treated wood kiln dried to maximum 19% moisture content.

.6 Cut end liquid wood preservative as recommended by manufacturer of treated wood.

.6 "Fire Treated" Wood and Plywood:

.1 Koppers Company Inc., Dricon, Distributed by Hikson Building Products Limited.

.2 Timber Specialties Flame Proof LHC.

.3 Flame Spread: Max 25 in 30 minutes in accordance with CAN/ULC-S102.

.4 Provide fire treated wood kiln dried to max 19% moisture content.

.5 Do not resurface or rip fire treated wood if it affects the ULC label.

.6 Provide fire treated material bearing the stamp of the Canadian Wood Preservers Bureau and the ULC stamp.

.7 Interior Fire Retardant Treatment Lumber and Plywood: Pressure treated lumber and plywood with fire retardant chemicals to meet an UL-fr-5 rating with a surface-burning characteristics rating of 25 or less for flame spread, fuel contributed and smoke developed. Ensure each piece of fire retardant treated lumber and plywood bears a ULC label or imprint attesting to this rating.

2.2 PANEL MATERIALS

.1 Exterior Plywood: 19 mm (3/4") thick, waterproof, grade stamped exterior grade Douglas Fir plywood (DFP), select grade, unsanded conforming to CSA O121.

.2 Canadian softwood plywood (CSP): to CSA O151, standard construction.

2.3 ACCESSORIES

.1 Rough Hardware: Supply rough hardware to frame and fix rough carpentry. This includes bolts, anchors, nails, expansion shields and other fastenings required. Hot dip galvanize hardware for exterior work; elsewhere, provide cadmium plated hardware. Provide spiral thread nails except as indicated otherwise.

.2 Nails, spikes and staples: to ASTM F1667.

.3 Bolts: 12.5 mm diameter, unless indicated otherwise, complete with nuts and washers.

.4 Proprietary fasteners: toggle bolts, expansion shields and lag bolts, screws and lead or inorganic fibre plugs, explosive actuated fastening devices, recommended for purpose by manufacturer.

2.4 FINISHES

.1 Galvanizing: to ASTM A123/A123M, use galvanized fasteners for exterior work, interior highly humid areas, pressure-preservative, fire-retardant, treated lumber.

.2 Stainless steel: use stainless steel 316 alloy, as indicated.

2.5 WOOD PRESERVATIVE

.1 Pressure treated lumber CAN/CSA O80 Series to average net retention of 4.0 kg/m^3 of CCA preservative.

.2 Pressure treated plywood CAN/CSA O80 to average net retention of 4.0 kg/m^3 of CCA preservative.

PART 3 EXECUTION

3.1 EXAMINATION

.1 Verify actual site dimensions and location of adjacent materials prior to commencing work. Notify Engineer in writing of any conditions which would be detrimental to the installation.

.2 Beginning of installation indicates acceptance of site conditions.

3.2 PREPARATION

.1 Treat surfaces of material with wood preservative, before installation.

.2 Apply preservative by dipping or by brush to completely saturate and maintain wet film on surface for minimum three (3) minute soak on lumber and one (1) minute soak on plywood.

.3 Retreat surfaces exposed by cutting, trimming or boring with liberal brush application of preservative before installation.

.4 Mix intumescent paint coating product to manufacturer's recommendations. Do not thin or stain. Apply primer and paint coating providing fire resistant barrier in accordance with manufacturer's recommendations to achieve requirements of authorities having jurisdiction.

.5 Treat material as indicated:

.1 Wood cants, fascia backing, curbs, nailers, sleepers on roof deck.

.2 Wood furring and framing on outside surface of exterior masonry and concrete wall.

.3 Plywood backing for cement stucco.

3.3 INSTALLATION

.1 Comply with requirements of the OBC, supplemented by the following paragraphs.

.1 Properly frame together parts of the work with members accurately cut to size, closely fitted, well spiked and erected in a substantial manner, plumb, level, square and true to dimension.

.2 Install furring and blocking as required to space out and support casework, cabinets, wall and ceiling finishes, facings, fascia, soffit, siding and other work, as required.

.3 Locate joints over bearing or supporting surfaces.

.4 Provide running members full length wherever possible.

.5 Design for expansion and contraction of the materials.

.6 Install wood frame backing as shown on the drawings and as required for cement stucco finish.

.7 Install prefabricated roof trusses, plywood sheeting and any related framing, as required to complete installation.

.8 Align and plumb faces of furring and blocking to tolerance of 1:600.

.9 Install rough bucks, nailers and linings to rough openings, as required to provide backing for frames and other work.

.10 Install wood cants, fascia backing, nailers, curbs and other wood supports, as required, and secure using galvanized steel fasteners.

.11 Install wood backing, dressed, tapered and recessed slightly below top surface of roof insulation for roof hopper.

.12 Install sleepers as indicated.

.13 Install Tectum board to walls and ceiling, where indicated on the drawings.

.14 Frame, anchor, fasten, tie and brace members to provide necessary strength and rigidity.

.15 Countersink bolts where necessary to provide clearance for other work.

.16 Provide electrical equipment backboards for mounting electrical equipment as indicated. Use 19 mm thick plywood on 19 mm x 38 mm furring around spacing, perimeter and at maximum 300 mm intermediate.

3.4 POST-INSTALLATION

.1 Replace damaged work which cannot be satisfactorily repaired, restored or cleaned, to satisfaction of Engineer at no cost to Owner.

3.5 CLEANING

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

.2 Progress Cleaning: Perform cleanup as work progresses

.1 Leave work area clean at end of each day.

.3 Final cleaning: Upon completion, remove surplus materials, rubbish, tools, and equipment

.4 Waste Management:

.1 Collect recyclable waste and dispose of or recycle field generated construction waste created during construction or final cleaning related to work of this Section.

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

END OF SECTION

FIBREGLASS REINFORCED PLASTICS

PART 1 GENERAL

1.1 SCOPE OF WORK

.1 The Contractor shall furnish, fabricate and install all fibreglass reinforced plastic (FRP) items, with all appurtenances, accessories and incidentals necessary to produce a complete, operable and serviceable installation as shown on the Contract Drawings and as specified herein and in accordance with the requirements of the Contract Documents.

1.2 REFERENCES

.1 American Society for Testing and Materials (ASTM):

.1 ASTM D495-14 - Standard Test Method for High-Voltage, Low-Current, Dry Arc Resistance of Solid Electrical Insulation

.2 ASTM D635-14 - Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position

.3 ASTM D638-14 - Standard Test Method for Tensile Properties of Plastics

.4 ASTM D696-16 - Standard Test Method for Coefficient of Linear Thermal Expansion of Plastics Between -30°C and 30° with a Vitreous Silica Dilatometer

.5 ASTM D790-15e2 - Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials

.6 ASTM D2344/D2344M-16 - Standard Test Method for Short-Beam Strength of Polymer Matrix Composite Materials and Their Laminates

.7 ASTM E84-16 - Standard Test Method for Surface Burning Characteristics of Building Materials

.2 Canadian Standards Association (CSA):

.1 CSA S806-12 (R2021) – Design and Construction of building structures with FRP.

.2 CSA S807-19 – Specification for Fiber-Reinforced Polymers.

.3 Ontario Building Code 2012 with Latest Amendments.

1.3 SUBMITTALS

.1 The Contractor shall furnish shop drawings of all fabricated items and accessories in accordance with the provisions of this section.

.2 All submittals, calculations and drawings sealed by a Professional Engineer registered in the province of Ontario.

.3 All documentations shall be prepared in Metric (SI) units. Documentations prepared in Imperial units will not be accepted.

.4 Submit manufacturer's shop drawings clearly showing material sizes, types, styles, part or catalogue numbers, complete details for the fabrication and erection of components including, but not limited to, location, lengths, type and sizes of fasteners, clip angles, member sizes and connection details.

.5 Submit the manufacturer's published literature including structural design data, structural properties data, grating load/deflection tables, corrosion resistance tables, certificates of compliance, test reports as applicable, concrete anchor systems and their allowable load tables and design calculations for systems not sized or designed in the Contract Documents.

.6 The Contractor may be requested to submit sample pieces of each item specified herein for acceptance by the Engineer as to quality and color. Sample pieces shall be manufactured by the method to be used in the work.

.7 Submit Environmental Product Declarations (EPD) showing Global Warming Potential (GWP) impact category.

1.4 QUALITY ASSURANCE

.1 All items to be provided under this section shall be furnished only by manufacturers having experience in the design and manufacture of similar products and systems. If requested, experience shall be demonstrated by a record of at least five (5) previous separate, similar successful installations in the last five (5) years.

1.5 PRODUCT DELIVERY AND STORAGE

.1 Delivery of Materials: Manufactured materials shall be delivered in original, unbroken pallets, packages, containers or bundles bearing the label of the manufacturer. Adhesives, resins and their catalysts and hardeners shall be crated or boxed separately and noted as such to facilitate their movement to a dry, indoor storage facility.

.2 Storage of Products: All materials shall be carefully handled to prevent them from abrasion, cracking, chipping, twisting, other deformations and other types of damage. Store items in an enclosed area and free from contact with soil and water. Store adhesives, resins and their catalysts and hardeners in dry indoor storage facilities between 21ºC to 29ºC until they are required.

1.6 WARRANTY

.1 Submit a two-year warranty for work for this Section against in materials and workmanship including, but not limited to:

.2 Performance failure of units.

.3 Fading, discoloration or evidence of other defects of exterior surface.

PART 2 PRODUCTS

2.1 DESIGN CRITERIA

.1 General

.1 FRP shall be designed and constructed for a “post-disaster” importance category as defined in the OBC.

.2 Deflections

.1 Maximum deflection for total load is L/360, but no more than 6 mm.

.3 Design Loads

.1 FRP to support live loads, concentrated loads and wheel loads as shown on Contract drawings.

.4 Environmental Conditions

.1 Exposed to UV

.2 Clean up time: maximum 48 hours

.3 Temperature: ambient, exposed to the elements.

2.2 MANUFACTURER

.1 Acceptable manufacturers:

.1 Access Industrial Inc., Telephone: 905-602-4020

.2 Fibergrate Composite Structures Inc., Telephone: 1-800-263-3112

.3 Strongwell and distributed in Canada by Southwell Corp, Telephone: 1-877-984-7788

2.3 GENERAL

.1 All FRP items furnished under this section shall be composed of fibreglass reinforcement and resin in qualities, quantities, properties, arrangements and dimensions as necessary to meet the design requirements and dimensions as specified in the Contract Documents.

.2 Fibreglass reinforcement shall be continuous roving in sufficient quantities as needed by the application and/or physical properties required.

.3 Resin shall be Isophthalic Polyester for all systems, with chemical formulations as necessary to provide the corrosion resistance, strength and other physical properties as required.

.4 All finished surfaces of FRP items and fabrications shall be smooth, resin-rich, and free of voids and without dry spots, cracks, crazes or unreinforced areas. All glass fibres shall be well covered with resin to protect against their exposure due to wear or weathering.

2.4 MOLDED FRP GRATING – SQUARE MESH

.1 Grating shall be of a one (1) piece molded construction with tops and bottoms of bearing bars and cross bars in the same plane. Grating shall have a square mesh pattern providing bi-directional strength. Gratings shall be reinforced with rovings of equal number of layers in each direction. The top layer of reinforcement shall be no more than 5 mm below the top surface of the grating so as to provide maximum stiffness and prevent resin chipping of unreinforced surfaces. Percentage of glass (by weight) shall not exceed 35 percent so as to achieve maximum corrosion resistance and as required to maintain the structural requirements of the Contract.

.2 After molding, no dry glass fibre shall be visible on any surface of bearing bars or cross bars. All bars shall be smooth and uniform with no evidence of fibre orientation irregularities, interlaminar voids, porosity, resin rich or resin starved areas.

.3 Non slip surfacing: Grating shall be manufactured with a concave profile on the top of each bar providing maximum slip resistance. Secondarily applied grit shall be allowed as long as the top surface does not exceed 2 mm.

.4 Fire rating: Grating shall be fire retardant with a tested flame spread rating of 25 or less when tested in accordance with ASTM E84. Certifications shall be dated within the past two (2) years and test data performed only on the resin shall not be acceptable.

.5 Resin system: The resin system used in the manufacture of the grating shall be VI COR®, a premium grade vinyl ester fire retardant resin. Manufacturer may be required to submit corrosion data from tests performed on actual grating products in standard chemical environments. Corrosion resistance data of the base resin from the manufacturer is not a true indicator of grating product corrosion resistance and shall not be accepted.

.6 Color: Dark Grey

.7 Depth: 38mm with a tolerance of plus or minus 2 mm.

.8 Mesh Configuration: 38 mm x 38 mm with a tolerance of plus or minus 2 mm mesh centre line to centre line.

2.5 FRP COVER PANELS

.1 All panels and structural shapes are to be manufactured by the pultrusion process with a glass content minimum of 45 percent, maximum of 55 percent by weight for maximum sunlight and chemical resistance. The structural shapes shall be composed of fibreglass reinforcement and resin in qualities, quantities, properties, arrangements and dimensions as necessary to meet the design requirements and dimensions as specified in the Contract Documents.

.2 Panels and shapes shall be manufactured using a pultruded process vinyl ester grey resin with flame retardant and ultraviolet (UV) inhibitor additives. A synthetic surface veil fabric shall encase the glass reinforcement. FRP shapes shall achieve a flame spread rating of 25 or less in accordance with ASTM test method E-84, the flammability characteristics of UL 94 V0 and the self-extinguishing requirements of ASTM D635.

.3 Depth: 80 mm thickness panels.

.4 Top surface to be non-slip surface.

.5 Each panel shall come with recessed handles.

.6 Panels shall be fabricated in panels that can be easily handled by plant personnel. Unless otherwise indicated on the drawings, the weight of individual panels shall not exceed 35 kg.

.7 Provide embedded angle supports to be cast-in to the concrete.

.8 Pultruded structural shapes are to have the minimum longitudinal mechanical properties listed below:

Property	**ASTM Method**	**Value**	**Units**
Tensile Strength	D638	206 (30,000)	MPa (psi)
Tensile Modulus	D638	17.2 (2.5 x 106)	GPa (psi)
Flexural Strength	D790	206 (30,000)	MPa (psi)
Flexural Modulus	D790	12.4 (1.8 x 106)	GPa (psi)
Flexural Modulus (Full Section)	N/A	19.3 (2.8 x 106)	GPa (psi)
Short Beam Shear (Transverse)	D2344/D2344M	31 (4,500)	MPa (psi)
Shear Modulus (Transverse)	N/A	3.1 (4.5 x 105)	GPa (psi)
Coefficient of Thermal Expansion	D696	1.4 x 10-6	Cm/cm/°C
Flame Spread	E84	(8.0 x 10-6)	(In/in/°F)

PART 3 EXECUTION

3.1 GENERAL

.1 Measurements

.1 FRP Structures and systems supplied shall meet the dimensional requirements and tolerances as shown or specified. The Contractor shall provide and/or verify measurements in the field for work fabricated to fit field conditions as required by manufacturer to complete the work. When

field dimensions are not required, Contractor shall determine correct size and locations of required holes or cutouts from field dimensions before grating fabrication.

.2 Sealing

.1 All shop fabricated cuts, drilled holes, etc. shall be coated with vinyl ester resin to provide maximum corrosion resistance. All field fabricated cuts, drilled holes, etc. shall be coated similarly by the Contractor in accordance with the manufacturer's instructions.

.3 Hardware

.1 All hardware shall be Type 316 stainless steel. Type 316 stainless steel hold-down clips shall be provided and spaced at a maximum of 1220 mm apart with a minimum of four (4) per piece of panel or as recommended by the manufacturer.

3.2 GRATING

.1 Each grating section shall be readily removable, except where indicated on drawings. Manufacturer to provide openings and holes where located on the Contract Drawings and coordinated with other trades. Provide additional framing as required to support these openings.

.2 Grating openings, which fit around protrusions (pipes, cables, machinery, etc.), shall be discontinuous at approximately the centre line of opening so each section of grating is readily removable.

.3 Gratings shall be fabricated free from warps, twists or other defects that affect appearance and serviceability.

.4 Gratings shall be fabricated in panels that can be easily handled by plant personnel. Unless otherwise indicated on the drawings, the weight of individual panels shall not exceed 35 kg.

.5 Lock grating panels securely in place with hold-down fasteners as specified herein.

3.3 FRP COVER PANELS

.1 Each panel section shall be readily removable, except where indicated on drawings. Manufacturer to provide openings and holes where located on the Contract Drawings and coordinated with other trades. Provide additional framing as required to support these openings.

.2 Panel openings, which fit around protrusions (pipes, cables, machinery, etc.), shall be discontinuous at approximately the centre line of opening so each section of grating is readily removable.

.3 Panels shall be fabricated free from warps, twists or other defects that affect appearance and serviceability.

3.4 STRUCTURAL SYSTEMS

.1 Structural systems shall be assembled and erected in accordance with the manufacturers erection drawings. The Contractor shall ascertain that plumbness, level and alignment are within acceptable tolerances.

.2 Normal erection operations include the correction of minor misfits by moderate amounts of reaming or cutting to draw the elements into line. Errors which cannot be corrected by the foregoing means or require major changes in member configuration should be immediately reported to the Owner and fabricator to enable whoever is responsible to either correct the error or approve the most efficient and economic method of correction to be used.

3.5 INSPECTION

.1 Shop inspection is authorized as required by the Owner and shall be at Owner's expense. The fabricator shall give ample notice to Contractor, prior to the beginning of any fabrication work, so that inspection may be provided. The grating shall be as free as commercially possible from visual defects such as foreign inclusions, delamination, blisters, resin burns, air bubbles and pits. The surface shall have a smooth finish (except for non-slip top surfaces).

3.6 INSTALLATION

.1 Contractor shall install FRP structures in accordance with manufacturer's assembly drawings.

.2 Field cut and drill fibreglass reinforced plastic products with carbide or diamond tipped bits and blades.

.3 Seal cut or drilled surfaces in accordance with manufacturer's instructions. Follow manufacturer's instructions when cutting or drilling fibreglass products or using resin products; provide adequate ventilation.

END OF SECTION

DIVISION 07 INDEX

SHEET WATERPROOFING MEMBRANE

PART 1 GENERAL

1.1 INTENT

.1 This section describes the materials and procedures for the sheet waterproofing membranes installed by all trades including work in relation to below grade wall foundations and buried chambers, below grade chamber top slab or any other below grade concrete structures.

1.2 RELATED SECTIONS

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

.2 Section 07 21 20 – Board Insulation

.3 Section 07 90 00 – Joint Sealants

1.3 REFERENCES

.1 American Society for Testing of Materials (ASTM):

.1 ASTM D1970/D1970M-20 - Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection

.2 ASTM E96 / E96M-16 - Water Vapor Transmission of Materials

.3 ASTM D412-16 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers – Tension

.4 ASTM D882-18 - Standard Test Method for Tensile Properties of Thin Plastic Sheeting

.5 ASTM E154/E154M-08a (2019) - Standard Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover

.6 ASTM C578-19 – Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation

.2 Canadian General Standards Board (CGSB):

.1 CGSB 37.29-M89 – Rubber-Asphalt Sealing Compound

1.4 QUALITY ASSURANCE

.1 Submit in writing, a document stating that the applicator of the sheet waterproofing membranes specified in this section is recognized by the manufacturer as suitable for the execution of the work.

.2 Perform work in accordance with the printed requirements of the membrane manufacturer and this specification.

.3 Maintain one (1) copy of manufacturer instructions on site.

.4 At the beginning of the work and at all times during the execution of the work, allow access to work site by the membrane manufacturer's representative.

.5 Components used in this section shall be sourced from one (1) manufacturer, including sheet membrane, air/vapour barrier sealants, primers, mastics and adhesives.

.6 Ensure products used are compatible with existing materials.

.7 Mock-up

1.5 ADMINISTRATIVE REQUIREMENTS

.1 Pre-installation meetings: comply with Section 01 30 00 - Administrative Requirements. Conduct pre-installation meeting one week prior to commencing work of this Section and on-site installations to:

.1 Verify project requirements, including mock-up requirements.

.2 Verify substrate conditions.

.3 Co-ordinate products, installation methods and techniques.

.4 Sequence work of related sections.

.5 Co-ordinate with other building sub-trades leaving all chases, slots and reglets and building-in all frames, sleeves, anchors, bolts, etc. as supplied by others and to ensure proper installation and site preparation.

.6 Review manufacturer's installation instructions.

.7 Review masonry cutting operations, methods and tools and determine worker safety and protection from dust during cutting operations.

.8 Review warranty requirements.

.2 Sequencing: sequence with other work in accordance with Section 01 13 00 Work Sequences and Tie-Ins.

1.6 SUBMITTALS

.1 Prior to commencing the work, submit copies of manufacturer's current certification to ISO 9002. Membrane, primers, sealants, adhesives and associated auxiliary materials shall be included.

.2 Prior to commencing the work, submit references clearly indicating that the materials proposed have been installed for not less than five (5) years on projects of similar scope and nature. Submit references for a minimum of 10 projects.

.3 Prior to commencing the work, submit manufacturer's complete set of standard details for sheet waterproofing.

.4 Alternatives

.1 Submit requests for alternatives in accordance with Section 01 20 00 – Alternatives.

1.7 DELIVERY, STORAGE AND HANDLING

.1 Deliver material to the job site in undamaged and original packaging indicating the name of the manufacturer and product.

.2 Store roll materials horizontally in original packaging.

.3 Store adhesives and primers at temperatures of 5°C and above to facilitate handling.

.4 Keep solvent away from open flame and excessive heat.

.5 Protect rolls from direct sunlight until ready to use.

1.8 COORDINATION

.1 Ensure continuity of the waterproofing membrane throughout the scope of this section.

1.9 WARRANTY

.1 For the work of this section, the 12 month warranty period prescribed in [Section 01 76 00 – Warranty Works] is extended to [24 months] **[60 months]**.

.2 CONTRACTOR hereby warrants that the waterproofing membrane will stay in place and remain leakproof in accordance with Section 01 76 00 – Warranty Works, but for two (2) years.

.3 Waterproofing membrane manufacturer hereby warrants that the waterproofing membrane will remain in a watertight condition and will not leak as a result of faulty materials for a period of five (5) years. Scope of warranty shall include material required to return the membrane to a watertight condition.

PART 2 PRODUCTS

2.1 APPROVED MANUFACTURERS

.1 Henry Canada, 15 Wallsend Drive, Scarborough, Ontario, Canada, M1E 3X6, Phone: (800) 523-0268, e-mail: mclyde@henry.com, URL: www.bakor.com.

.2 SOPREMA Canada , 60 Sovereign Court, Woodbridge, Ontario, Canada L7L 6K8, Phone: (905) 265- 8088, e-mail:jharquail@soprema.ca, URL: www.soprema.ca.

.3 W.R Meadows of Canada, 70 Hannant Court, Milton, Ontario, Canada L9T 5C1, Phone: (905) 878-4122, e-mail: mmooney@wrmeadows.com, URL: www.wrmeadows.com.

.4 Equivalent products may be submitted for Engineer's approval providing the product submitted meets or exceeds the performance criteria of the products specified.

2.2 MATERIALS

.1 Self Adhered Waterproofing Membranes having the following physical properties:

.1 Thickness: 1.5 mm minimum.

.2 Flexibility: Pass @ -40°C to ASTM D1970/D1970M

.3 Vapour permeance: 2.8 ng/Pa.s.m^2 (0.05 perms) to ASTM E96/E96M.

.4 Tensile Strength (membrane): 2.24 MPa to ASTM D412.

.5 Tensile Strength (film): 34.5 MPa to ASTM D882.

.6 Elongation: 300 percent to ASTM D412.

.7 Puncture resistance: 200 N minimum to ASTM E154/E154M.

.8 Acceptable products

.1 Blueskin WP 200 as manufactured by Henry Canada, SBS modified bitumen, self-adhering sheet membrane with cross-laminated polyethylene film.

.2 Mel-Rol as manufactured by W.R. Meadows, 56 mil thick layer of polymeric waterproofing membrane on a heavy duty, four-mil thick, cross-laminated polyethylene carrier film.

.3 Colphene 3000 as manufactured by Soprema, A 1.5 mm self-adhesive waterproofing membrane composed of SBS modified bitumen and a Tri-Laminate Woven Polyethylene facer. The self-adhesive side is covered by a silicone release sheet

.2 Primer

.1 Primer for self-adhering waterproofing membrane having the following physical properties.

.1 Weight: 1.0 kg/l.

.2 Solids by weight: 53 percent.

.3 Water-based, no solvent odours.

.4 Drying time (initial set): 30 minutes.

.5 Acceptable products

.1 Aquatac Primer as manufactured by Henry Canada., a polymer emulsion based adhesive type, quick setting for temperatures above –40°C.

.2 MEL-PRIME as manufactured by W.R. Meadows,

.3 Sopraseal Stick Primer as manufactured by Soprema.

.2 Primer for self-adhering waterproofing membrane having the following physical properties.

.1 Weight: 0.8 kg/l.

.2 Solids by weight: 35 percent.

.3 Drying time (initial set): 30 minutes

.4 Acceptable products

.1 Blueskin Primer as manufactured by Henry Canada, a synthetic rubber-based adhesive type, quick setting for all temperatures.

.2 A blend of elastomeric bitumen, volatile solvents, and adhesive enhancing resins used to prime porous substrates and non-porous substrates to enhance the adhesion of self-adhesive membranes at temperatures above -30°C.

.3 Liquid Membrane

.1 Liquid membrane having the following physical properties.

.1 Compatible with sheet waterproofing membrane substrate and insulation materials.

.2 Solids by volume: 60 percent.

.3 Vapour permeance: 2.9 ng/Pa.m^2.s ASTM E96/E96M.

.4 Remains flexible with aging.

.5 Chemical resistance: Alkalis, calcium chloride, mild acid and salt solutions.

.6 Acceptable products

.1 Elasto-Seal LM as manufactured by Henry Canada, a cold-applied, one compound elastomeric waterproofing compound sealant designed to be used in conjuncture with sheet membrane.

.2 MEL-ROL LIQUID MEMBRANE as manufactured by W.R. Meadows, a two-component material.

.3 Hydralastic 836 for horizontal and vertical application as manufactured by W.R. Meadows

.4 Sopraseal LM200 T as manufactured by Soprema, water based single component Air and vapour barrier liquid membrane.

.4 Termination Sealant

.1 Sealant used to terminate edges of membrane with the following physical properties.

.1 Compatible with sheet waterproofing membrane, substrate and insulation materials.

.2 Solids by volume: 70 percent.

.3 Vapour Permeance: 2.9 ng/Pa.m^{2}s, ASTM E96/E96M.

.4 Complies with CGSB 37.29.

.5 Remains flexible with aging.

.6 Adheres to wet surfaces.

.7 Chemical resistance: Alkalis, calcium chloride, mild acid and salt solutions.

.8 Acceptable products

.1 Polybitume 570-05 Polymer Modified Sealing Compound as manufactured by Henry Canada, a polymer modified sealing compound

.2 Pointing mastic as manufactured by W.R. Meadows.

.3 Sopraseal Sealant as manufactured by Soprema, White solvent-based high-performance, moisture cure, solvent free polyether (STPE) sealant.

.5 Protection Board

.1 Protection Board having the following physical properties.

.1 Thickness: 2 mm.

.2 Weight: 0.45 kg/m^2.

.3 Compression Strength: 0.45 kg/cm^2.

.4 Acceptable products

.1 990-31 Polypropylene Protection Board as manufactured by Henry Canada, a polypropylene extruded flexible twin-wall protection board.

.2 Protection Course as manufactured by W.R. Meadows.

.3 TREMDrain 1000 as manufactured by Tremco

.4 SOPRABOARD as manufactured by Soprema, 3.2 mm thick mineral fortified Asphalt core support panel formed between two layers of asphalt saturated glass mat.

.2 Protection Board Adhesive having the following physical properties.

.1 Compatible with waterproofing membrane and substrate.

.2 Long term flexibility: Pass ASTM C578.

.3 Chemical resistance: Alkalis, mild acid and salt solutions.

.4 Acceptable products

.1 230-21 Adhesive as manufactured by Henry Canada, a synthetic rubber-base compound.

.2 POINTING MASTIC as manufactured by W.R. Meadows, a solvent-based adhesive.

.6 Drainage Board

.1 Drainage board: a dimple-raised moulded polystyrene fabric

.1 Acceptable products

.1 MEL-DRAIN, as manufactured by W.R. Meadows.

.2 Sopradrain 10 G as manufactured by Soprema, Polypropylene core high strength drainage panel with factory laminated geotextile.

PART 3 EXECUTION

3.1 EXAMINATION

.1 Verify that surfaces and conditions are ready to accept the work of this section. Commencement of the work or any parts thereof shall mean acceptance of the prepared substrate.

3.2 PREPARATION

.1 All surfaces must be sound, dry, clean and free of oil, grease, dirt, excess mortar, frost or other contaminants. Fill spalled area in substrate to provide an even plane.

.2 New concrete should be cured for a minimum of seven (7) days and must be dry before waterproofing membranes are applied. Lightweight structural concrete must be cured a minimum of 14 days.

.3 Use appropriate waterproofing membrane primer as recommended by manufacturer based on air and surface temperature at time of application.

3.3 PRIMER

.1 Apply primer for self-adhering membrane by roller or spray at rate recommended by manufacturer.

.2 Allow minimum of 30 minutes open time. Primed surfaces not covered by waterproofing membrane during the same working day must be re-primed.

3.4 JOINT AND CRACK TREATMENT

.1 All cracks in concrete 1.5 mm to 3 mm wide are to be pre-treated with as per manufacturer’s published recommendations.

.2 Horizontal to vertical inside corner transition areas are to be pre-treated as per manufacturers published recommendations. Apply a minimum 225 mm strip of membrane centred at the joint.

.3 All outside corners are to be pre-treated with a minimum 225 mm strip of membrane centred at the joint

.4 Where three (3) or more planes come into contact, reinforce with cut sections of reinforcement sheet as per manufacturer’s instructions.

3.5 PROJECTIONS

.1 Extend membrane tight to projection and seal with liquid membrane extending 65 mm along projection and 65 mm onto membrane.

3.6 WATERPROOFING MEMBRANE – VERTICAL APPLICATIONS

.1 Apply waterproofing membrane to prepared substrate in lengths of 2400 mm or less.

.2 Provide 65 mm laps at both sides and ends. Position for alignment and remove protective film. Press firmly into place. Promptly roll all laps with a countertop roller to effect seal. If more than one (1) length is required on a vertical surface, apply in a shingle fashion.

.3 Terminate membrane using specified mastic/ sealant or terminator bar, reglet or counter flashing as indicated. Refer to manufacturer's standard details.

.4 All laps within 300 mm of a 90º change in plane area are to be sealed with mastic/ sealant as per manufactures publish recommendations.

3.7 PROTECTION OF FINISHED WORK

.1 The waterproofing membrane is not designed for permanent exposure. Protect membrane from job site abuse as soon as possible following membrane application. Follow manufacturer's recommendations for the application of protection boards or drainage panels.

3.8 CLEANING

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

END OF SECTION

DRAINAGE BOARD

PART 1 GENERAL

1.1 DESCRIPTION

.1 This section specifies the requirements for the supply and installation of the elements required for drainage board at below grade structures.

.2 Waterproofing system: Thermofusible SBS modified bitumen membrane.

1.2 RELATED WORK

.1 Division [02 40 00] [Demolition and Structure Moving]

.2 Division [03 00 00] [Concrete]

.3 Division [04 00 00] [Masonry]

.4 Division [07 10 00] [Dampproofing and Waterproofing]

.5 Division [07 21 00] [Thermal Insulation]

1.3 COMPLEMENTARY WORK TO BE EXECUTED BY THE SUB-CONTRACTOR

1.4 TECHNICAL DOCUMENTS

.1 Submit two (2) copies of the most current technical data sheets. These documents must describe the physical properties of the material, [and explanations about product installation, including installation techniques, restrictions, limitations and other manufacturer recommendations.]

1.5 CONTRACTOR QUALIFICATIONS

.1 Waterproofing work shall be performed only by skilled applicators, employed by an installation contractor operating all adequate and necessary equipment to execute such work in accordance with the manufacturer’s recommendations and recognized standards.

1.6 MANUFACTURER’S REPRESENTATIVE

.1 The waterproofing materials manufacturer may delegate a representative to visit the work site at commencement of work.

.2 At all times, the contractor shall permit and facilitate access to the site by the manufacturer's representative cited above.

1.7 MATERIALS STORAGE

.1 Rolls of materials should be handled with care and proper equipment.

.2 Rolls of materials shall be carefully stored and adequately protected in accordance with the manufacturer's recommendations.

1.8 QUALITY ASSURANCE AND ENVIRONMENTAL MANAGEMENT

.1 The manufacturer of elastomeric bitumen products will provide proof of ISO 9001 and ISO 14001 certifications.

1.9 WARRANTIES

.1 The product manufacturer shall issue a written and signed document in the name of the owner, certifying the product will meet all the physical characteristic published by the manufacturer, for a period of 5 years, starting from the date of completion of installation of membranes. No letter amending the manufacturer's standard warranty will be accepted and the warranty certificate must reflect these requirements.

1.10 PARTIAL OWNER OCCUPANCY [NOT USED]

.1 Schedule and substantially complete designated portion so Work for Owner's occupancy prior to Substantial Performance of entire Work as require to phase and complete the project as per the approved schedule and in accordance with the Contract Administrator.

1.11 ALTERATIONS, ADDITIONS OR REPAIRS TO EXISTING FACILITIES

PART 2 PRODUCTS

2.1 DRAINAGE BOARD

.1 Description: SOPRADRAIN 10-G drainage panel, when installed in a conventional foundation, can be partially fixed (3a) or adhered (3b); when installed in a blindside waterproofing system, it is mechanically fastened (3c.).

.2 High-density polypropylene core drainage panel with a compressive Strength of 550 kPa (11 000 psf)

.3 Specified product: SOPRADRAIN 10G by SOPREMA.

2.2 FASTENERS

.1 Description: Concrete screws with 2" plates

PART 3 EXECUTION

3.1 EXAMINATION AND PREPARATION OF SURFACES

.1 Surface examination and preparation must be completed in conformance with recommendations in the SOPREMA Specifications Manual.

.2 Before waterproofing work begins, the owner's representative and the membrane contractor's foreman will inspect and approve substrate condition and ensure that related work has been properly executed. If necessary, a non-conformity notice will be issued to the contractor so that required corrections can be made. The start of the membrane application will mean that substrate conditions are acceptable for work completion.

.3 Before commencing work, all surfaces must be smooth, dry, clean and free of ice and debris as per manufacturer's recommendations.

.4 No materials will be installed during rain or snowfall.

3.2 METHOD OF EXECUTION

.1 Work shall be performed on a continuous basis as surface and weather conditions allow.

.2 Adjoining surfaces shall be protected against any damage that could result from the waterproofing installation.

3.3 EQUIPMENT

.1 Maintain all equipment and tools in good working order.

3.4 DRAINAGE BOARD INSTALLATION

.1 Install the drainage panel with the geotextile facing the retaining wall for blindside waterproofing systems and facing the backfill for conventional foundations.

.2 Unroll SOPRADRAIN 10-G and cut to desired length. Ensure that the geotextile overlap is correctly positioned on the adjacent panel and fold any excess fabric at ends under the core. If needed, seal the joints using strips of self-adhesive membrane such as SOPRASEAL FLASHPRO.

.3 3a. Fasten at leading edge only, above the waterproofing layer, using a termination bar. Fasten at a minimum of 305 mm (12 in) O.C.. Hold in place using backfill materials.

.4 3b. Partially adhere by applying spots of adhesive compatible with the substrate. Hold in place using backfill materials.

.5 3c. Fasten the panel using mechanical anchors adapted to the substrate and washers with a minimum diameter of 25 mm (1 in). Install an anchor at least

every 600 mm (24 in) at the top end with a ratio of one anchor per square metre (10 ft²) on the panel. (1) Use additional anchors where necessary at angle changes and details, so that the panel rests directly on a solid support.

END OF SECTION

SHEET VAPOUR RETARDERS

PART 1 GENERAL

1.1 INTENT

.1 This section describes the materials and procedures for sheet vapour retarders installed by all trades to provide a continuous barrier within the building envelope including work in relation to all openings through exterior walls / roofs, exterior service opening from electrical, mechanical and process.

1.2 RELATED WORK

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

.2 Section 04 05 00 – Masonry Procedures.

.3 Section 07 52 10 – MBM – Torch Applied Roofing

.4 Section 081 11 00 - Metal Doors and Frames.

.5 Division 15 Mechanical

.6 Division 16 - Electrical

1.3 REFERENCES

.1 CAN/CGSB-51.33-[M89], Vapour Barrier Sheet, Excluding Polyethylene, for Use in Building Construction.

.2 CAN/CGSB-51.34-M86 – M86 Vapour Barrier, Polyethylene Sheet, for Use in Building Construction

1.4 SUBMITTALS

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

.2 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet and include:

.1 Product characteristics.

.2 Performance criteria.

.3 Limitations.

.3 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS).

.4 Quality assurance submittals:

.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 and comply with written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

1.5 QUALITY ASSURANCE

.1 Health and Safety Requirements: do construction occupational health and safety in accordance with Health and Safety Requirements.

.2 Mock-Ups:

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

.2 Construct mock-up of sheet vapour barrier installation including one lap joint, one inside corner and at one electrical box. Mock-up may be part of finished work.

.3 Mock-up will be used to judge workmanship, substrate preparation, and material application.

.4 Allow 24 hours for inspection of mock-up by the Engineer before proceeding with vapour barrier work.

.3 When accepted, mock-up will demonstrate minimum standard of quality required for this work. Approved mock-up may remain as part of the finished work.

PART 2 PRODUCTS

2.1 SHEET VAPOUR BARRIER

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

2.2 ACCESSORIES

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

.2 Sealants: compatible with vapour retarder materials, recommended by vapour retarder manufacturer.

.3 Staples: minimum 6 mm leg.

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

PART 3 EXECUTION

3.1 INSTALLATION

.1 Ensure services are installed and inspected, prior to installation of retarder.

.2 Provide a bead of caulking on the face of the wood framing prior to installing the sheet vapour retarder.

.3 Install sheet vapour retarder on warm side of exterior assemblies, prior to installation of finishes, to form continuous retarder.

.4 Use sheets of largest practical size to minimize joints.

.5 Inspect for continuity. Repair punctures and tears with sealing tape before work is concealed.

3.2 EXTERIOR SURFACE OPENINGS

.1 Cut sheet vapour retarder to form openings and ensure material is lapped and sealed to frame.

3.3 PERIMETER SEALS

.1 Seal perimeter of sheet vapour barrier as follows:

.1 Apply continuous bead of sealant to substrate at perimeter of sheets and at all interior framing.
.2 Lap sheet over sealant and press into sealant bead.
.3 Install staples through lapped sheets at sealant bead into wood substrate.
.4 Ensure that no gaps exist in sealant bead. Smooth out folds and ripples occurring in sheet over sealant.

3.4 LAP JOINT SEALS

.1 Seal lap joints of sheet vapour barrier as follows:

.1 Attach first sheet to substrate.
.2 Apply continuous bead of sealant over solid backing at joint.
.3 Lap adjoining sheet minimum 150 mm and press into sealant bead.
.4 Install staples through lapped sheets at sealant bead into wood substrate.
.5 Ensure that no gaps exist in sealant bead. Smooth out folds and ripples occurring in sheet over sealant.

3.5 ELECTRICAL BOXES

.1 Seal electrical switch and outlet device boxes that penetrate vapour barrier as follows:

.1 Install moulded box vapour barrier.

.2 Apply sealant to seal edges of flange to main vapour barrier and seal wiring penetrations through box cover.

3.6 CLEANING

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

.2 Progress Cleaning: Perform cleanup as work progresses.

.1 Leave work area clean at end of each day.

.3 Final cleaning: Upon completion, remove surplus materials, rubbish, tools, and equipment.

.4 Waste Management:

.1 Collect recyclable waste and dispose of or recycle field generated construction waste created during construction or final cleaning related to work of this Section.

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

END OF SECTION

PART 1 GENERAL REQUIREMENTS

1.1 DESCRIPTION

.1 Supply labour, materials, and equipment required to complete the installation of the entire coating system for balconies above living space made of PMMA specified in this section, including the accessories used to complete the application of the PMMA-based liquid membranes.

.2 Refer to roofing specifications to complete system under PMMA-based liquid membranes.

.3 The guidelines in this document should be read in conjunction with the product data sheets.

.4 PMMA waterproofing system: ALSAN DECK 230-R by SOPREMA.

1.2 PERFORMANCE REQUIREMENTS

.1 Install waterproofing system to accommodate movements of the materials and structural elements in place.

.2 Ensure the continuity of waterproofing materials and assemblies of PMMA-based systems in accordance with the materials described in the related sections.

1.3 REFERENCES

.1 ASTM D2240: Standard Test Method for Rubber Property—Durometer Hardness

.2 ASTM D4060: Standard Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser

.3 ASTM D562: Standard Test Method for Consistency of Paints Measuring Krebs Unit (KU) Viscosity Using a Stormer-Type Viscometer

.4 ASTM D1475: Standard Test Method for Density of Liquid Coatings, Inks, and Related Products

.5 CAN/CSA-A23.1-04/A23.2-04 SECTION 6B: Concrete materials and methods of concrete construction/Test methods and standard practices for concrete

1.4 RELATED WORK

.1 Division [01 00 00] [General Requirements]

.2 Section [01 33 00] [Submittals Procedure]

.3 Section [03 01 00] [Maintenance of Concrete]

.4 Section [03 30 00] [Cast-in-place concrete]

.5 Section [03 31 00] [Structural concrete]

.6 Section [03 35 00] [Concrete Finishing]

.7 Section [03 39 00] [Concrete Curing]

1.5 SUBMITTALS

.1 Submit manufacturers' current product data sheets for the components of specified PMMA system and its accessories.

.2 Submit colour samples on rigid substrate for approval by the Owner, Architect or Engineer specified in Section 01 33 00 – Documents/Samples to Be Submitted.

1.6 CONTRACTOR QUALIFICATIONS

.1 Works described in this section must be carried out by a competent contractor certified in PMMA-based waterproofing, employed by a company having the adequate experience and equipment necessary for the works described in this document.

1.7 MANUFACTURER'S REPRESENTATIVE

.1 The waterproofing materials manufacturer may delegate a representative to visit the work site at commencement of work.

.2 The contractor shall at all times permit and facilitate job site access to any representative of the liquid-applied waterproofing materials manufacturer.

1.8 STORAGE OF MATERIALS

.1 The materials will be delivered to the work site in the sealed, undamaged original containers.

.2 The containers must display the lot number and date of manufacture of the product.

.3 The delivered materials will be carefully stored and adequately protected according to the manufacturer's recommendations in order to prevent deterioration caused by humidity, heat, direct sunlight, or any other source.

.4 Ensure storage areas sheltering coating materials are above 0 °C (32 °F) and below 25 °C (77 °F).

1.9 QUALITY ASSURANCE AND ENVIRONMENTAL MANAGEMENT

.1 Supply all coats of coating systems (including related components and accessories) from a single coating manufacturer to ensure complete system compatibility and integrity.

.2 The coating products manufacturer will provide proof of its ISO 9001 and ISO 14001 certifications.

1.10 WORK SAMPLES

.1 A sample of at least 2 m^2 (20 ft^2) representative of each system must be taken on site, reviewed, and accepted by all parties before starting any work. The sample will serve as a guide for the installation of each system in the entire project.

1.11 WARRANTIES

.1 The product manufacturer shall issue a written and signed document in the name of the owner, certifying the product will meet all the physical characteristic published by the manufacturer, for a period of five (5) years, starting from the date of completion of the application of liquid membranes. No letter amending the manufacturer's standard warranty will be accepted and the warranty certificate must reflect these requirements.

PART 2 PRODUCTS

2.1 MANUFACURER:

.1 SOPREMA CANADA INC

.2 1688 Jean-Berchmans-Michaud

.3 Drummondville, QC, J2C 8E9

.4 Web site: www.soprema.ca

2.2 LIQUID WATERPROOFING MEMBRANE ON FIELD SURFACE

.1 Description: Two-component polymethyl methacrylate-based (PMMA) liquid membrane is combined with fleece fabric to form a reinforced field membrane.

.2 Specified product: ALSAN RS 230 FIELD by SOPREMA.

2.3 LIQUID WATERPROOFING MEMBRANE ON FLASHINGS AND DETAILS

.1 Description: Two-component polymethyl methacrylate-based (PMMA) liquid membrane is combined with fleece fabric to form a reinforced flashing membrane.

.2 Specified product: ALSAN RS 230 FLASH by SOPREMA.

2.4 REINFORCEMENT

.1 Description: Non-woven, needle-punched polyester fabric used as fabric reinforcement in liquid-applied membrane systems.

.2 Specified product: ALSAN RS FLEECE by SOPREMA

2.5 WEARING COURSE

.1 Description: Two-component polymethyl methacrylate-based (PMMA) colourless liquid resin to which a coloured paste is added.

.2 Specified product: ALSAN RS 287 FINISH BASE by SOPREMA.

2.6 ACCESSORIES

.1 Catalyst

.1 Description: Reactive agent based on dibenzoyl peroxide used to induce curing of resin products during membrane application.

.2 Specified product: ALSAN RS CATALYST POWDER by SOPREMA

.2 Finish colour additive

.1 Description: Coloured additive to be added to a polymethyl methacrylate-based (PMMA) clear resin.

.2 Specified product: ALSAN RS COLOR ADDITIVE by SOPREMA

.3 Aggregate (silica sand)

.1 Description: Minimum hardness of 6 on Moh’s scale. Dry with screening at 32 (mesh).

.4 Cleaner

.1 Description: Clear solvent used to clean and reactivate the transition area of in-place rapid-curing. It can also be used as a solvent for cleaning product spills, tools and equipment.

.2 Specified product: ALSAN RS CLEANER by SOPREMA

PART 3 EXECUTION

3.1 EXAMINATION AND PREPARATION OF SURFACES

.1 Do not begin any work until surfaces are dry, and free of ice, oil, grease, dirt or other contaminants.

.2 Before waterproofing work begins, the owner's representative and the membrane contractor's foreman will inspect and approve substrate condition and ensure that related work has been properly executed. If necessary, a nonconformity notice will be issued to the contractor so that required corrections can be made.

.3 The decision to begin application of materials constitutes an implicit acceptance of the surface conditions.

.4 Apply coating materials in accordance with the safety and atmospheric conditions required by the manufacturer of the coating materials or in compliance with municipal, provincial or federal laws and regulations.

3.2 EXECUTION METHOD

.1 Waterproofing system work must be executed continuously as surfaces are prepared and weather conditions permit.

.2 Protect adjacent surfaces against any damage resulting from installation work.

.3 Installation temperatures must be higher than 10 °C (50 °F) during the installation for the summer version and -5 °C (23 °F) for the winter version.

.4 Products installation temperatures must always be respected, refer to technical data sheet of the specified product.

3.3 EQUIPMENT

.1 Maintain equipment and tools clean and in good working order.

3.4 APPLICATION OF THE WATERPROOFING MEMBRANE ON FLASHINGS AND DETAILS

.1 Note: Wherever possible, install flashing membranes before installing field-surface membranes to minimize traffic on the surfaces already installed.

.2 Note: All flashing membranes must be installed together with the surface membranes as the work progresses.

.3 Using a slow-speed mechanical agitator (200 to 400 rpm), thoroughly mix the entire container of resin for two minutes.

.4 Add the pre-measured catalyst to the resin according to the amounts indicated in the manufacturer's Catalyst Mixing Chart and mix for two minutes. Add the catalyst only to the amount of materials that will be used within the next 10 to 15 minutes.

.5 Apply the first layer of resin to the vertical substrate using rollers, brushes or squeegees provided for this purpose. The first layer must have a wet film thickness of 1.9 mm (75 mil).

.6 Lay out the specified polyester reinforcement on the resin immediately to prevent the formation of wrinkles, swellings or fishmouths. Each reinforcement shall overlap the previous one by 50 mm (2 in) laterally, and by 100 mm (4 in) at the endlaps.

.7 Use rollers, brushes or squeegees in order to fully saturate the reinforcement with resin and remove wrinkles and air bubbles under the reinforcement. The appearance of the reinforcement should be slightly opaque without any white trace. It is important to correct these defaults before the resin cures.

.8 Immediately apply the second layer of resin on top of the reinforcement using rollers, brushes or squeegees provided for this purpose. The second layer must have a wet film thickness of 815 µm (32 mil).

.9 Excess resin which is not absorbed should be used to saturate adjacent reinforcement.

3.5 INSTALLATION OF THE WATERPROOFING MEMBRANE ON THE FIELD SURFACE

.1 Using a slow-speed mechanical agitator (200 to 400 rpm), thoroughly mix the entire container of resin for two minutes.

.2 Add the pre-measured catalyst to the resin according to the amounts indicated in manufacturer's Catalyst Mixing Chart and mix for two minutes. Add the catalyst only to the amount of materials that will be used within the next 10 to 15 minutes.

.3 Apply the first layer of resin to the field surface using rollers, brushes or squeegees provided for this purpose. The first layer must have a wet film thickness of 1.9 mm (75 mil).

.4 Lay out the polyester reinforcement on the resin immediately to prevent the formation of wrinkles, swellings or fishmouths. Each reinforcement shall overlap the previous one by 50 mm (2 in) laterally, and by 100 mm (4 in) at the ends.

.5 Use rollers, brushes or squeegees in order to fully saturate the reinforcement with resin and remove wrinkles and air bubbles under the reinforcement. The appearance of the reinforcement should be slightly opaque without any white trace. It is important to correct these defaults before the resin cures.

.6 Immediately apply the second layer of resin on top of the reinforcement using rollers, brushes or squeegees provided for this purpose. The second layer must have a wet film thickness of 815 µm (32 mil).

.7 Excess resin which is not absorbed should be used to saturate adjacent reinforcement.

.8 Note: The waterproofing membrane layer must be dry before the wearing course is applied. Allow 1h to 1h30 for the summer formula and 1h to 2h for the winter formula.

3.6 APPLICATION OF THE WEARING COURSE

.1 Using a slow-speed mechanical agitator (200 to 400 rpm), thoroughly mix the entire container of resin for two minutes before each use.

.2 Add the coloured paste to the colourless resin mixture and mix for another two minutes.

.3 Add the silica sand to the colored resin at a ratio of approximately 10% of the resin volume and mix for about two minutes.

.4 Add the pre-measured catalyst to the resin according to the amounts indicated in the manufacturer's Catalyst Mixing Chart and mix for two minutes. Add the catalyst only to the amount of materials that will be used within the next 10 to 15 minutes.

.5 Apply the finishing resin layer on the self-levelling mortar using rollers, brushes or squeegees provided for this purpose. The layer most have a wet film thickness of 510 µm (20 mil).

3.7 INSPECTION

.1 Inspect all coats of the specified system applied in the liquid state at the end of the work before continuing with the covering work. All imperfections will need to be repaired.

.2 If water leakage should occur under a new waterproofing membrane caused by the incomplete installation of a flashing, the affected area should be removed and replaced at the contractor's expense.

3.8 CLEANING AND PROTECTION

.1 The applicator shall protect the liquid-applied waterproofing system from damage during its installation. The general contractor shall make provisions to protect the liquid-applied waterproofing during the remainder of the construction period. Repair any damage that may occur after application.

.2 Remove protective materials after application.

.3 Clean and remove daily all waste and debris from the worksite to avoid damage and operation disruption.

.4 Clean tools with a specified cleaner.

.5 It is recommended to cover the installation as soon as possible.

Note: SOPREMA INC. reserves the right to make changes to this specification and associated details without prior notice

END OF SECTION

BOARD INSULATION

PART 1 GENERAL

1.1 RELATED SECTIONS

.1 Section 04 05 00 Masonry Procedures

.2 Section 07 27 00 Self-Adhered Air Vapour Barrier Membrane

.3 Section 07 52 10 MBM – Torch Applied Roofing

.4 DIVISION 15 MECHANICAL

1.2 REFERENCES

.1 American Society for Testing and Materials (ASTM):

.1 ASTM C165-07 (R2017) – Recommended Practice for Measuring Compressive Properties of Thermal Insulations.

.2 ASTM C552-17e1 – Cellular Glass Thermal Insulation

.3 ASTM C578-19 – Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation

.4 ASTM C612-14 (R2019) – Mineral Fiber Block and Board Thermal InsulationASTM C1396/C1396M-14a – Standard Specification for Gypsum Board

.5 ASTM D1621-16 – Test Method for Compressive Properties of Rigid Cellular Plastics.

.6 ASTM E84-20 – Test Method for Surface Burning Characteristics of Building Materials.

.7 ASTM E96/E96M-16 - Standard Test Methods for Water Vapour Transmission of Materials

.2 Canadian General Standards Board (CGSB):

.1 CGSB 71-GP-24M-77 - Adhesive, Flexible, for Bonding Cellular Polystyrene Insulation

.3 Canadian Standards Association (CSA):

.1 CSA B149.1-20 - Natural Gas and Propane Installation Code

.2 Underwriters' Laboratories of Canada (ULC):

.3 CAN/ULC S701.1-2017 - Thermal Insulation, Polystyrene Boards

.4 CAN/ULC S704.1-2017 - Thermal Insulation, Polyurethane and Polyisocyanurate Boards, Faced

.5 CAN/ULC S126-14 (R2019) - Standard Method of Test for Fire Spread Under Roof-Deck Assemblies

1.3 QUALITY ASSURANCE

.1 In addition to the requirements of 01 45 00 – Quality Control, the following measures are required:

.2 Contractors Qualifications

.1 Work of this section shall be carried out by a firm specialized in the type of work specified herein. Use competent installers, experienced, trained and approved by material or system manufacturer for application of materials and systems being used. Installers shall have a minimum five (5) years of experience in installation and provide documentation of examples minimum of (5) five previous projects completed more than (1) year since construction closeout upon request by engineer.

1.4 SUBMITTALS

.1 Complete submittals in accordance with Specification Section 01 33 00.

.2 Product Data:

.1 Submit product data for each type of product specified including manufacturer's technical product data, installation instructions and recommendations for each type of roofing product required for the following items;

.3 Test Reports:

.1 Submit certified test reports showing compliance with specified performance characteristics and physical properties.

.4 Manufacturer's Instructions:

.1 Submit manufacturer's installation instructions.

1.5 DELIVERY STORAGE AND HANDLING

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

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

.3 Storage and Handling Requirements:

.1 In cold weather, store materials off ground, indoors, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

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

.3 Replace defective or damaged materials with new.

1.6 ENVIRONMENTAL AND SITE CONDITIONS

.1 Protect surfaces, and in particular the building cladding finishes, from being marred or contaminated by the materials. Examine the work of other Sections where such work is closely associated with the work of this Section and report any damage done to the work of this Section.

.2 Protect work of this Section from damage due to high velocity winds until building cladding or other permanent protection is in place.

.3 Maintain surface and ambient temperatures constantly between 10˚C and 38˚C during application and curing of adhesive except as permitted otherwise by the Contract Administrator in writing.

1.7 WARRANTY

.1 Submit a two-year warranty for the Work of this Section against defects in materials, and workmanship including but not limited to integrity and continuity of the thermal, air and vapour barriers.

.2 Contractor must submit a written warranty, signed and issued in the name of the Owner, certifying the thermal, air and vapour barriers will remain in place and maintain a minimum performance as day installed for a period of 2 years from the date of substantial completion.

PART 2 PRODUCTS

2.1 APPROVED MANUFACTURERS

.1 Dow Chemical Canada ULC Dow Building Solutions, 450 – 1st Street SW suit 2100, Calgary, Alberta, Canada, T2P 5H1, Phone: (866) 583-2583, URL: www.dowbuildingsolutions.com.

.2 Owens Corning, 3450 McNicoll Avenue, Scarborough, Ontario, Canada, M1V 1Z5, Phone: (905) 679-8120, e-mail:Tyler.simpson@owenscorning.com, URL: www.owenscorning.ca.

.3 SOPREMA Canada , 60 Sovereign Court, Woodbridge, Ontario, Canada L7L 6K8, Phone: (905) 265- 8088, e-mail:jharquail@soprema.ca, URL: www.soprema.ca.

.4 Equivalent products may be submitted for Engineer’s approval providing the product submitted meets or exceeds the performance criteria of the products specified.

2.2 MATERIALS

.1 Roof Insulation

.1 Polyisocyanurate to thickness as indicated on contract drawings. Maximum dimension when adhered shall be 1219 mm (4 feet).

.1 Conforming to CAN/ULC S704 type ii, faced, type 2, CAN/ULC-S107-M87, ASTM E119, ASTM C1289-95 and FM Standard 4450/4470. Conforming to CAN/ULC-S770

.2 Acceptable or Agency Approved Equivalent products:

.1 Sopra-iso PLUS as manufactured by Soprema

.2 Energy 3 CGF as manufactured by Johns Manville.

.3 EnergyGuard Ultra as Manufactured by GAF

.4 ACFoam III as manufactured by Atlas.

.2 Wall Insulation

(Rigid insulation for below grade applications and walls as indicated on Drawings).

Polyisocyanurate to thickness as indicated on contract drawings. Maximum dimension when adhered shall be 1219 mm (4 feet).

.1 Conforming to CAN/ULC S704 type ii, faced, type 2, CAN/ULC-S107-M87, ASTM E119, ASTM C1289-95 and FM Standard 4450/4470. Conforming to CAN/ULC-S770

.2 Acceptable or Agency Approved Equivalent products:

.1 Sopra-iso PLUS as manufactured by Soprema

.2 Energy 3 CGF as manufactured by Johns Manville.

.3 EnergyGuard Ultra as Manufactured by GAF

.4 ACFoam III as manufactured by Atlas.

.3 Under concrete slab on grade

.1 Extruded polystyrene: to CAN/ULC S701, Type 4, thickness as indicated, CFC free and HCFC free without ozone depletion potential greater than zero, Eco-Logo certified, square, shiplapped vented edges and certified low GWP.

.1 Acceptable material:

.1 SOPRA XPS 40 – Low GWP as manufactured by Soprema Inc

.2 Styrofoam™ Highload 40 (Type 4) – Low GWP by DuPont

.4 Sloped Roof Insulation

.1 Tapered Insulation: Posi-Slope Faced Polyisocyanurate: foam panels chemically bonded during the foaming process to facers on the top and bottom organic or inorganic surfaces. Tapered panels shall not be less

than 13 mm at any point of the roof to CAN/ULC-S704-03 meeting the requirements of CAN/ULC-S126.

.5 Miscellaneous Insulation

.1 Sheathing: 12.5 mm thick reinforced cement board

.2 Fibre board: to ASTM C612, ASTM C1396/C1396M.

.1 Type: 1VB.

.2 Density: 64 kg/m³ minimum.

.3 Thickness: 100 mm minimum.

.4 Acceptable material: Roxul Inc., CurtainRock.

.6 Perimeter Foundation Insulation: Extruded polystyrene board to ASTM C578

.1 (CAN/ULC-S701) Type IV, rigid, closed cell, with integral high density skin, c/w integral 5/16" (8mm) thick latex-modified concrete facing.

.1 Thermal Resistance: Long term aged R-value of 5per inch (0.03m2 K/W per mm), to ASTM C 518

.2 Board Size: 2' x 4' x 2 5/16" or 3 5/16" (610mm x 1219mm x 59mm or 84mm)

.3 Compressive Strength: to ASTM D 1621, minimum 40psi (275.6 kPa)

.4 Water Absorption: to ASTM D 2842, <0.1 (0.7% by volume max)

.5 Edges: Tongue and groove sides, square edge ends.

.6 Water Vapor Permeance: to ASTM E96, 0.8 (50 ng/Pas m2)

.7 Acceptable material:

.1 Styrofoam™ Brand Perimate™ - Low GWP.

.2 Metal Cap Flashing: 24ga (0.61mm) galvanized steel J-channel; 2 ¼" (57mm) wide, 4" (102mm) long leg and 2 ¼" (57mm) short leg; prefinished in color selected by Consultant, and supplied by other.

.3 Clips and Fasteners: corrosion-resistant type, sized to suit application; as supplied by insulation manufacturer.

.7 Adhesive

.1 Adhesive for polystyrene: to CGSB 71-GP-24M,

.1 Type 2

.2 Class B

.3 Low VOC.

2.3 ACCESSORIES

.1 Insulation clips: impale type, perforated 50 mm x 50 mm cold rolled carbon steel 0.8 mm thick, adhesive back, spindle of 2.5 mm diameter annealed steel, length to suit insulation, 25 mm diameter washers of self-locking type.

PART 3 EXECUTION

3.1 EXAMINATION

.1 Ensure that surfaces to receive adhesive or insulation are dry, suitable for bond, and free from loose material, projections, ice, frost, grease, oil or other matter detrimental to bond of the adhesive or uniform bedding of the insulation.

.2 Examine substrate and report unacceptable conditions. Commencing work will imply acceptance of substrate conditions.

3.2 INSTALLATION - GENERAL

.1 Install materials in accordance with the manufacturers' printed instructions and as specified.

.2 Install insulation to maintain continuity of thermal protection to building elements and spaces.

.3 In construction separating interior from exterior, locate air and vapour barrier on the warm-in-winter side of the insulation.

.4 Where hangers, anchors, and supports pass through insulation and vapour barrier construction, butter apertures with vapour barrier adhesive and ensure continuity of thermal and air and vapour barrier provisions.

.5 Fit insulation tight around electrical boxes, plumbing and heating pipes and ducts, around exterior doors and windows, brick anchors and other protrusions and butter all edges.

.6 Keep insulation minimum 75 mm from heat emitting devices such as recessed light fixtures and minimum 50 mm from sidewalls of CAN/ULC S604 Type A chimneys and CSA B149.1 Type B and L vents.

.7 Cut and trim insulation neatly to fit spaces. Butt joints tightly and butter with vapour sealer, offset vertical joints. Use only insulation boards free from chipped or broken edges. Use largest possible dimensions to reduce number of joints.

.8 Offset both vertical and horizontal joints in multiple layer applications.

.9 Do not enclose insulation until it has been inspected and approved by Engineer.

.10 Provide protection as recommended by manufacturer to maintain integrity of installed insulation until facing materials are in place.

3.3 INSTALLATION - MECHANICAL FASTENERS

.1 Install clips to supplement adhesive attachment of insulation. Apply clips to concrete or steel or on underside of structural slab substrate using adhesive or, where accepted, using powder-actuated or pneumatic fixing or welded

fastenings. Install mechanical fasteners 25 mm from end and edge of board at 600 mm o.c. and at the rate of one per square metre (one/10 ft²) for remainder of board.

.2 Do not support insulation on clips until adhesive has set. Where insulation adhesive is to form a vapour barrier, arrange clips generally at 300 mm centres both ways. Where insulation occurs on the undersides of horizontal construction, provide each clip with a 50 mm diameter 0.47 mm galvanized steel washer before applying retainer.

.3 For polyethylene or polyester faced air and vapour barrier torch apply clips and embed into air and vapour barrier.

.4 Mechanical fasteners applied to steel air and vapour barriers, remove primer paint and adhere stick clips to clean, bare metal. Alternatively, use welded insulation clips.

3.4 PERIMETER FOUNDATION INSULATION

.1 Interior application: extend boards 1600 mm as indicated, installed on inside face of perimeter foundation walls.

.2 Exterior application: extend boards 1600 mm minimum below finish grade, as indicated or to top of footing. Install on exterior face of perimeter foundation wall with adhesive.

.3 Under slab application: extend boards 1220 mm in from perimeter foundation wall. Lay boards on level compacted fill.

3.5 CAVITY WALL INSTALLATION

.1 Install specified vapour barrier on the exterior face of the interior wythe of the cavity wall to the manufacturer's specifications.

.2 Install polystyrene insulation boards on outer surface of inner wythe of wall cavity over impaling clips.

3.6 POLYISOCYANURATE ROOF INSULATION

.1 All tapered panels shall have a uniform slope and valley corners and crickets to be factory mitred by Posi-Slope Ent. Inc. All boards to be clearly coded and shall provide arrows to indicate the slope direction of each board. Manufacture in accordance with architect approved pre-engineered shop drawings by Posi-Slope.

.2 Slope: Taper insulation to provide the slope shown on the contract drawings.

.3 Total insulation system to have a minimum R Value of 15 at the roof drain.

3.7 PERIMETER INSULATION

.1 Layout concrete-faced insulation boards to maximize board sizes. Do not use boards less than 6" (150mm) wide

.2 Install concrete-faced insulation board system (horizontally) (vertically), complete with fastening clips and cap flashing in accordance with manufacturer's installation guidelines.

3.8 CLEANING

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

.2 Progress Cleaning: Perform cleanup as work progresses

.1 Leave work area clean at end of each day.

.3 Final cleaning: Upon completion, remove surplus materials, rubbish, tools, and equipment

.4 Waste Management:

.1 Collect recyclable waste and dispose of or recycle field generated construction waste created during construction or final cleaning related to work of this Section.

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

END OF SECTION

SPRAY IN PLACE URETHANE FOAM INSULATION

PART 1 GENERAL

1.1 INTENT

.1 This section describes

.2 Provide all articles, labour, materials, equipment and transportation, hoisting and incidentals noted, specified or required to complete the work of this Section.

1.2 RELATED SPECIFICATION SECTIONS

.1 In addition to the general project requirements in Division 1, the following sections are referenced in this section:

.2 Section 04 05 00 Masonry Procedures.

.3 Section 06 10 10 Rough Carpentry.

.4 Section 07 21 20 Board Insulation.

.5 Section 07 62 00 Sheet Metal Flashing and Trim

.6 Section 07 84 00 Fire Stopping.

1.3 CODE AND REGULATORY REQUIREMENTS

.1 All products shall conform to the following standards and regulations:

.1 Green Seal Environmental Standards

.1 Standard GC-03-93, Anti-Corrosive Paints.

.2 Standard GS-11-97, Architectural Paints.

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

.1 Material Safety Data Sheets (MSDS).

.3 Underwriters' Laboratories of Canada (ULC)

.1 CAN/ULC-S101-07, Fire Endurance Tests of Building Construction and Materials.

.2 CAN/ULC-S102-10, Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.

.3 CAN/ULC-S705.1-01, Standard for Thermal Insulation - Spray Applied Rigid Polyurethane Foam, Medium Density, Material Specification.

.4 CAN/ULC-S705.2-05, Standard for Thermal Insulation - Spray Applied Rigid Polyurethane Foam, Medium Density, Application.

1.4 QUALITY ASSURANCE

.1 In addition to the requirements of 01450 – Quality Control, the following measures are required:

.2 Applicators to conform to CAN/ULC-S705.2-05 and the manufacturers Quality Assurance Program.

.3 Contractors Qualifications

.1 Work of this section shall be carried out by a firm specialized in the type of work specified herein. Use competent installers, experienced, trained and approved by material or system manufacturer for application of materials and systems being used. Installers shall have a minimum five (5) years of experience in installation and provide documentation of examples minimum of (5) five previous projects completed more than (1) year since construction closeout upon request by engineer. Installers must be Certified by manufacturer as having successfully completed the manufacturers Quality Assurance and Training Program. The contractor is required to provide a letter to the manufacturer recognizing the certificate of the applicator.

.4 Mock-up

.1 Construct mock-up in accordance with Section 01450 - Quality Control.

.2 Construct mock-up 10 m² minimum, of sprayed insulation including one inside corner and one outside corner, door and window openings.

.3 Mock-up may be part of finished work.

.4 Allow 48 hours for inspection of mock-up by Engineer before proceeding with sprayed insulation work.

.5 Convene pre-installation meeting one week prior to beginning work of this Section and on-site installations in accordance with Section 01 31 00 – Project Management.

.1 Verify project requirements.

.2 Review installation and substrate conditions.

.3 Co-ordinate with other building subtrades.

.4 Review manufacturer's installation instructions and warranty requirements.

.6 Health and Safety Requirements: worker protection:

.1 Protect workers as recommended by CAN/ULC-S705.2 and manufacturer's recommendations:

.2 Workers must wear gloves, respirators, eye protection and long-sleeved protective clothing when applying foam insulation.

.7 Workers must not eat, drink or smoke while applying foam insulation.

1.5 SUBMITTALS

.1 Complete submittals in accordance with Specification Section 013300

.2 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Submit two copies WHMIS MSDS - Material Safety Data Sheets.

.3 Quality assurance submittals: submit following in accordance with Section 01450 - Quality Control.

.1 Test reports: submit certified test reports for insulation from approved independent testing laboratories, indicating compliance with specifications for specified performance characteristics and physical properties.

.2 Submit test reports in accordance with CAN/ULC-S102 for surface burning characteristics.

.3 Manufacturer's Instructions: submit manufacturer's installation instructions and special handling criteria, installation sequence and cleaning procedures.

.4 Manufacturer's Field Reports: submit to manufacturer's written reports within 3 days of review, verifying compliance of Work, as described in PART 3 - FIELD QUALITY CONTROL.

.4 Alternatives

.1 Submit requests for alternatives in accordance with Section 016300 Equivalents and Alternatives.

.2 Submit requests for alternatives for this section a minimum of 10 working days prior to tender closing for evaluation.

.3 Acceptable alternatives will be confirmed by addendum. Substitution materials not approved in writing prior to tender closing shall not be permitted for use on this project.

1.6 DELIVERY STORAGE AND HANDLING

.1 Refer to Specification Section 016100

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

.3 Packing, shipping, handling and unloading:

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

.4 Replace defective or damaged materials with new.

PART 2 PRODUCTS

2.1 APPROVED MANUFACTURERS

.1 Polyurethane Foam Systems Inc., 440 Conestogo Road, Waterloo, Ontario, Canada N2L 4E2, Phone: (888) 783-0751, e-mail: pfsi@demilec.com, URL: www.polarfoamsoya.ca.

.2 BASF Canada, 100 Milverton Drive, Mississauga, ON, L5R4H1 as represented by Building Resource inc, Phone: (866) 533 0233 URL: www.walltite.basf.ca.

.3 Icynene Inc, 6747 Campobello Road, Mississauga, Ontario, Canada L5N 2L7, Phone: (800) 758-7325, URL: www.icynene.com

.4 Soprema Canada, 60 Sovereign Ct, Woodbridge, ON Canada L4L 8M1, Phone: (905) 265- 8088, URL: https://www.soprema.ca/

2.2 MATERIALS

.1 Insulation: spray polyurethane to CAN/ULC-S705.1.

.2 Wall Insulation Foam: Poly-urethane Foam conforming to CAN/ULC S705. 1, with integral air and vapour barrier, min RSI value of 1.05 per 25 mm, (R value 6.0 per inch), thickness as indicated on Drawings.

.1 Acceptable products include:

.1 Demilec, Heatlok Soy

.2 Polar Foam PF-7300-0, by Polyurethane Foam Systems Inc.

.3 WALLTITE V3 by BASF Canada

.4 SOPRA SPF+ by SOPREMA

.3 Polyurethane Foam: low density polyurethane spray foam insulation with carbon dioxide blowing agent, density of 0.5 lb/ft3, RSI value of 0.62 per 25 mm (R value of 3.6 per inch).

.1 Acceptable products:

.1 Icynene Inc.

.2 Enertite as manufactured by BASF Canada

.3

.4 Primers: in accordance with manufacturer's recommendations for surface conditions.

.1 Maximum VOC limit 100 g/l to SCAQMD Rule 1113.

.5 Transition Membrane: Self-adhering SBS modified bitumen sheet membrane with laminated polyethylene film facer:.

.1 Acceptable products include:

.1 SOPREMA SOPRASEAL STICK 1100T (self adhearing) as manufactured by Soprema.

.2 SOPREMA SOPRASEAL 60FF (tocrch applied) as manufactured by Soprema.

.3 ExoAir 110 as manufactured by Tremco.

.4 Blueskin SA as manufactured by Henry Bakor.

.6 Through-Wall Flashing: Self-adhering SBS modified bitumen membrane with laminated polyethylene film facer:

.1 Acceptable products include:

.1 SOPREMA, SOPRASEAL WFM as manufactured by Soprema.

.2 Henry Bakor Blueskin TWF as manufactured by Henry Bakor.

PART 3 EXECUTION

3.1 GENERAL

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

3.2 EXAMINATION

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

.1 Visually inspect substrate in presence of Construction Administrator.

.2 Inform Engineer 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 Engineer.

3.3 PREPARATION FOR INSTALLATION

.1 Ventilate area in accordance with Section 01510 – Temporary Utilities.

.2 Ventilate area to receive insulation by introducing fresh air and exhausting air continuously during and 24 hours after application to maintain non-toxic, unpolluted, safe working conditions.

.3 Provide temporary enclosures to prevent spray and noxious vapours from contaminating air beyond application.

.4 Protect work as recommended by insulation manufacturer.

.5 Protect adjacent surfaces and equipment from damage by overspray, fall-out and dusting of insulation materials.

.6 Apply insulation only when surfaces and ambient temperatures are within manufacturers' prescribed limits.

3.4 INSTALLATION

.1 Prior to polyurethane foam application, install transition membranes and through wall flashings at all areas where movement may occur. This includes changes in substrate type, expansion joints, at openings and as described in the spray foam manufacturers installation guide and/ or indicated on the drawings.

.2 Apply insulation to clean surfaces in accordance with CAN/ULC-S705.2 and manufacturer's printed instructions.

.3 Use primer where recommended by manufacturer.

.4 Apply to a minimum cured thickness as required in the contract documents and within a tolerance of 12mm thicker than specified.

.5 Spray the mixed foam onto the substrate in multiple rises increments of 50 mm maximum, or as recommended by the manufacturer. The foam will expand and give off heat.

.6 Install caulking as required, where gap is 3mm or less and is too small for foam sealant, with approved caulking compound or other sealant at all locations requiring an infiltration seal.

.7 Trim foam flush with the inside surfaces.

.8 Remove foam from finished surfaces such as window glass, casings, and gypsum board.

.9 Coordinate spray foam application with installation of air/vapour barrier membrane as per drawings.

.10 Do not apply insulation to metal with less than 35 years old, in this application, all metal fabrication shall be primed in accordance to Section 05 50 00 Metal Fabrications.

3.5 FIELD QUALITY CONTROL

.1 Manufacturer's Field Services:

.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 Manufacturer is require to check if the application is up to the standard.

.4 Manufacturer is require to check if the application is up to the standard.

3.6 CLEANING

.1 Clean in accordance with Section 017411 - Cleaning.

.2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

.3 Progress Cleaning: Perform cleanup as work progresses

.1 Leave work area clean at end of each day

.4 Final cleaning: Upon completion, remove surplus materials, rubbish, tools, and equipment

.5 Waste Management:

.1 Collect recyclable waste and dispose of or recycle field generated construction waste created during construction or final cleaning related to work of this Section

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

END OF SECTION

SELF-ADHERED AIR VAPOUR BARRIER MEMBRANE

PART 1 GENERAL

1.1 INTENT

.1 This section describes the materials and procedures for sheet applied air barriers installed by all trades including work in relation to building veneers, all wall openings and penetrations.

.2 Provide all articles, labour, materials, equipment and transportation, hoisting and incidentals noted, specified or required to complete the work of this Section.

1.2 RELATED SPECIFICATION SECTIONS

.1 In addition to the general project requirements in Division 1, the following sections are referenced in this section:

.1	Section 04 05 00	Masonry Procedures.
.2	Section 07 21 20	Board Insulation
.3	Section 07 52 10	MBM – Torch Applied Roofing
.4	Section 07 90 00	Joint Sealants.
.5	Section 08 11 00	Metal Doors and Frames.
.6	Divisions 15 and 25-28	Mechanical & Electrical

1.3 CODE AND REGULATORY REQUIREMENTS

.1 All products shall conform to the following standards and regulations:

.1 ASTM International Inc.

.1 ASTM C1305-16 - Standard Test Method for Crack Bridging Ability of Liquid-Applied Waterproofing Membrane

.2 ASTM E96/E96M-16 – Standard Test Methods for Water Vapor Transmission of Materials

.3 ASTM E283/E283M - 19 - Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.

.4 ASTM E330/E330M-14 - Standard Test Method for Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference.

.5 ASTM E331-00(2016) - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference

.6 ASTM E1105-15 - Standard Test Method for Field Determination of Water Penetration of Installed Exterior Windows, Skylights, Doors, and Curtain Walls, by Uniform or Cyclic Static Air Pressure Difference

.7 ASTM E1677-19 - Specification for Air Retarder (AR) Material or System for Low-Rise Framed Building Walls

.8 ASTM E2178-21 - Standard Test Method for Air Permeance of Building Materials

.9 ASTM E2357-18 - Standard Test Method for Determining Air Leakage of Air Barrier Assemblies

.2 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-19.13M-M87, Sealing Compound, One Component, Elastomeric Chemical Curing.

.2 CAN/CGSB-19.24M-M90, Multi-Component, Chemical Curing Sealing Compound.

.3 CGSB 19-GP-14M-84, Sealing Compound, One Component, Butyl-Polyisobutylene Polymer Base, Solvent Curing.

.4 CGSB 37-GP-56M - Membrane, Modified, Bituminous, Prefabricated, and Reinforced.

.3 Underwriters' Laboratories of Canada (ULC)

.1 CAN/ULC S741-08(R2020) – Standard for Air Barrier Materials

.2 CAN/ULC S742-2020 - Standard for Air Barrier Assemblies

.4 Sealant and Waterproofer's Institute - Sealant and Caulking Guide Specification.

1.4 QUALITY ASSURANCE

.1 In addition to the requirements of 01 45 00 – Quality Control, the following measures are required:

.2 Contractors Qualifications

.1 Work of this section shall be carried out by a firm specialized in the type of work specified herein. Use installers, experienced, trained and approved by material or system manufacturer for application of materials and systems being used. Installers shall have a minimum five (5) years of experience in installation and provide documentation of examples minimum of (5) five previous projects completed more than (1) year since construction closeout upon request by engineer.

.3 Pre-installation meetings: comply with Section 01 31 00 – Project Management. Conduct pre-installation meeting one week prior to commencing work of this Section and on-site installations to:

.1 Notify attendees 2 weeks prior to meeting and ensure meeting attendees include as minimum:

.1 Owner;

.2 Engineer;

.3 All Affected Subcontractors;

.4 Manufacturer’s Technical Representative.

.2 Verify project requirements, including mock-up requirements.

.3 Verify substrate conditions.

.4 Co-ordinate products, installation methods and techniques.

.5 Sequence work of related sections.

.6 Co-ordinate with other building sub-trades to ensure proper installation and site preparation.

.7 Review manufacturer's installation instructions.

.8 Review warranty requirements.

.4 Review manufacturer's installation instructions and warranty requirements.

.5 Mock-up

.1 Construct mock-up in accordance with Section 01 45 00 - Quality Control, Product Data and Samples.

.2 Coordinate mock-up requirements with specifications listed in section 1.2 - Related Specification Sections

.3 Construct typical exterior wall panel, 3 m long by 3 m wide, incorporating window, frame, sill, insulation, building corner condition and junction with roof system; illustrating materials interface and seals.

.4 Mock-up may remain as part of finished work.

.5 Allow 48 hours for inspection of mock-up by Engineer before proceeding with air/vapour barrier Work.

.6 Site Meetings: as part of Manufacturer's Services described in PART 3 - FIELD QUALITY CONTROL, schedule site visits, to review Work, at stages listed.

.1 After delivery and storage of products, and when preparatory Work is complete, but before installation begins.

.2 Twice during progress of Work at 25% and 60% complete.

.3 Upon completion of Work, after cleaning is carried out.

.4

1.5 SUBMITTALS

.1 Complete submittals in accordance with Specification Section 01 33 00

.2 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Submit WHMIS MSDS - Material Safety Data Sheets.

.3 Provide shop drawings of special joint conditions.

.4 Quality Assurance Submittals: submit following in accordance with Section 01 45 00 - Quality Control.

.1 Existing Substrate Condition: report deviations, as described in PART 3 - EXAMINATION in writing to Engineer.

.2 Manufacturer's Instructions: submit manufacturer's installation instructions and special handling criteria, installation sequence and cleaning procedures.

.3 Manufacturer's Field Reports: submit manufacturer's written reports within 3 days of review, verifying compliance of Work, as described in PART 3 - FIELD QUALITY CONTROL.

.5 Closeout Submittals: Provide maintenance data for cleaning and maintenance for incorporation into operations manual

.6 Warranty: Submit unexecuted warranty for review

.7 Alternatives

.1 Acceptable alternatives will be confirmed by addendum. Substitute materials not approved in writing prior to tender closing shall not be permitted for use on this project

.2 Alternate submission format to include:

.1 Submit evidence that alternate materials meet or exceed performance characteristics of Product requirements as well as documentation from an approved independent testing laboratory certifying that the air leakage and vapour permeance rates of the air/ vapour barrier membranes, including primary membrane and transition sheets, exceed the requirements of the National Building Code, ASTM E 2357, the Massachusetts Energy Code and in accordance with ASTM E 2178.

.1 Test report submittals shall include test results on porous substrate and include sustained wind load and gust load air leakage results.

.2 Test reports to be provided for both regular and low temperature grades.

.2 Submit manufacturers' complete set of standard details for air/vapour barrier membrane systems showing a continuous plane of air tightness throughout the building envelope.

1.6 DELIVERY STORAGE AND HANDLING

.1 Refer to Specification Section 01 61 00 - Common Product Requirements, stipulations.

.2 Deliver materials to the job site in undamaged and original packaging indicating the name of the manufacturer and product.

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

.4 Store role materials on end in original packaging.

.5 Protect rolls from direct sunlight until ready for use.

.6 Store adhesives and primers at temperatures of 5 degrees C and above to facilitate handling.

.7 Keep solvent away from open flame or excessive heat.

.8 Avoid spillage: immediately notify Engineer if spillage occurs and start clean up procedures.

.9 Clean spills and leave area as it was prior to spill.

1.7 ENVIRONMENTAL AND SITE CONDITIONS

.1 Refer to Specification Section 01 61 00 - Common Product Requirements stipulations

.2 Install solvent curing sealants and vapour release adhesive materials in open spaces with ventilation.

.3 Maintain temperature and humidity recommended by materials manufactures before, during and after installation.

1.8 SEQUENCING

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

1.9 WARRANTY

.1 In addition to the contractual warranty terms, Provide a total 60 month warranty from the date of substantial completion for all labour and materials for sealant and sheet materials covered under this specification.

.2 Warranty: include coverage of installed sealant and sheet materials which:

.1 Fail to achieve air tight and watertight seal.

.2 Exhibit loss of adhesion or cohesion.

.3 Do not cure.

PART 2 PRODUCTS

2.1 DESIGN CRITERIA

.1 ASTM E96 permeance maximum 0.03 US Perm (1.72 ng/s□m²□Pa)

2.2 APPROVED MANUFACTURERS

.1 Henry Company, 15 Wallsend Dr. Scarborough, ON. M1E 3X6, Phone: (800) 486-1278, e-mail: productsupport@henry.com, URL: ca.henry.com.

.2 W.R. Meadows of Canada, 70 Hannant Court, Milton, Ontario, Canada L9T 5C1, Phone: (905) 878-4215, e-mail: wrmcan@wrmeadows.com, URL: www.wrmeadows.com.

.3 SOPREMA Canada , 60 Sovereign Court, Woodbridge, Ontario, Canada L7L 6K8, Phone: (905) 265- 8088, e-mail:jharquail@soprema.ca, URL: www.soprema.ca.

2.3 MATERIALS

.1 Flexible Membrane:

.1 Blueskin TG or SA, as manufactured by Henry Company, complete with all adhesives and primers and supplementary sealing materials.

.2 Air-Shield as manufactured by W.R. Meadows.

.3 Sopraseal Stick 1100 T as manufactured by Soprema

.2 Masonry air/vapour barrier, including transitions to other materials and openings within masonry are to be provided with membrane flashings using Blueskin SA or AG with primer as manufactured by Henry, Air-Shield Thru-Wall Flashing as manufactured by W.R. Meadows or SOPRASEAL STICK 1100 T as manufactured by SOPREMA

.3 Masonry cavity wall air and vapour barriers shall be compatible with through-wall flashings. Submit written confirmation of compatibility.

2.4 ACCESSORIES

.1 Sealants in accordance with Section 07 90 00 - Joint Sealants.

.2 Adhesives, Sealants, Tape and Accessories for wall air and vapour barrier: as recommended by membrane manufacturer to achieve a complete and effective air and vapour barrier.

.1 Sealant Primer: recommended by sealant manufacturer, appropriate to application.

.2 Substrate Cleaner: non-corrosive, type recommended by sealant manufacturer, compatible with adjacent materials.

.3 For adhering flexible membrane flashings to the wall air / vapour barrier (at edges, openings, etc.) use Airbloc 21 as manufactured by Henry, Pointing Mastic as manufactured by W.R. Meadows or SOPASEAL SEALANT as manufactured by SOPREMA.

.4 For Adhering flexible membrane flashings to wood or metal, use Blueskin Adhesive as manufactured by Henry, Mel-Prime as manufactured by W.R. Meadows or SOPRASEAL STICK PRIMER as manufactured by SOPREMA.

PART 3 EXECUTION

3.1 GENERAL

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

.2 Perform Work in accordance with Sealant and Waterproofer's Institute - Sealant and Caulking Guide Specification requirements for materials and installation.

.3 Perform Work in accordance with National Air Barrier Association - Professional Contractor Quality Assurance Program and requirements for materials and installation.

.4 Perform Work in accordance with Canadian Urethane Foam Contractor's Association - Professional Contractor Quality Assurance Program and requirements for materials and installation.

3.2 EXAMINATION

.1 Verify that surfaces and conditions are ready to accept work of this section.

.2 Ensure surfaces are clean, dry, sound, smooth, continuous and comply with air barrier manufacturer's requirements.

.3 Where curing compounds are used they must be clear resin based without oil, wax or pigments.

.4 Report unsatisfactory conditions to Engineer in writing.

.5 Do not start work until deficiencies have been corrected.

.1 Beginning of installation indicates acceptance of site conditions.

3.3 PREPARATION FOR INSTALLATION

.1 Remove loose or foreign matter, which might impair adhesion of materials.

.2 Ensure substrates are clean of oil or excess dust; masonry joints struck flush, and open joints filled; and concrete surfaces free of large voids, spalled areas or sharp protrusions.

.3 Ensure substrates are free of surface moisture prior to application of self-adhesive or membrane and primer.

.4 New concrete should be cured for a minimum of 14 days and must be dry before barrier is applied.

.5 Ensure metal closures are free of sharp edges and burrs.

.6 Prime substrate surfaces to receive adhesive and sealants in accordance with manufacturer's instructions.

.7 Concrete surfaces should be free of large spalled areas and voids. Fill any large voids or spalled areas to provide and even plane.

.8 Cracks in masonry and concrete should be sealed with a strip of air barrier membrane lapped a minimum of 75 mm on both sides of the crack.

.9 Cement board and plywood joints should be taped.

3.4 INSTALLATION

.1 Install materials in accordance with manufacturer's instructions.

.2 Apply air barrier membrane to all connections of masonry block to steel or concrete; drywall or plywood to steel or concrete; and all beams, columns, window and door frames, etc. using strips of the air barrier lapped a minimum of 75mm on both substrates and centred over joint.

.3 Adhesive or Primer for Transition and Through-wall Flashing Membrane (Self-Adhering)

.1 Apply adhesive or primer for self-adhering membranes at rate recommended by manufacturer.

.2 Apply to all areas to receive transition sheet and / or through-wall flashing membrane, as indicated on drawings by roller or spray and allow minimum 30 minute open time. Surfaces not covered by self-adhering transition membrane or self-adhering through-wall flashing membrane during the same working day must be re-applied.

.3 Apply sealant within recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.

.4 Transition Membrane (Self-Adhering)

.1 Align and position self-adhering transition membrane, remove protective film and press firmly into place. Ensure minimum 50 mm overlap at all end and side laps.

.2 Tie-in to window frames, aluminium screens, hollow metal doorframes, spandrel panels, roofing system and at the interface of dissimilar materials as indicated in drawings

.3 Promptly roll all laps and membrane with a counter top roller to effect seal.

.4 Ensure all preparatory work is complete prior to applying liquid applied air vapour barrier membrane.

.5 Through-wall Flashing Membrane & Dampproof Course (Self-Adhering)

.1 Apply through-wall flashing and dampproof coursing membrane in accordance with CSA A371-94 Masonry Construction for Buildings; along the base of masonry veneer walls, over windows, doors and other wall openings required to be protected.

.2 Applications shall form a continuous flashing membrane and shall extend up a minimum of 200 mm up the back-up wall.

.3 At the end of each days work seal the top edge of the membrane where it meets the substrate using liquid air seal mastic. Trowel apply a feathered edge to seal termination and shed water.

.4 Ensure through-wall flashing membrane extends fully to the exterior face of the exterior masonry veneer. At locations where flashing terminates or intersects wall openings including door frames, “end dam” flashing to protect openings and redirect water out. Trim off excess as directed by the consultant.

.5 Apply dampproof coursing membrane over slabs on grade, prepare and prime surfaces, align and position membrane between slab and masonry block work.

.6 Align and position the leading edge of self-adhering through-wall flashing membrane with the front horizontal edge of the foundation walls, self angles and other substrates to be protected, partially remove protective film and roll membrane over surface and up vertically.

.7 Press firmly into place. Ensure minimum 50 mm overlap at all end and side laps. Promptly roll all laps and membrane to affect the seal.

.8 Ensure all preparatory work is complete prior to applying self-adhering through-wall flashing membrane.

.9 Ensure through-wall flashing membrane extends fully to the exterior face of the exterior masonry veneer. Trim off excess as directed by the consultant.

.6 Air/Vapour Barrier Membrane

.1 Use sheets of largest practical size to minimize joints

.2 Apply self-adhering membrane complete and continuous to prepared and primed substrate in an overlapping shingle fashion and in accordance with manufacturer's recommendations and written instructions. Stagger all vertical joints.

.3 Align and position self-adhering membrane, remove protective film and press firmly into place. Ensure minimum 50 mm overlap at all end and side laps. Promptly roll all laps and membrane with a counter top roller to affect the seal.

.4 At the end of each days work seal the top edge of the membrane where it meets the substrate using liquid air seal mastic. Trowel apply a feathered edge to seal termination and shed water.

.5 Tie-in to window frames, aluminium screens, hollow metal doorframes, spandrel panels, roofing system and at the interface of dissimilar materials as indicated in drawings. Refer to manufacturers' standard details.

.6 Any blocking required to install these items shall not interfere with the continuity of the air/vapour barrier

.7 Ensure all projections, including wall ties, are properly sealed with a caulk application of liquid air seal mastic.

.8 Mechanically fasten membrane through securement bars to all window, door, louvers and curtain wall sections as recommended by membrane manufacturer where proper adhesion and bonding cannot be maintained.

.9 Membrane applied to the underside of substrate surfaces shall receive special attention on application to ensure maximum surface area adhesion is obtained.

.10 Seal to roof vapour barrier at wall/roof intersection to create a continuous membrane.

.7 Inspect sheets for continuity. Repair punctures and tears in air barrier with manufacturer's recommended repair before work is concealed.

.8 Spray foam is not to be used to create the continuity of the air/vapour barrier between door/window frame and the exterior wall. If used the Contractor will be required to remove and re-install the frame in the correct manner at his own expense, and shall be responsible for the cost of the work of other trades affected by this replacement.

3.5 FIELD QUALITY CONTROL

.1 Notify engineer when sections of work are complete so as to allow for review prior to installing insulation.

.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 Section 01 33 00 - 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.

3.6 PROTECTION OF WORK

.1 Ensure finished work is protected from climatic conditions. Adhesive air/vapour barrier membrane cannot be left exposed to the elements. It must be covered immediately by insulation to prevent blistering or surface crazing of membrane in order to provide a positive bond for the insulation.

.2 Do not permit adjacent work to damage work of this section.

3.7 CLEANING

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

.2 Progress Cleaning: Perform cleanup as work progresses.

.1 Leave work area clean at end of each day.

.3 Final cleaning: Upon completion, remove surplus materials, rubbish, tools, and equipment

.4 Waste Management:

.1 Collect recyclable waste and dispose of or recycle field generated construction waste created during construction or final cleaning related to work of this Section

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

END OF SECTION

ARCHITECTURAL SCREEN WALL

PART 1 GENERAL

1.1 SCOPE OF WORK

.1 Supply and installation of self-supporting aluminum screen walls.

1.2 RELATED SECTIONS

.1 07 52 00 - Modified bitumen membrane roofing

1.3 REFERENCE STANDARDS

.1 ASTM A653-17: “Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or

.2 Zinc-Iron Alloy-Coated (Galvannealed) by Hot Dip Process”

.3 ASTM C645-15: “Standard Specification for Non-structural Steel Framing Members” . 3 ASTM B308/308M, Specification for aluminum alloy.

.4 ASTM B 221M-13, Standard Specification for Aluminum and Aluminum-Alloy

.5 Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric)

.6 ASTM B241 / B241M, Standard Specification for Aluminum and Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube.

.7 CAN/CSA S136-12: North American specification for the design of cold-formed steel structural members

.8 CSA S-157-17 - Strength design in aluminum

.9 Ontario Building Code 2012 with latest amendments

1.4 SUBMITTALS

.1 Submit the required documents/samples in accordance with section 01 33 00 - Submittals

.2 Data sheets

.1 Submit the required technical data sheets as well as the manufacturer's instructions and documentation. Technical documents must indicate product characteristics, performance criteria, dimensions, limitations and finish.

.2 Submit the manufacturer's written instructions as well as specific comments on the project.

.3 Shop Drawings

.1 Submitted shop drawings must bear the seal and signature of a professional engineer licensed to practice in the province of Ontario.

.2 Shop drawings must indicate profiles, component dimensions and connections, anchors, fastener type and dimensions, and accessories.

.3 The drawings must indicate the installation of the screen wall system, including plans, elevations, sections, component details, anchor details and clearances to adjacent elements. The drawings must indicate on-site dimensions and discrepancies.

.4 Samples

.1 At the request of the Architect, submit a sample of each piece of the screen wall system for review and acceptance.

.2 The samples will be given to the Contractor, who must incorporate them into the work.

1.5 DESIGN PERFORMANCE

.1 Wind load in accordance with Ontario Building Code.

.2 Building Importance – Normal.

1.6 QUALITY ASSURANCE

.1 Test reports: submit test reports certifying that the products, materials and equipment comply with the requirements regarding physical characteristics and calculation criteria.

.2 Certification of quality and local content:

.1 Submit a letter from the manufacturer certifying that the assembly and structural parts are molded and manufactured according to the respective ASTM standards, by Quebec companies holding ISO:9001 certification.

.2 Submit a letter from the manufacturer certifying that the 6061-T6 aluminum tubes are extruded according to the ASTM B-221 standard by a Canadian company holding ISO:9001 certification.

1.7 WARRANTY

.1 The contractor will provide the building owner with a manufacturer's warranty attesting that the assembly and structural components of the self-supporting screen walls will remain free from any manufacturing and design defects for the following periods:

.1 Painting, hardware and accessories: 1 year;

.2 Assembly parts and round aluminum tube: 5 years

1.8 WORK INSPECTION

.1 A representative of the manufacturer may, at his discretion, be present on the site continuously or sporadically throughout the installation of the structure. He will ensure that all components are assembled in accordance with the installation plan. He will also be responsible for verifying, without limitation, the following elements:

.1 Verification of surfaces
.2 Verification of levels and admissible deviations
.3 Quality of the assembly
.4 The good condition of the materials before their installation

1.9 TRANSPORT, STORAGE AND HANDLING

.1 The contractor is responsible for transporting, storing and handling the materials according to the general conditions as well as the manufacturer's instructions.

PART 2 PRODUCTS

2.1 ASSEMBLY PARTS OF THE SELF-SUPPORTING STRUCTURE OF THE SCREEN WALL

.1 Cast Aluminum 535 unions according to the properties in the table below with threaded holes and stainless-steel clamping nut insert

.2 Galvanized steel anchor plate designed and manufactured to receive the structure on the concrete bases.

.3 Elbow: 90 Degrees corner piece.

.4 Joints: linear union, "T" shaped union or "Y" shaped union; Fixing base.

.5 Fixing base receiving the aluminum tube; properties of aluminum alloy 535

Physical property	**Metric**	**English**
Density	2.57 g/cc	0.0928 lb/in^3
Alloy components	**Metric**	**English**
Aluminum, Al	91.4 - 93.3%	91.4 - 93.3%
Copper, Cu	<= 0.10%	<= 0.10%
Iron, Fe	<= 0.15%	<= 0.15%
Magnesium, Mg	6.6 - 7.5%	6.6 - 7.5%
Manganese, Mn	0.10 - 0.25%	0.10 - 0.25%
Other, each	<= 0.05%	<= 0.05%
Other, total	<= 0.15%	<= 0.15%

Silicone, If	<= 0.20%	<= 0.20%
Titanium, Ti	<= 0.25%	<= 0.25%

.6 Product: Self-supporting structure parts

2.2 SELF-SUPPORTING STRUCTURE OF THE SCREEN WALL

.1 Posts and crossbars: 6061-T6 aluminum tube DE 1.9" dia. X 0.145".

.2 optional tube painting: Polyester-based thermosetting powder. See plan for requested color.

.3 Plastic cap: Clasp for the end of the tubes.

.4 Stackable bases: Counterweight of 18.91 kg (41.7 lbs) each measuring 406mm x 356 mm (16" x 14") in cast steel according to ASTM A-48 class 30, covered with two layers anticorrosion protection.

.5 12.5 mm (1/2") thick protective mat

.6 Product: Self-supporting structure for screen wall

2.3 APPROVED MANUFACTURER

.1 Product: Self-supporting structure for screen wall manufactured by Millenium manufacturing agent inc. – Millenium Plus - Telephone: 1 833 454-3176.

.2 Or Approved equivalent

PART 3 EXECUTION

3.1 FACILITY

.1 Ensure that the installation surface is free of debris throughout the intervention area. Clean the roof of any debris, snow, ice, accumulation of granules, or other at the location of each of the counterweight bases.

.2 Install the screen wall system as indicated and shown on the shop drawings sealed by an engineer and approved by the architect.

.3 Install on the concrete bases all the galvanized steel bases provided by the manufacturer for the vertical posts of the structure.

.4 Position the counterweights and connect the vertical posts according to the instructions. Refer to the installation plan and manual to comply with all assembly specifications.

.5 The counterweights must be placed on protective mats as well as an additional thickness of roofing membrane (sacrifice membrane). This protective membrane must be welded to the membrane in place. Coordinate this membrane with the specialized contractor responsible for section 07 52 00.

.6 Secure the vertical posts to a counterweight base with four (4) stainless steel self-drilling screws. Use a spirit level to ensure the posts are straight in all directions. Then stack the required counterweights at each post. Refer to the shop drawing for the number of counterweights.

.7 Insert the corresponding and necessary junction pieces (Elbow, T or Cross) into each vertical post.

.8 Insert the horizontal rails into the connecting pieces of the vertical posts and complete the assembly by tightening the nuts or bolts according to the manufacturer's drawings.

.9 Plug the upper end of all vertical tubes with a sturdy plastic cap of appropriate size. The lower ends must remain open to allow water to drain.

3.2 CLEANING

.1 Once installation is complete, remove all excess materials and waste from the roof and site.

END OF SECTION

TORCH APPLIED ROOFING

PART 1 GENERAL

1.1 INTENT

.1 This Section specifies the installation of a low slope built-up bituminous roofing systems utilizing adhesives/ torched application and all associated accessories including membrane system, primers, and air/vapour barriers.

1.2 SCOPE OF WORK

.1 All labour, tools, equipment, and materials necessary to install and complete the work for the mopped / torch-applied built-up bituminous roofing system in accordance with the contract drawings and this performance specification, including:

.1 Roof Deck (by others).
.2 Primer & Air Vapour Barrier Membrane.
.3 Roof Insulation & Tapered Insulation.
.4 Composite Overlay Board with laminated base sheet membrane
.5 Self-adhesive Base Sheet Flashing
.6 Torched-on Cap Sheet & Cap Sheet Flashing.
.7 Metal Flashings and Accessories

1.3 RELATED WORK

.1 In addition to the general project requirements in Division 1, the following sections are referenced in this section:

.1 Section 03 30 00 Cast-in-Place Concrete
.2 Section 06 10 10 Rough Carpentry
.3 Section 07 62 00 Sheet Metal Flashing and Trim
.4 Section 07 76 00 Roof Pavers
.5 Section 07 90 00 Joint Sealants
.6 DIVISION 15 MECHANICAL

1.4 REFERENCES

.1 American Society of Testing and Materials (ASTM):

.1 ASTM C1177/C1177M-13 Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing.
.2 ASTM D1863/D1863M-05(2011)e1 - Specification for Mineral Aggregate Used on Built-up Roofs
.3 ASTM E96 Standard Test Methods for Water Vapor Transmission of Materials

.2 ASTM E2178-13 Standard Test Method for Air Permeance of Building Materials. Canadian Standards Association (CSA):

.1 CAN/CSA-A123.4-04(R2013) - Asphalt for Construction Built-Up Roof Coverings and Waterproofing Systems

.2 CAN/CSA-A123.21-14 - Standard test method for the dynamic wind uplift resistance of membrane-roofing systems report number, SOPI 210663-05 (basis of design)

.3 CSA A231.1-14/A231.2-14 – Pre-cast Concrete Paving Slabs

.4 CSA A123.23-15 Product specification for polymer-modified bitumen sheet, prefabricated, and reinforced.

.3 Canadian General Standards Board (CGSB):

.1 CAN/CGSB-37.9 - Primer, Asphalt, Unfilled for Asphalt Roofing, Dampproofing and Waterproofing.

.2 CAN/CGSB-37.29 - Rubber-Asphalt Sealing Compound.

.3 CAN/CGSB-51.33-M89 - Vapour Barrier Sheet, Excluding Polyethylene, for Use in Building Construction

.4 CGSB 37-GP-56M - Membrane, Modified, Bituminous, Prefabricated, and Reinforced for Roofing.

.4 Underwriters Laboratories of Canada (ULC):

.1 CAN/ULC S107-10 – Methods of Fire Tests of Roof Coverings

.2 CAN/ULC S126-14 – Standard Method of for Fire Spread Under Roof-Deck Assemblies

.3 CAN/ULC-S701-11 – Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering

.4 CAN/ULC S704-11 – Thermal Insulation, Polyurethane and Polyisocyanurate, Boards, Faced

.5 CAN/ULC-S770-15 - Standard Test Method for Determination of Long-Term Thermal Resistance (LTTR) of Closed Cell Thermal Insulating Foams

.5 1.4.5 Canadian Roofing Contractors' Association (CRCA) Roofing Specifications Manual

1.5 QUALITY ASSURANCE

.1 In addition to the requirements of 01 45 00 – Quality Control, the following measures are required:

.1 Perform work in accordance with the printed requirements of the membrane manufacturer and this specification. Advise the Engineer of any discrepancies prior to the commencement of the work.

.2 Maintain one (1) copy of the specification and manufacturer's literature on-site throughout the execution of the work.

.3 At the beginning of the work and, at all times during the execution of the work, allow access to the site by the roofing membrane manufacturer's representative.

.4 Require the Installer to maintain a full-time Supervisor/Foreman on the job site during all phases of bituminous sheet roofing work and at any time roofing work is in progress, full-time supervision of workmen shall be maintained.

.5 The successful manufacturer must provide daily job site inspections intended to assure compliance with the specification and manufacturer's requirements for warranty. These inspections are to be documented online weekly with all appropriate parties given user names and passwords to follow job progress. Reports shall discuss work completed, # of men on site, weather, and contractor and/or manufacturer's concerns. All reports must include progress pictures for review.

.6 Materials used in this section, including primers, mastics, and membranes, shall be fully compatible, approved by the manufacturer to be installed and shall be sourced from one (1) manufacturer.

.7 It shall be the Contractor's responsibility to respond immediately to correction of roof leakage during construction. If the contractor does not respond within 24 hours, the Region has the right to hire a qualified contractor and back charge the original contractor.

.8 Insurance Certification: Assist Region in preparation and submittal of roof installation acceptance certification as may be necessary in connection with fire and extended coverage insurance on roofing and associated work.

.2 Manufactures Qualifications

.1 Submit copies of the membrane manufacturer's current certification to ISO 9001, which include the manufacturing of the membrane, primer, mastics, adhesives, and protection board.

.2 Membrane manufacturer must have been producing built-up bituminous roofing membranes for at least ten (10) years.

.3 Contractors Qualifications

.1 Be a member of the Ontario Industrial Roofing Contractor's Association (OIRCA).

.2 Work of this section shall be carried out by a firm specialized in the type of work specified herein. Use material/system manufacturer-approved and qualified installers, for application of materials and systems being used.

.3 Installers shall have a minimum of five (5) years of experience in installation and provide documented examples of a minimum (5) five previous projects completed more than one (1) year since construction closeout.

.4 Pre-installation meetings:

.1 Notify attendees 2 weeks prior to the meeting and ensure meeting attendees include as a minimum:

.1 Owner;

.2 Engineer;

.3 All Affected Subcontractors;

.4 Manufacturer's Technical Representative.

.2 Comply with Section 01120 - Coordination and Sequence of Construction. Conduct a pre-installation meeting one week prior to commencing work of this Section and on-site installations to:

.1 Coordinate with related specifications listed in section 1.3 - Related Specification Sections

.2 Verify project requirements, including mock-up requirements.

.3 Review methods of removing the existing roofing and insulation. Examine existing roof deck structure, slope, and area of replacing roofing for daily output.

.4 Verify substrate conditions.

.5 Review loading limitations of the deck during and after roofing.

.6 Review and confirm all roofing products are acceptable for installation in the environmental temperature and humidity range.

.7 Coordinate products, installation methods, and techniques including flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect roofing.

.8 Sequence work of related sections.

.9 Coordinate with other building sub-trades to ensure proper installation and site preparation, including all roofing openings, sizes, locations, and curb or post supports.

.10 Review the manufacturer's installation instructions.

.11 Review governing regulations and requirements for insurance, certifications, and inspection and testing, if applicable.

.12 Review temporary protection requirements for roofing system during and after installation.

.13 Review roof observation and repair procedures after roofing installation.

.14 Review warranty requirements.

.1 Document proceedings, including corrective measures or actions required, and furnish copy of record to each participant.

1.6 SUBMITTALS

.1 Complete submittals in accordance with Specification Section 01 33 00.

.2 Provide a cover sheet listing all roof system products submitted, indicating function within roof system as outlined in this specification and organized by installation process from the structural deck up.

.3 Product Data:

.1 Submit product data for each type of product specified including manufacturer's technical product data, installation instructions, MSDS sheets, WHIMS sheets, and recommendations for each type of roofing product.

.2 Manufacturer to submit in writing, a document stating that the materials specified in this section are fully compatible and the contractor installing the specified roofing system is recognized by the manufacturer as suitable for the execution of the work.

.4 Samples:

.1 Upon Engineers request, submit samples in accordance with Section 01 33 00 – Submittals.

.1 Submit 70 x 90 mm samples of all sheet products.

.2 170g samples of loose materials.

.5 Shop Drawings

.1 Submit shop drawings in accordance with Section 01 30 00 – Submittal Procedures.

.2 Include details of penetrations and plan view(s).

.3 Indicate any special procedures required to join the roof membrane, wall/roof air barrier, and vapour barrier to ensure the integrity of the building envelope's waterproofing.

.4 Indicate tapered insulation layouts.

.5 Submit third-party documentation from a certified testing laboratory facility proving the design of the roofing system meets the requirements to withstand roof system wind uplift based on the testing requirements of CAN/CSA-A123.21 and on the requirements of the OBC latest edition for the location in which the roof system will be installed.

.6 Closeout Submittals:

.1 Provide maintenance program for continued care and future maintenance of roof to Owner for incorporation into manual specified in Section 01 81 00 – Testing and Commissioning.

.7 Warranty:

.1 Submit an unexecuted warranty for review, clearly stating the roof system name, the terms of the specified warranty, and duration, prior to any installation.

.2 Submit an unsigned warranty for review, clearly stating the roof system name, the terms of the specified warranty, and the duration, prior to any installation.

.8 Construction Schedule and Critical Path:

.1 Submit a work schedule in accordance with the requirements of Section 01 32 00 – Construction Progress and Documentation.

.9 Alternatives

.1 In addition to the submittal requirements as outlined in section 1.6, alternate submission format to include:

.1 Submit evidence that alternate materials meet or exceed performance characteristics of Product requirements and documentation from an approved independent testing laboratory certifying that the performance of the roofing membrane system including air vapour barrier and transition sheets, exceeds the requirements of the National Building Code.

.2 Submit copies of manufacturers' current ISO certification.

.3 Submit references clearly indicating that the membrane manufacturer has successfully completed projects on an annual basis of similar scope and nature for a minimum of five years.

.1 Submit manufacturers' complete set of standard details for the air/vapour barrier and roofing membrane systems showing a continuous plane of air tightness throughout the building envelope.

.2 Submit laboratory test reports certifying compliance of bitumen with specification requirements in accordance with Section 01 30 00 – Submittal Procedures.

.3 Submit documentation certifying that the primary membrane complies with CSA A123.4-04 and CGSB 37-GP-56M

.1 Substitute materials not approved in writing prior to tender closing shall not be permitted for use on this project. Acceptable alternates will be confirmed by addendum.

1.7 DELIVERY STORAGE AND HANDLING

.1 Delivery of Materials:

.1 In addition to the requirements of Specification 01 61 00, receiving, handling, storing and protecting materials shall comply with the manufacturer's instructions.

.2 Materials shall be delivered to the job site in the manufacturer's original, unopened, undamaged containers with marked labels indicating the name of the manufacturer and products.

.3 Deliver fasteners in boxes or kegs and keep them in protective storage until used. Do not oil or grease fasteners.

.2 Storage of Materials:

.1 Provide and maintain dry, off-ground weatherproof storage.

.2 Store all roofing material in a controlled space set at a temperature and humidity as outlined in manufacturer technical literature.

.3 Store combustible material away from open flames or excessive heat.

.4 Store roll materials on end in an upright position Do not double stack unless the product is on pallets and packaging as received from the factory. Never stack more than two pallets high without racking.

.5 Store insulation away from sunlight and the weather and any deleterious substance.

.6 Avoid the accumulation of materials on the roofs, which could, in specific areas, compromise structural soundness by placing more weight on it than is recommended.

.7 Do not leave unused materials on the roof overnight or when roofing work is not in progress unless protected from weather and other moisture sources.

.8 Remove only in quantities required for same-day use.

.9 Place plywood runways over work to enable movement of material and other traffic.

.3 Handling or Materials:

.1 Primer contains solvent and is flammable. Do not use near open flame.

.2 Avoid overheating hot rubberized asphalt. Recommended application temperature is 190°C (375°F) to 230°C (450°F). Do not heat above 260°C (500°F) maximum agitate regularly.

1.8 ENVIRONMENTAL AND SITE CONDITIONS

.1 Stop work when the temperature remains consistently below the minimum allowable application temperature as outlined by manufacturer technical documentation, especially when the wind chill effect would tend to set bitumen before proper adhesive takes place.

.2 Application temperature shall be considered to be the temperature minus half of the wind speed as recommended by the Canadian Roofing Contractors Association (CRCA).

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

.4 No membrane installation work shall be performed during rainy, inclement weather or when a 40 percent chance of precipitation is expected. (time frame) Proceed with roofing work only when existing and forecasted weather conditions will permit the unit of work to be installed in accordance with the manufacturer's recommendations and warranty requirements.

.5 Primers contain petroleum distillates and are extremely flammable. Do not breathe vapours or use near an open fire. Do not use in confined areas without adequate ventilation. Consult container or packaging labels and Material Safety Data Sheets (MSDS) for specific safety information.

.6 Do not allow waste products (petroleum, grease, oil, solvents, vegetable or mineral oil, animal fat, etc.) to come in contact with the waterproofing membrane. Any exposure to foreign materials or chemical discharges shall be presented to the membrane manufacturer or evaluation to determine any impact on the waterproof membrane assembly performance.

.7 Over its service life, do not expose membrane or accessories to a constant temperature in excess of 82°C (i.e., hot pipes and vents or direct steam venting, etc.).

.8 Do not permit traffic of any kind over unprotected membranes.

1.9 WARRANTY

.1 Membrane manufacturer must submit a written warranty, signed and issued in the name of the Owner, certifying the roofing system and flashings will remain in place and stay waterproof in accordance with General Condition article GC-12.3, except the warranty period shall be **20 years** from the date of substantial completion. The warranty shall state it will repair any leaks in the roofing membrane to restore the roofing system to a dry and watertight condition, to the extent that manufacturing or installation defects caused such water infiltration. The warranty must cover the total cost of repair(s) during the entire warranty period. The warranty must be transferable, at no extra cost, to subsequent building owners. The warranty certificate must reflect these requirements. The scope of this warranty must not be limited by other system components manufactured or distributed by the membrane manufacturer. No letter amending the manufacturer's standard warranty will be accepted and the warranty certificate must reflect these requirements.

.2 Contractor must submit a written warranty, signed and issued in the name of the Owner, certifying the roofing system and flashing will remain in place and stay waterproof for a period of **5 years** from the date of substantial completion. This warranty will cover the removal and replacement of defective roof membrane products, including labour. The warranty must remain a full warranty for the duration of the period specified. The scope of this warranty must not be limited by other system components manufactured or distributed by the membrane manufacturer. No letter amending the manufacturer's standard warranty will be accepted and the warranty certificate must reflect these requirements.

.1 Materials: **5 years**.

.2 All membrane system materials are to be supplied by the membrane manufacturer.

.1 Labour and materials**: 2 years** by applicators approved by the roof membrane manufacturer.

.3 Membrane manufacturer to provide a thermal warranty meeting a minimum of 80% R value retention for a period of **15 years**.

PART 2 PRODUCTS

2.1 GENERAL

.1 Use one (1) manufacturer's system only for the roofing system.

2.2 APPROVED MANUFACTURERS

.1 SOPREMA Canada , 60 Sovereign Court, Woodbridge, Ontario, Canada L7L 6K8, Phone: (905) 265- 8088, e-mail:jharquail@soprema.ca, URL: www.soprema.ca.

.2 Henry Canada, 15 Wallsend Drive, Scarborough, Ontario, Canada, M1E 3X6, Phone: (800) 523-0268, e-mail: mclyde@henry.com, URL: www.bakor.com.

.3 Johns Manville Canada, contact Steven Ioannides, Architectural & Technical Rep, North 49 Sales Agency, 87 Edmonton Road, North York, Ontario M2J 3W9, (647)518-0908, e-mail: sioannides@north49all.com, www.north49alliance.com

.4 Equivalent products may be submitted for Engineer's approval providing the product submitted meets or exceeds the performance criteria of the products specified.

2.3 MATERIALS

.1 Exterior sheathing:

.1 13 mm Fiberglass-Mat Faced Gypsum Sheathing to ASTM C1177 as specified in 09252 – Exterior Sheathing.

.2 Gypsum board fasteners shall be No. 10 flat countersunk head self-tapping screws, Type AB, Phillips head, and cadmium plated **25 mm** long.

.3 Gypsum Board Adhesive

.1 Conforming to CSA B35.3

.2 Acceptable products:

.1 DUOTACK as manufactured by SOPREMA Canada

.2 Thermostik 880-33 as manufactured by Henry Canada.

.3 Two-Part UIA (Urethane Insulation Adhesive) by Johns Manville Canada.

.2 Primers

.1 Self-adhered base sheet flashings

.1 Acceptable products:
.1 ELASTOCOL STICK as manufactured by SOPREMA Canada
.2 930-38 as manufactured by Henry Canada.
.3 SA Primer by Johns Manville Canada.

.2 Self-adhered transition air/vapour barrier membranes
.1 Acceptable products:
.1 ELASTOCOL STICK as manufactured by SOPREMA Canada
.2 Blueskin® Primer as manufactured by Henry Canada.
.3 SA Primer by Johns Manville Canada.

.3 Air/Vapour Barrier Membranes

.1 Transition tape (Self-Adhered) SBS modified bitumen self-adhering membrane reinforced with a cross-laminated polyethylene film and having a minimum thickness of 1.0 mm (40 mils), used over joints and penetrations of the substrate to reduce the risks during hot applications.
.1 Acceptable products:
.1 SOPRASEAL STICK 1100T as manufactured by SOPREMA Canada
.2 FlamGuard Self-Adhesive Tape as manufactured by Henry Canada
.3 Vanguard Lap Stick-S by Lexcor.

.2 Air/vapour barrier (Self-Adhered), a SBS modified bitumen self-adhering glass reinforced membrane and having a minimum thickness of 1.4 mm (56 mils). Water vapour permeability: 2.86 ng/Pa•s•m² (0.05 Perm)
.1 Acceptable products:
.2 SOPRAVAP'R as manufactured by SOPREMA Canada
.3 VaporBloc SA as manufactured by Henry Canada
.4 Vapour Barrier SAR by Johns Manville Canada.

.4 Adhesive

.1 Description: Low-rise two-part urethane adhesive with no solvents. Allows a complete cure in few minutes, with no temperature restrictions.
.1 Acceptable products
.1 DUOTACK INSULATION ADHESIVE by SOPREMA Canada
.2 THERMOSTICK 840-10 by Henry Company
.3 Two-Part UIA (Urethane Insulation Adhesive) by Johns Manville Canada

.5 Roof Insulation:

.1 Polyisocyanurate to thickness as indicated on contract drawings. Maximum dimension when adhered shall be 1219 mm (4 feet).

.1 Conforming to CAN/ULC S704 faced, type 2, CAN/ULC-S107-M87, ASTM E119, ASTM C1289-95 and FM Standard 4450/4470. Conforming to CAN/ULC-S770

.2 Acceptable products:

.1 Sopra-iso PLUS as manufactured by Soprema

.2 Energy 3 CGF as manufactured by Johns Manville.

.3 EnergyGuard Ultra as Manufactured by GAF

.4 ACFoam III as manufactured by Atlas.

.2 Spray applied in place Polyurethane Foam Insulation for roof R3

.1 Acceptable products:

.1 SOPRA-SPF 200 -100 mm

.6 Tapered Insulation

.1 Impregnated board, square edge, 600 mm x 1200 mm, thickness and tapered as indicated in the drawings.

.2 Thickness as indicated in tapered drawings and minimum slope of 1:50 (2%).

.1 Conforming to specific requirements of CSA Standard CAN/ULC S706 Type 1, high density,

.2 Acceptable products:

.1 Sopra-iso PLUS tapered as manufactured by Soprema

.2 Posi-Slope as manufactured by Posi-Slope.

.3 ACFoam III as manufactured by Atlas

.4 ENRGY 3 CGF as manufactured by Johns Manville.

.7 Insulation Overlay Boards:

.1 Asphaltic Overlay Board With Laminated Base Sheet Membrane

.1 SBS modified base sheet membrane and polyester reinforcement, factory-laminated on a semi-rigid asphaltic board. Board measures measures 0.91 m x 2.44 m (3 ft x 8 ft). Top surface covered with poly film. Membrane side lap is 60% self-adhesive and 40% thermofusible. Total thickness 7mm. (Asphaltic board,4.8 mm + membrane 2.2 mm)

.2 Acceptable products

.1 2-1 SOPRASMART BOARD by SOPREMA Canada

.2 LexBase R+ by Lexcor

.8 Torch Applied Base Sheet:

.1 Membrane base sheets (Heavy Duty), an SBS modified bitumen membrane with a polyester and fiberglass mat composite reinforcement. Top and bottom face covered with a thermofusible plastic film.

.2 Conforming to CGSB 37-GP-56M Type 2 Class C Grade 2.

.1 Acceptable products:

.1 SOPRAPLY 520 base as manufactured by SOPREMA Canada

.2 modifiedPLUS NP180s/s as manufactured by Henry Canada

.3 DynaWeld 180 S by Johns Manville Canada.

.9 Roof membrane base sheet flashing:

.1 Roofing membrane with polyester and fiberglass mat composite reinforcement and SBS modified bitumen. The top face is covered with a thermofusible plastic film, the under side is self-adhesive.

.2 Conforming to CGSB 37-GP-56M Type 2 Class C Grade 2.

.1 Acceptable products:

.1 SOPRAPLY FLAM STICK as manufactured by SOPREMA Canada

.2 ModifiedPlus HD Composite as manufactured by Henry Canada

.3 DynaGrip PR P/SA 3.0mm by Johns Manville Canada.

.10 Roofing membrane cap sheet and cap sheet flashing:

.1 ULC certifications, Class C

.2 Cap sheet and cap sheet flashing (Standard Duty), an SBS modified bitumen membrane non-woven polyester reinforcement and elastomeric bitumen. The top face is covered protected by coloured granules, the under face is covered with a thermos fusible plastic film.

.1 Acceptable products:

.1 SOPRAPLY TRAFFIC CAP as manufactured by SOPREMA Canada

.2 ModifiedPlus 250gT4 Cap Sheet as manufactured by Henry Canada.

.3 DynaWeld Cap 250 by Johns Manville Canada.

.11 Control joint membrane

.12 Expansion joint membrane with a maximum 20 mm shear movement

.1 Conforming to following minimal properties.

.1 Minimum Tensile Strength of 10 MPa (145 lb/ft^2) to ASTM D412C

.2 Minimum Elongation Break of 500% to ASTM D412C

.3 Minimum Tear Resistance of 10 N/mm (57 lb/in) to ASTM D624B

.2 Acceptable products:

.1 SOPRAJOINT as manufactured by SOPREMA Canada

.2 990-25 as manufactured by Henry Canada

.3 Expand-O-Flash and Expand-O-Gard by Johns Manville Canada.

.13 Expansion joint membrane with a shear movement between 20 mm to 125 mm .

.1 Conforming to following minimal properties.

.1 Minimum Tensile Strength of 10 MPa (145 lb/ft²) to ASTM D412C

.2 Minimum Elongation Break of 500% to ASTM D412C

.3 Minimum Tear Resistance of 10 N/mm (57 lb/in) to ASTM D624B

.2 Acceptable products:

.1 SOPRAJOINT PLUS as manufactured by SOPREMA Canada

.2 Expand-O-Flash and Expand-O-Gard by Johns Manville Canada

.3 RJ RoofJoint Expansion joint as manufactured by Emseal

.4 Red Line as manufactured by Situra Inc

.14 Plastic Cement

.1 Plastic Roof Cement.

.2 Conforming to CAN/CGSB-37.5

.3 Acceptable products:

.1 810-21 Wet/Dry Plastic Roof Cement as manufactured by Henry Canada

.2 MBR Utility Cement by Johns Manville Canada.

.15 Pitch Pocket Mastic non-shrink 100% solids pourable mastic

.1 Acceptable products:

.1 SOPRAMASTIC PF as manufactured by SOPREMA Canada

.2 Thermostic 840-10 Internal Setting Roof Adhesive, a in conjunction with Blueskin Primer Ultra manufactured by Bakor.

.3 RoofCurbII BUR & SBS Penetration Sealer by Lexcor.

.16 Membrane sealant.

.1 Conforming to CAN/CGSB 37.29

.2 Acceptable products:

.1 SOPRAMASTIC as manufactured by SOPREMA Canada.

.2 POLYBITUME 570-05 Polymer Modified Sealing Compound manufactured by Bakor.

.3 MBR Utility Cement by Johns Manville Canada.

.17 Insulated Vent Pipe Sleeve Flashing

.1 Insulated Vent Pipe Sleeve Flashing: SJ-26, Aluminum Stack Jack as manufactured by Thaler Roofing Specialties Products Inc. or approved equal.

.18 Paving Slab

.1 Paving slabs: to CSA A231.1/A231.2 of 600 mm x 600 mm x 45 mm sizes natural air entrained precast concrete paving slabs.

.2 Pedestals and levelling pads made of high-density polyethylene with integral spacer ribs on upper surface.

PART 3 EXECUTION

3.1 GENERAL

.1 Ensure all required preparatory work, penetrations and repair work is complete and approved prior to start.

3.2 WORKMANSHIP

.1 Do roofing work in accordance with applicable standard in Canadian Roofing Contractors' Association (CRCA) Roofing Specifications Manual and to FM 190 ULC S126, S107 except where specified otherwise.

.2 Do priming for asphalt roofing in accordance with CGSB 37-GP-15M.

3.3 PLANT AND EQUIPMENT

3.4 EXAMINATION

.1 Examine substrates, areas, and conditions under which roofing will be applied with Installer present and immediately inform Consultant in writing of defects. Do not cover any areas of questionable welds or deck out of plane.

.2 Prior to commencement of work ensure:

.1 Decks are securely fastened, firm, straight, smooth, dry, free of snow, ice or frost and swept clean of dust and debris.

.2 Verify that deck have no projecting fasteners and with no adjacent units in excess of 1/16 inch (1.5 mm) out of plane.

.3 Verify that roof openings and penetrations are in place, set and braced.

.4 Verify that wood blocking, curbs, and nailers are securely anchored to roof deck at roof penetrations and terminations and match the thicknesses of insulation required.

.1 Verify that wood nailer strips are located perpendicular to roof slope and are spaced per requirements of roofing system manufacturer.

.5 Roof drains have been installed, properly clamped into position at proper elevations relative to finished roof surface.

.6 Plywood and lumber nailer plates have been installed to deck, walls and parapets as indicated.

.7 Do not proceed with installation until unsatisfactory conditions have been corrected.

3.5 PREPARATION

.1 Clean substrate of dust, debris, and other substances detrimental to roofing installation according to roofing system manufacturer's written instructions. Remove sharp projections.

.2 Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction. Remove roof-drain plugs when no work is taking place or when rain is forecast.

3.6 INSTALLATION

.1 Substrate Joint Treatment for Hot Applications

.1 Apply primer by roller or spray to all surfaces to be covered with self-adhered transition tape as required and allow to dry.

.2 Unroll and align transition membrane centered at low point of roof or drain. Apply transition membrane by removing release paper providing 50 mm (2 inches) side and end laps.

.2 Self-Adhered Air/Vapour Barriers

.1 Apply primer by roller or spray to all surfaces to be covered with self-adhered transition tape as required and allow to dry.

.2 Unroll and align transition membrane centered at low point of roof or drain. Apply transition membrane by removing release paper providing 50 mm (2 inches) side and end laps.

.3 Apply membrane complete and continuous to prepared and primed substrate in an overlapping shingle fashion and in accordance with manufacturer's written instructions. Stagger all vertical joints. Unroll and align air/vapour barrier centered at edge or low point of roof.

.4 Align and position membrane, remove protective film and press firmly into place. Ensure minimum 75 mm (3 inches) overlap at all side laps and 150 mm (6 inches) at all end . Promptly roll all laps and membrane with a counter top roller to effect the seal.

.3 Insulation Installation

.1 Install insulation board stock and tapered insulation with specified adhesive in continuous strips spaced as indicated on the wind uplift report.

.2 Install only as much insulation as can be covered in the same day.

.3 Around the drains lower insulation by 1” to create a sump 4’ X 4’ in area. Bevel the edge of the 3” insulation on a 45° angle.

.4 Install tapered insulation in adhesive where indicated on drawings.

.5 Apply insulation to vapour retarder with adhesive in conformance with manufacturer's written recommendations to meet uplift requirements

.4 Installation of Overlay Board and Base Sheet Composite Panel

.1 Apply composite board to insulation with adhesive in conformance with manufacturer's written recommendations.

.2 Install only as much insulation as can be covered in the same day.

.3 Boards are NOT staggered.

.4 Seal end laps by welding a 330-mm (13-in) wide cover strip centered on the joint.

.5 Avoid forming wrinkles, swelling or fishmouths

.5 Membrane Cap Sheet (Torch applied)

.1 Apply base sheet beginning at the low point of the roof and align membrane along centerline of roof drain. Re-roll and torch apply to substrate following manufacturers printed instructions.

.2 Install end laps of the cap sheet are offset from those of the base sheet a minimum of 300 mm (12 inches) for side and 450 mm (18 inches) for end laps.

.3 Field cap sheets stop at the toe of the cant.

.4 Seal around all projections with an additional ply of membrane as per manufacturer’s instructions.

.6 Flashing at Roof Edge (Self adhered)

.1 Apply primer to the substrate at a rate of .25 L/m2. Allow primer to dry before installation of Base Sheet

.2 Install reinforcing gussets at all inside and outside corners

.3 Install base sheet flashing in one- (1) metre widths to cover roofing substrate over 100 mm. Overlap side laps by 75 mm. Stagger side laps by at least 100 mm from base sheet overlaps on roof to avoid excessive layering.

.4 Apply base sheet flashing directly onto substrate by removing release paper cover sheet. Proceed from top to bottom. Once in place, apply pressure manually in a uniform fashion to obtain homogenous adherence over entire surface. Preferably seal seams with rubber roller. Nail outside edge at 300 mm o/c.

.5 Avoid forming wrinkles, air pockets or fishmouths.

.6 Always seal overlaps at the end of the workday

.7 Cap sheet flashings (Torch applied)

.1 Apply cap sheet beginning at the low point of the roof or centre of drain. Re-roll and torch apply to base sheet following manufacturers printed instructions.

.2 Begin 150 mm (6 inches) from toe of cant strip and extend vertically as indicated.

.8 Control Joints (Torch Applied Method)

.1 At raised curb control joint details, install control joint membrane at the plane of the air/vapour barrier membrane.

.2 Loop flashing membrane down into joint ensuring that the depth of loop is a minimum 35 mm or 1.5 x the width. Extend flashing membrane minimum of 150 mm (6 inches) on each side of joint. Lap end joints a minimum of 150 mm (6 inches).

.3 Construct curbs, install insulation and overlay as detailed.

.4 Apply membrane base sheet flashing and membrane cap sheet flashing by torching as per manufacturers' instructions to primed substrate. Refer to manufacturers' standard details.

.5 Mechanically fasten base sheet flashing using 25 mm (1 inch) round top nails on 200 mm (8 inches) centres.

.9 Expansion Joints (Membrane set in Hot Asphalt)

.1 At raised curb control joint details, install control joint membrane at the plane of the air/vapour barrier membrane.

.2 Loop flashing membrane down into joint ensuring that the depth of loop is a minimum 35 mm or 1.5 x the width. Extend flashing membrane minimum of 150 mm (6 inches) on each side of joint. Lap end joints a minimum of 150 mm (6 inches).

.3 Construct curbs, install insulation and overlay as specified.

.4 Apply membrane base sheet flashing and membrane cap sheet flashing by torching as per manufacturers' instructions to primed substrate. Refer to manufacturers' standard details.

.5 Mechanically fasten base sheet flashing using 25 mm (1 inch) round top nails on 200 mm (8 inches) centres.

.10 Flashing Vent Stacks

.1 Install polyethylene back-up rope between roof deck and vent stack and caulk joint.

.2 Embed vent stack flashing flange in 3 mm thickness of plastic cement on top of roofing felts.

.3 Embed two (2) plies of organic felt into heavy coatings of hot bitumen. Extend plies 100 mm and 200 mm beyond outer edge of flange.

.4 Lap joints 100 mm, remove wrinkles and buckles and overcoat with hot bitumen.

.11 Flashing Curbs for Roof-Mounted Apparatus

.1 Do flashing at curbs for roof mounted apparatus same as for vertical surfaces except extend elastomeric sheeting embedded in hot elastomeric asphalt across top of curb and into the opening.

.2 Minimum height of curbs: 400 mm.

.12 Flashing Roof Drains

.1 Cut 225 mm diameter opening through new membrane and insulation coinciding with an existing drain opening.

.2 Adhere drain flange to membrane with flashing adhesive and mechanically fasten to deck minimum of four (4) fasteners per drain.

.3 Reinforcing membrane :

.1 Provide 1000 mm x 1000 mm elastomeric sheeting reinforcement to drain.

.1 Centre sheeting over drain.

.2 Adhere membrane with a torch

.3 Remove wrinkles/entrapped air.

.13 Flashing Roof Area Divider

.1 Install elastomeric sheeting centred over area divider.

.2 Adhere sheeting membrane completely to horizontal and vertical blocking surfaces with elastomeric adhesive. Press sheeting into adhesive. Ensure a complete bond and continuity without wrinkles or voids.

.3 Flashing membrane is to be of sufficient width to extend onto the adjacent roofing a minimum of 150 mm.

.4 Lap sheeting ends 100 mm and adhere with flashing adhesive.

.5 Tie-in leading edge of sheeting with stripping ply adhesive.

.6 Overcoat lap edges with stripping ply adhesive.

.14 Installation of Expansion Joints Exceeding 20 mm Movement

.1 Identify the installation starting point of the expansion joint.

.2 Unroll the entire roll before installation to ensure positioning and measurements are accurate.

.3 Using a propane torch, heat the base sheet on which the expansion joint will be installed.

.4 Place or unroll the expansion joint on the liquefied bitumen of the base sheet and apply pressure to the surface,

.5 Weld a minimum of 150 mm (6 in) reinforcing strip centered on the edge of the flange and apply pressure to the surface.

.6 Cover the flanges with a cap sheet membrane all the way up to the edge of the core and apply pressure to the surface.

.7 According to surface constraints and when it is necessary to protect the core of the expansion joint, cover with a cap sheet of at least 330 mm (13 in), centered over the joint and fixed on one side to allow expansion movements, or use a steel plate, concrete or other mechanical protection.

.8 Install the base sheet and the cap sheet on the same day as the expansion joint to prevent risk of moisture absorption in the fabric.

.15 Installation of Expansion Joints with Less The 20 mm Movement

.1 Identify the installation starting point of the expansion joint.

.2 Unroll the entire roll before installation to ensure positioning and measurements are accurate.

.3 Using a propane torch, heat the base sheet on which the expansion joint will be installed.

.4 Place or unroll the expansion joint on the liquefied bitumen of the base sheet and apply pressure to the surface,

.5 Weld a minimum of 150 mm (6 in) reinforcing strip centered on the edge of the flange and apply pressure to the surface.

.6 Cover the flanges with a cap sheet membrane all the way up to the edge of the core and apply pressure to the surface.

.7 According to surface constraints and when it is necessary to protect the core of the expansion joint, cover with a cap sheet of at least 330 mm (13 in), centered over the joint and fixed on one side to allow expansion movements, or use a steel plate, concrete or other mechanical protection

.16 Control Joint at Wall-Roof Junction

.1 Apply as per manufactures publish specifications

.2 Fill any open joint with loose insulation.

.3 Adhere elastomeric sheeting completely to flashing surface, cant and roofing with flashing adhesive. Ensure that the leading edge of the sheeting extends onto the roof surface a distance of 150 mm.

.4 Ensure complete bond and continuity without wrinkles or voids. Lap sheeting ends 100 mm with adhesive. Membrane is not to be stretched tight and is to be formed with “V” loop at expansion joint.

.5 Flashing height shall be not less than 200 mm above the finished roof surface.

.6 Tie-in leading edge of the sheeting with Stripping Ply Membrane embedded between alternate courses of Stripping Ply Adhesive.

.7 Overcoat lap edges with Stripping Ply Adhesive and Membrane.

.8 Flashing Adhesive and Stripping Ply Adhesive are to be applied at a rate of 1.2 kg/m^2.

.17 Expansion Joint at Wall-Roof Junction

.1 Apply as per manufactures publish specifications

.2 Fill any open joint with loose insulation.

.3 Adhere elastomeric sheeting completely to flashing surface, cant and roofing with flashing adhesive. Ensure that the leading edge of the sheeting extends onto the roof surface a distance of 150 mm.

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.5 Flashing height shall be not less than 200 mm above the finished roof surface.

.6 Tie-in leading edge of the sheeting with Stripping Ply Membrane embedded between alternate courses of Stripping Ply Adhesive.

.7 Overcoat lap edges with Stripping Ply Adhesive and Membrane.

.8 Flashing Adhesive and Stripping Ply Adhesive are to be applied at a rate of 1.2 kg/m2.

.9 Walkway Planks

.1 Install concrete pavers on top of extruded polystyrene around all roof-top equipment and access to same.

.10 Pipe Supports

.1 Install concrete pavers on top of extruded polystyrene for gas pipe supports.

.18 Field Quality Control

.1 The Contractor shall employ and pay for a qualified third party inspection agent for daily inspection work for this project, 5 days per week minimum. A daily report shall be submitted to the Owner, Architect and Warranty manufacturer for their records. See Specification Section 01400, Quality Control for details.

.2 If accepted by the Owner, Engineer and Warranty manufacturer, it is also the Contractor's option to have the Manufacturer's technical personnel on the job site for daily inspections, 5 days per week minimum, and to prepare and submit the same reports as the third party inspection agent.

.3 Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion and submit report to Engineer.

.1 Notify Engineer and Owner 48 hours in advance of the date and time of inspection.

3.7 PROTECTION

.1 Maintain fire watch for one hour following each day's work when membranes are thermofused.

.2 Maintain one fully operational fire extinguisher per torch applicator within 10 m of point of work.

.3 Cover walls and adjacent work where materials hoisted or used.

.4 Use warning signs and barriers. Maintain in good order until completion of work.

.5 Clean off drips and smears of bituminous material immediately.

.6 Dispose of rain water off roof and away from face of building until roof drains or hoppers installed and connected.

.7 Protect roof from traffic and damage. Comply with precautions deemed necessary by Consultant. Repair damage caused by non-compliance with Consultant requirements.

.8 Provide plywood protective walkways over the membrane to permit circulation of workers and materials and to prevent mechanical damage or damage from spillage of oil or solvents until such time as permanent protection is provided.

.9 At end of each day's work or when stoppage occurs due to inclement weather, provide protection for completed work and materials out of storage.

.10 Waterproof edges and ballast them.

3.8 SITE ACCEPTANCE TESTING

.1 Inspection and testing of roofing application will be carried out by testing laboratory designated by Engineer.

.2 Include for full-time inspection to CRCA Roof Inspection Guide modified as follows:

.1 Ensure reports are sent to Engineer and Primary Material Manufacturer.

.3 On-Site Quality Control

.1 Built-Up Bituminous Roof membrane inspection and testing shall be carried out by an inspection agency selected by the Engineer, in accordance with Section 01 45 00 - Quality Control.

3.9 POST-INSTALLATION

.1 At completion of roofing installation and associated work, meet with Installer, installer of associated work, Region, roofing system manufacturer's representative, and other representatives directly concerned with performance of roofing system.

.2 Walk roof surface areas of the building, inspect perimeter building edges as well as flashing of roof penetrations, walls, curbs and other equipment. List all items requiring correction or completion and furnish copy of list to each parting attending.

.3 The Roofing System Manufacturer reserves the right to request a thermographic scan of the roof during final inspection to determine if any damp or wet materials have been installed. The thermographic scan shall be provided by the Roofing Contractor at a negotiated price.

.4 Core cuts of the roof system may be requested by the Engineer upon the discovery of defects in the roof system to verify the presence of damp or wet materials, the Roofing Contractor shall be required to replace the damaged areas at his own expense.

.5 Repair or replace (as required) deteriorated or defective work found at time above inspection to a condition free of damage and deterioration at time of substantial performance and according to warranty requirements.

.6 The Contractor is to notify the Engineer upon completion of corrections.

.7 Following the final inspection, acceptance will be made in writing by the material manufacturer and submitted to the Engineer for review.

3.10 CLEANING

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

.2 Progress Cleaning: Perform cleanup as work progresses

.3 Leave work area clean at end of each day. Final cleaning: Upon completion, remove surplus materials, rubbish, tools, and equipment. Waste Management: Collect recyclable waste and dispose of or recycle field generated construction waste created during construction or final cleaning related to work of this Section.Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

SHEET METAL FLASHING AND TRIM

PART 1 GENERAL

1.1 INTENT

.1 Provide all articles, labour, materials, equipment and transportation, hoisting and incidentals noted, specified or required to complete the work of this Section.

1.2 RELATED SECTIONS

.1 Division 1

.2 Section 03 30 00 – Cast-in-Place Concrete

.3 Section 04 05 00 – Masonry Procedures

.4 Section 04 05 23 – Masonry Accessories

.5 Section 06 10 10 – Rough Carpentry

.6 Section 07 27 00 – Self-Adhered Air Vapour Barrier Membrane.

.7 Section 07 21 20 – Board Insulation.

.8 Section 07 52 10 – MBM – Torch Applied Roofing

.9 Divisions 15 and 25-28 - Mechanical & Electrical as applicable

1.3 REFERENCES

.1 The Aluminum Association Inc. (AAI)

.1 AAI-Aluminum Sheet Metal Work in Building Construction-2002.

.2 AAI DAF45-03(R2009), Designation System for Aluminum Finishes.

.2 American Society for Testing and Materials (ASTM):

.1 ASTM A167-99(2009), Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.

.2 ASTM A240/A240M-20, Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.

.3 ASTM A606/A660M-18, Standard Specification for Steel, Sheet and Strip, High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, with Improved Atmospheric Corrosion Resistance.

.4 ASTM A653/A653M-20, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

.5 ASTM A792/A792M-10(2015), Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.

.6 ASTM A879/A879-12(2017) – Standard Specification for Steel Sheet, Zinc Coated by the Electrolytic Process for Applications Requiring Designation of the Coating Mass on Each Surface

.7 ASTM B32-20 – Standard Specification for Solder Metal

.8 ASTM B370-12(2019), Standard Specification for Copper Sheet and Strip for Building Construction.

.9 ASTM D523-14(2018), Standard Test Method for Specular Gloss.

.10 ASTM D822/D822M-13(2018) – Standard Practice for Filtered Open-Flame Carbon-Arc Exposure of Paint and Related Coatings

.3 Canadian Roofing Contractors Association (CRCA)

.1 Roofing Specifications Manual 1997.

.4 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-51.32-M77, Sheathing, Membrane, Breather Type.

.2 CAN/CGSB-93.1-M85, Sheet Aluminum Alloy, Prefinished, Residential.

.5 Canadian Standards Association (CSA):

.1 CSA A123.3-05(R2015), Asphalt Saturated Organic Roofing Felt.

.2 AAMA/WDMA/CSA 101/I.S.2/A440-17, Standard/Specification for Windows, Doors, and Unit Skylights.

.3 CSA B111-1974(R2003), Wire Nails, Spikes and Staples.

.4 CSA A440S1-19 – Windows, Doors and Skylights

.6 Green Seal Environmental Standards

.1 Standard GS-03-15, Anti-Corrosive Paints.

.2 Standard GS-11-15, Architectural Paints.

.3 Standard GS-36-13, Commercial Adhesives.

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

.1 Material Safety Data Sheets (MSDS).

1.4 QUALITY ASSURANCE

.1 Contractors Qualifications

.1 Work of this section shall be carried out by a firm specialized in the type of work specified herein. Use competent installers, experienced, trained and approved by material or system manufacturer for application of materials and systems being used. Installers shall have a minimum five (5) years of experience in installation and provide documentation of examples minimum of (5) five previous projects completed more than (1) year since construction closeout upon request by engineer.

.2 Pre-installation meetings: comply with Section 01 31 00 – Project Management. Conduct pre-installation meeting one week prior to commencing work of this Section and on-site installations to:

.1 Notify attendees 2 weeks prior to meeting and ensure meeting attendees include as minimum:

.1 Owner;

.2 Engineer;

.3 All Affected Subcontractors;

.4 Manufacturer's Technical Representative.

.2 Coordinate with related specification listed in section 1.3 - Related Specification Sections

.3 Verify project requirements, including mock-up requirements.

.4 Verify substrate conditions.

.5 Co-ordinate products, installation methods and techniques.

.6 Sequence work of related sections.

.7 Co-ordinate with other building sub-trades to ensure proper installation and site preparation.

.8 Review manufacturer's installation instructions.

.9 Review warranty requirements.

1.5 SUBMITTALS

.1 Complete submittals in accordance with Specification Section 01 33 00.

.2 Product Data:

.1 Submit manufacturer's printed product literature for sheet metal flashing systems materials, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Submit WHMIS MSDS - Material Safety Data Sheets in accordance with Health and Safety Requirements and 01 35 43 - Environmental Protection.

.3 Samples

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

.2 Submit duplicate 50 x 50 mm samples of each type of sheet metal material, finishes and colours.

.4 Alternatives

.1 Acceptable alternatives will be confirmed by addendum. Substitute materials not approved in writing prior to tender closing shall not be permitted for use on this project.

.5 Quality assurance submittals:

.1 Submit following in accordance with Section 01 45 00 - Quality Control.

.2 Manufacturer's Instructions: submit manufacturer's installation instructions and special handling criteria, installation sequence and cleaning procedures.

.3 Manufacturer's Field Reports: submit to manufacturer's written reports within 3 days of review, verifying compliance of Work, as described in PART 3, FIELD QUALITY CONTROL.

1.6 DELIVERY STORAGE AND HANDLING

.1 Refer to Specification Section 01 61 00 - Common Product Requirements.

.2 Deliver, store and handle materials in accordance to manufacturer's recommendations.

.3 Flashing will be stored to avoid creasing, buckling, scratching, or any other possible damage.

PART 2 PRODUCTS

2.1 SHEET METAL MATERIALS

.1 Zinc Coated Steel Sheet: .50 mm thickness, commercial quality to ASTM A653/A653M, with Z275 designation zinc coating.

.2 Galvanized scupper plate: 6mm to be cast-in with the wall parapet.

2.2 PRE-FINISHED STEEL SHEET

.1 Pre-finished steel sheet with factory applied Colourite HMP, 8000+ Series, or approved equivalent system.

.1 Class: F1S.

.2 Colour: to be selected by ENGINEER from manufacturer's standard range.

.3 Specular gloss: 30 units ±5 in accordance with ASTM D523.

.4 Coating thickness: not less than 25 ±5 micrometers.

.5 Resistance to accelerated weathering for chalk rating of 8, colour fade 5 units or less and erosion rate less than 20 percent to ASTM D822 as follows:

.1 Outdoor exposure period: 2500 hours.

.2 Humidity resistance exposure period: 5000 hours.

2.3 ALUMINUM SHEET

.1 Alcan Industrial Building Sheet, Alloy 1100 H14, Duranar 22 micron thick DFT minimum, coated after forming. Finish sheet after forming. Colour to be selected at later date.

.2 Coping flashings, cap flashings, counter flashings: 1.0 mm thick aluminum sheet.

.3 Counter flashings in other locations: 0.8 mm thick aluminum sheet.

.4 Locking strip: 1.63 mm thick aluminum sheet nominal thickness.

.5 Accessories: As required, compatible with materials used.

.6 Fastenings: Same finish as sheet being fastened, sized to suit site conditions, stainless steel

.7 Sealant: CAN/CGSB-19.13-M, one component DC795 by Dow Corning Inc. Primer as recommended by sealant manufacturer. Colour to match flashing finish colour.

.8 Backpaint: ASTM D1187 Bituminous Paint.

2.4 ACCESSORIES

.1 Isolating coating: alkali resistant bituminous paint.

.2 Underlay for metal flashing: No. 15 perforated asphalt felt to CSA A123.3.

.3 Sealants: to Section 07 90 00 – Joint Sealers.

.4 Cleats: of same material, and temper as sheet metal, minimum 50 mm wide. Thickness: same as sheet metal being secured.

.5 Fasteners: of same material as sheet metal, to CSA B111, ring thread flat head roofing nails of length and thickness suitable for metal flashing application.

.6 Washers: of same material as sheet metal, 1 mm thick with rubber packings.

.7 Solder: to ASTM B32.

.8 Flux: rosin, cut hydrochloric acid or commercial preparation suitable for materials to be soldered.

.9 Touch-up paint: as recommended by pre-finished material manufacturer.

2.5 FABRICATION

.1 Fabricate metal flashings and other sheet metal work in accordance with applicable CRCA ‘FL’ series details as indicated.

.2 Form pieces in 2400 mm maximum lengths.

.1 Make allowance for expansion at joints.

.3 Hem exposed edges on underside 12 mm.

.1 Mitre and seal corners with sealant.

.4 Form sections square, true and accurate to size, free from distortion and other defects detrimental to appearance or performance.

.5 Apply isolation coating to metal surfaces to be embedded in concrete or mortar.

2.6 METAL FLASHINGS

.1 Form flashings and copings to profiles indicated of .50 mm thick pre-finished steel.

2.7 REGLETS AND CAP FLASHINGS

.1 Form recessed reglets metal cap flashing of .50 mm thick steel sheet metal to be built-in masonry work for base flashings as detailed. Provide slotted fixing holes and steel/plastic washer fasteners. Cover face and ends with plastic tape.

2.8 EAVES TROUGHS AND DOWNPIPES

.1 Form eaves troughs and downpipes from .50 mm thick pre-finished steel sheet metal.

.2 Size 1 trough 125 mm wide @ 0.5 percent slope, downpipes 100 mm wide.

.3 Provide goosenecks, outlets, strainer baskets and necessary fastenings.

.4 Form 600 mm x 600 mm splash pans from .91 mm thick galvanized steel sheet metal.

PART 3 EXECUTION

3.1 INSTALLATION

.1 Install sheet metal work in accordance with CRCA FL series details, as detailed.

.2 Flashing to be installed with a minimum slope of 1:10 unless indicated otherwise on drawings.

.3 Use concealed fastenings, except where approved before installation.

.4 Provide underlay under sheet metal.

.1 Secure in place and lap joints 100 mm.

.5 Counterflash bituminous flashings at intersections of roof with vertical surfaces and curbs.

.1 Flash joints using S-lock forming tight fit over hook strips, as detailed.

.6 Lock end joints and caulk with sealant.

.7 Install surface mounted reglets true and level, and caulk top of reglet with sealant.

.8 Insert metal flashing into reglets to form weather tight junction.

.9 Turn top edge of flashing into recessed reglet or mortar joint minimum of 25 mm. Lead wedge flashing securely into joint.

.10 Caulk flashing where required and at reglet with sealant.

.11 Install pans, where shown around items projecting through roof membrane.

3.2 EAVES TROUGHS AND DOWNPIPES

.1 Install eaves troughs and secure to building at 750 mm on centre with eaves trough spikes through spacer ferrles.

.1 Slope eaves troughs to downpipes as indicated.

.2 Solder seal joints watertight.

.3

3.3 PROTECTION:

.1 Examine casework for damaged or soiled areas; replace, repair, and touch-up as required.

.2 Touch-up, repair or replace damaged products before Substantial Completion.

.3 Install downpipes and provide goosenecks back to wall.

.1 Secure downpipes to wall with straps at 1800 mm on centre; minimum two (2) straps per downpipe.

.2 Connect downpipes to drainage system and seal joint with plastic cement.

.4 Install splash pans at all downspouts, unless noted otherwise.

3.4 SCUPPERS

.1 Install scuppers as indicated.

3.5 CLEANING

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

.2 Progress Cleaning: Perform cleanup as work progresses

.1 Leave work area clean at end of each day

.3 Final cleaning: Upon completion, remove surplus materials, rubbish, tools, and equipment

.4 Waste Management

.1 Collect recyclable waste and dispose of or recycle field generated construction waste created during construction or final cleaning related to work of this Section

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

.5 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment

.6 Leave work areas clean, free from grease, finger marks and stains

END OF SECTION

ROOF HATCHES

PART 1 GENERAL

1.1 SUMMARY

.1 Work includes: Furnishing and installing factory fabricated roof hatches.

1.2 RELATED WORK

.1 Division 1

.2 Section 05 50 00 – Metal Fabrications.

1.3 REFERENCES

.1 ASTM A53 / A53M-12 - Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless

.2 CAN/CGSB-1.40-M89 - Primer, Structural Steel, Oil Alkyd Type

.3 CAN/CGSB-1.108-M89 - Bituminous Solvent Type Paint

.4 CAN/CGSB-1.181-92 - Ready-Mixed, Organic Zinc-Rich Coating

.5 CAN/CSA-G40.20-13/G40.21-13 (2018) - Structural Quality Steels

.6 CAN/CSA-G164-M92 - Hot-Dip Galvanizing of Irregularly Shaped Articles

.7 CAN/CSA-S16-14 - Limit States Design of Steel Structures

.8 CSA W59-13 - Welded Steel Construction (Metal Arc Welding)

.9 ASTM A276/ A276M - 17 - Type 316 Stainless Steel

1.4 SUBMITTALS

.1 Product Data: Provide manufacturer's product data for all materials in this specification.

.2 Shop Drawings: Show profiles, accessories, location and dimensions. Stamped by a Professional Engineer licensed to practice in the Province of Ontario.

.3 Samples: Manufacturer to provide upon request; sized to represent material adequately.

.4 Contract Closeout: Roof hatch manufacturer shall provide the manufacturer's warranty prior to the contract closeout.

1.5 PRODUCT HANDLING

.1 All materials shall be delivered in manufacturer's original packaging.

.2 Store materials in a dry, protected, well-vented area. The Contractor shall thoroughly inspect product upon receipt and report damaged material immediately to delivering carrier and note such damage on the carrier's freight bill of lading.

.3 Remove protective wrapping immediately after installation, if applicable.

1.6 SUBSTITUTIONS

.1 Proposals for substitution products shall be accepted only from bidding contractors and not less than 10 working days before bid due date. Contractor guarantees that proposed substitution shall meet the performance and quality standards of this specification.

1.7 JOB CONDITIONS

.1 Verify that other trades with related work are complete before installing roof hatches.

.2 Mounting surfaces shall be straight and secure; substrates shall be of proper width.

.3 Refer to the construction documents, shop drawings and manufacturer's installation instructions.

.4 Coordinate installation with roof membrane and roof insulation manufacturer's instructions before starting.

1.8 WARRANTY

.1 Manufacturer's standard warranty: Materials shall be free of defects in material and workmanship for a period of five (5) years from the date of purchase. Should a part fail to function in normal use within this period, manufacturer shall furnish a new part at no charge.

PART 2 PRODUCTS

2.1 MANUFACTURER

.1 The BILCO Company, P.O. Box 1203, New Haven, CT 06505, Phone: 1-203-934-6363, Fax: 1-203-933-8478, Web: www.bilco.com or approved equal.

.2 Lexcor Roofing Accessories, 52 Bramwin Court, Brampton, Ontario L6T 5G2, Phone: 905-792-8300, Fax: 905-792-8305, Web: www.lexcor.net.

2.2 ROOF HATCH

.1 Furnish and install, where indicated on plans, metal roof hatch Type E-50, size width 914 mm x length 914 mm. Length denotes hinge side. The roof hatch shall be single leaf. The roof hatch shall be pre-assembled from the manufacturer.

.2 Performance characteristics:

.1 Cover shall be reinforced to support a minimum live load of 2.4 kPa (50 psf) with a maximum deflection of 1/150th of the span or 0.88 kPa (20 psf) wind uplift.

.2 Operation of the cover shall be smooth and easy with controlled operation throughout the entire arc of opening and closing.

.3 Operation of the cover shall not be affected by temperature.

.4 Entire hatch shall be weathertight with fully welded corner joints on cover and curb.

.3 Cover: Shall be 11 gauge aluminum with a 76 mm beaded flange with formed reinforcing members. Cover shall have a heavy extruded EPDM rubber gasket that is bonded to the cover interior to assure a continuous seal when compressed to the top surface of the curb.

.4 Cover insulation: Shall be fibreglass of 25.4 mm thickness, fully covered and protected by a metal liner of 18 gauge aluminum.

.5 Curb: Shall be 305 mm in height and of 11 gauge aluminum. The curb shall be formed with an 89 mm flange with 11.1 mm holes provided for securing to the roof deck. The curb shall be equipped with an integral metal cap flashing of the same gauge and material as the curb, fully welded at the corners, that features the Bil Clip® flashing system, including stamped tabs, 153 mm on center, to be bent inward to hold single ply roofing membrane securely in place.

.6 Curb insulation: Shall be rigid, high-density fibreboard of 25.4 mm thickness on outside of curb.

.7 Lifting mechanisms: Manufacturer shall provide compression spring operators enclosed in telescopic tubes to provide smooth, easy and controlled cover operation throughout the entire arc of opening and closing. The upper tube shall be the outer tube to prevent accumulation of moisture, grit and debris inside the lower tube assembly. The lower tube shall interlock with a flanged support shoe welded to the curb assembly.

.8 Hardware:

.1 Heavy pintle hinges shall be provided.

.2 Cover shall be equipped with a spring latch with interior and exterior turn handles.

.3 Roof hatch shall be equipped with interior and exterior padlock hasps.

.4 The latch strike shall be a stamped component bolted to the curb assembly.

.5 Cover shall automatically lock in the open position with a rigid hold open arm equipped with a 25.4 mm diameter red vinyl grip handle, to permit easy release for closing.

.6 All hardware shall be Type 316 stainless hardware.

.7 Cover hardware shall be bolted into heavy gauge channel reinforcing welded to the underside of the cover and concealed within the insulation space.

.9 Finishes: Factory finish shall be mill finish aluminum.

PART 3 EXECUTION

3.1 INSPECTION

.1 Verify that roof hatch installation will not disrupt other trades. Verify that the substrate is dry, clean and free of foreign matter. Report and correct defects prior to any installation.

3.2 INSTALLATION

.1 Submit product design drawings for review and approval to the Architect or specifier before fabrication.

.2 The installer shall check as-built conditions and verify the manufacturer's roof hatch details for accuracy to fit the application prior to fabrication. The installer shall comply with the roof hatch manufacturer's installation instructions.

.3 The installer shall furnish mechanical fasteners consistent with the roof requirements.

END OF SECTION

CONCRETE ROOF PAVERS

PART 1 GENERAL

1.1 INTENT

.1 This section describes the materials and procedures for the installation of concrete roof pavers and supporting pedestal system installed by trades including work in relation to the low slope roofing system.

1.2 RELATED SPECIFICATION SECTIONS

.1 In addition to the general project requirements in Division 1, the following sections are referenced in this section:

.1 Section 07 52 10 – MBM – Torch Applied Roofing

1.3 CODE AND REGULATORY REQUIREMENTS

.1 All products shall conform to the following standards and regulations:

.1 American Society for Testing and Materials (ASTM).

.1 ASTM C 33, Standard Specification for Concrete Aggregates.

.2 ASTM C 67, Standard Test Methods for Sampling and Testing Brick and Structural Clay Tile, Section 8, Freezing and Thawing.

.3 ASTM C 140, Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units.

.4 ASTM C 144, Standard Specifications for Aggregate for Masonry Mortar.

.5 ASTM C 293, Standards Test Method for Flexural Strength of Concrete.

.6 ASTM C 936, Standard Specification for Solid Concrete Interlocking Paving Units.

.7 ASTM C 979, Standard Specification for Pigments for Integrally Colored Concrete.

.8 ASTM C 1645, Standard Test Method for Freeze-thaw and De-icing Salt Durability of Solid Concrete Interlocking Paving Units.

.9 ASTM D 256, Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics.

.10 ASTM D 638, Standard Test Method for Tensile Properties of Plastics.

.11 ASTM D 648, Standard Test Method for Deflection Temperature of Plastics Under Flexural Load in the Edgewise Position.

.12 ASTM D 698, Test Methods for Moisture Density Relations of Soil and Soil Aggregate Mixtures Using a 5.5 lb (24.4 N) Rammer and 12 in. (305 mm) drop.

.13 ASTM D 792, Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement.

.14 ASTM D 1238, Standard Test Method for Melt Flow Rates of Thermoplastics by Extrusion Plastometer.

.15 ASTM D 1557, Test Methods for Moisture Density Relations of Soil and Soil Aggregate Mixtures Using a 10-lb (44.5 N) Rammer and 18 in. (457 mm) drop.

.2 Canadian Standards Association (CSA):

.1 CSA A231.1-06 Precast Concrete Paving Slabs

1.4 QUALITY ASSURANCE

.1 In addition to the requirements of 01 45 00 – Quality Control, the following measures are required:

.2 Manufacturer Qualifications

.1 Utilize a manufacturer having at least ten years of experience manufacturing concrete pavers on projects of similar nature or project size.

.2 Source Limitations:

.1 Obtain Roof Concrete Pavers from one source location with the resources to provide products of consistent quality in appearance and physical properties.

.2 Obtain Pedestal System from one manufacturer with complete integrated and adjustable products of consistent quality and function.

.3 Contractors Qualifications

.1 Work of this section shall be carried out by a firm specialized in the type of work specified herein. Use competent installers, experienced, trained and approved by material or system manufacturer for application of materials and systems being used. Installers shall have a minimum five (5) years of experience in installation and provide documentation of examples minimum of (5) five previous projects similar in design, material, and extent indicated on this project and completed more than (1) year since construction closeout upon request by engineer.

.2 Provide Owner/Client/General Contractor names, postal address, phone, fax, and email address.

.4 Mock-up

.1 Install a minimum 4 ft x 4 ft paver area.

.2 Use this area to determine joint sizes, lines, laying pattern(s) and levelness. This area will serve as the standard by which the workmanship will be judged.

.3 Subject to acceptance by owner, mock-up may be retained as part of finished work.

.4 If mock-up is not retained, remove and properly dispose.

.5 Pre-installation meetings: comply with Section 01 31 00 – Project Management. Conduct pre-installation meeting one week prior to commencing work of this Section and on-site installations to:

.1 Verify project requirements, including mock-up requirements.

.2 Verify substrate conditions.

.3 Co-ordinate products, installation methods and techniques.

.4 Sequence work of related sections.

.5 Co-ordinate with other building sub-trades to ensure proper installation and site preparation.

.6 Review manufacturer's installation instructions.

.7 Review warranty requirements.

1.5 SUBMITTALS

.1 Complete submittals in accordance with Specification Section 01 33 00.

.2 Product Data:

.1 Test results from an independent testing laboratory for compliance of concrete pavers with ASTM C 936, ASTM C 293 and/or CSA A231.1.

.2 Submit manufacturer's data sheets on each product to be used, including:

.1 Preparation instructions and recommendations.

.2 Installation instructions. Coordinate placement with locations noted on the Contract Drawings.

.3 Material safety data sheets for the safe handling of the specified materials and products.

.4 Storage and handling requirements and recommendations.

.3 Samples:

.1 Roof Concrete Pavers: Three representative full-size samples of each paver type, thickness, color and finish that indicate the range of color variation and texture expected upon project completion.

.2 Accepted samples become the standard of acceptance for the product produced.

.4 Closeout Submittals: Provide maintenance data for cleaning and maintenance for incorporation into operations manual

.5 Warranty: Submit unexecuted warranty for review

1.6 DELIVERY STORAGE AND HANDLING

.1 Refer to Specification Section 01 61 00.

.1 Deliver Roof Concrete Pavers in manufacturer's original, unopened and undamaged container packaging with identification labels intact.

.1 Coordinate delivery and paving schedule to minimize interference with normal use of streets and sidewalks adjacent to paver installation.

.2 Deliver Roof Concrete Pavers to the site in steel banded, plastic banded or plastic wrapped packaging capable of transfer by forklift or clamp lift.

.3 Unload pavers at job site in such a manner that no damage occurs to the product or adjacent surfaces.

.4 Evenly disperse bundled material on structural areas to eliminate overloading point load limits.

.2 Deliver and store Support Pedestal System components with labels intact and legible.

.1 Inspect all delivered materials to insure they are undamaged and in good condition.

.2 Store and dispose of solvent-based materials such as construction adhesive, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction

.3 Store and protect materials free from mud, dirt and other foreign materials.

1.7 ENVIRONMENTAL AND SITE CONDITIONS

.1 Refer to Specification Section 01 61 00.

.2 Special Considerations:

.1 Verify and confirm the structural capability and adequacy of the structure to carry the dead and live load weight(s) involved, and that the density of any insulation is satisfactory to resist crushing and damaging the waterproofing membrane.

.2 Immediately report any concerns or discrepancies.

.3 Environmental Requirements:

.1 Install Support Pedestal Systems free of standing water or ice.

.2 Install Support Pedestal Systems free of saturated or frozen granular base materials.

.4 Do not exceed structural capacity of roof.

.5 Roof Concrete Pavers and Support Pedestal System specified are to be used with pedestrian traffic only.

.6 Restrain Roof Concrete Pavers by perimeter blocking or walls on all sides. Lateral movement greater than one tab width is unacceptable and will be rejected.

.7 Provide positive drainage to the substrate immediately below the Support Pedestal System.

.8 Roof Concrete Pavers and Support Pedestal System over roofing and waterproofing:

.1 Install roof systems meeting local building codes and be in accordance with the NRCA recommended good construction practices. Use only roofing manufacturer-approved systems.

.2 Install the Support Pedestal System only over substrate surfaces structurally capable of carrying the dead and live loads anticipated.

.3 If integral roof insulation is installed immediately below the membrane, the type and density of the insulation are of utmost importance. Use Pedestal System Floating Insulation Bases (FIB) when installing roofing systems having “common” insulations with a medium density of 20 psi. FIBs are installed immediately below the Roof Concrete Paver and Support Pedestals System to disperse the load.

.4 If high-density closed-cell extruded 60 psi polystyrene insulation is installed on top of the membrane in a protected membrane system, Roof Concrete Paver Support Pedestals Systems may be installed directly on top of this type of insulation.

.5 Do not use Roof Concrete Paver and Supports Pedestal Systems over any insulation less than 20 psi or with low-density polystyrene (bead board) insulation.

1.8 WARRANTY

.1 Provide the Support Pedestal System manufacturer an executed copy of the manufacturer’s standard document outlining the terms, conditions, and limitations of their limited warranty against manufacturing defects for a period of three (3) years.

.2 Warrant all work will remain free from installation and manufacturer defects used for a minimum of three (3) years.

.3 Coordinate warranty requirements with any related sections or adjacent work. Notify the Engineer immediately of any potential lapses or limitations in warranty coverage.

1.9 ROOF CONCRETE PAVER OVERAGE AND ATTIC STOCK

.1 Provide a minimum of 5% additional material for overage to be used during construction.

.2 Furnish 1 square meter of each product and size used to the owner for maintenance and repair. Furnish Roof Concrete Pavers from the same production run as installed materials.

.3 Manufacturer to supply maintenance manuals for Roof Concrete Paver units.

PART 2 PRODUCTS

2.1 DESIGN CRITERIA

.1 The Roof Concrete Paver products are based on:

.1 Acceptable products:

.1 Umbriano as manufactured by Unilock

.2 Diamond Texture as manufactured by Brooklin

2.2 APPROVED MANUFACTURERS

.1 Unilock, 287 Armstrong Ave, Georgetown, Ontario, Canada, L7G 4X6, Phone: (647) 466-0227, e-mail: david.robbins@unilock.com, URL: www.commercial.unilock.com.

.2 Brooklin Concrete Products, 6760 Baldwin St N Brooklin, Ontario, Canada, L1M 1X8, Phone: (905)-655-3847, e-mail: brooklinsales@brooklin.com, URL: https://www.brooklin.com.

.3 Equivalent products may be submitted for Engineer's approval providing the product submitted meets or exceeds the performance criteria of the products specified.

2.3 MATERIALS

.1 Roof Concrete Paver: Unilock Umbriano

.1 Color: French Grey

.2 Finish: Granite appearance

.3 Edge: Chamfer - 3 mm rolled

.4 Size: Manufacture the sizes indicated with a maximum tolerance of plus or minus 1/16 in all directions.

.1 600 mm (24 in) x 600 mm (24 in) x 50 mm (2 in) thick (22 lbs./SF)

.2 Roof Concrete Paver: Diamond Texture

.1 Color: Natural Shotblast

.2 Finish: Natural

.3 Edge: Chamfer - 3 mm rolled

.4 Size: Manufacture the sizes indicated with a maximum tolerance of plus or minus 1/16 in all directions.

.1 600 mm (24 in) x 600 mm (24 in) x 45 mm (2-3/4 in) thick (31 lbs./SF)

.3 Provide pavers meeting the minimum material and physical properties set forth in ASTM C 936, Standard Specification for Interlocking Concrete Paving Units. Efflorescence is not a cause for rejection.

.1 Average compressive strength 8000 psi (55MPa) with no individual unit under 7,200 psi (50 MPa).

.2 Average absorption of 5% with no unit greater than 7% when tested according to ASTM C 140.

.3 Resistance to 50 freeze-thaw cycles, when tested according to ASTM C1645, with no breakage greater than 1.0% loss in dry weight of any individual unit. Conduct this test method not more than 12 months prior to delivery of units.

.4 Provide pavers meeting the minimum material and physical properties set forth in CSA A231.1-06, Precast Concrete Paving Slabs. (For all Roof Paver types)

.1 Minimum compressive strength 5000 psi (55MPa).

.5 Provide pavers meeting the minimum flexural strength of 650 psi when tested in accordance to ASTM C293 Standards Test Method for Flexural Strength of Concrete.

.6 Accept only pigments in concrete pavers conforming to ASTM C 979.

.7 Provide pavers meeting the minimum slip resistance for the coefficient of friction of 0.6 per the NIST-Brungraber Test.

.8 Maximum allowable breakage of product is 5%.

.9 TX Active is a Portland Cement (white) Type I, II, and III complying with ASTM C 150 with the addition of proprietary particles of titanium dioxide (TiO2) specifically engineered for use in the manufacture of concrete and concrete products.

.1 TX Active - Self-cleaning and pollution reduction

.1 Concrete will resist most organic and inorganic pollutants that gather on the surface causing discoloration.

.2 Concrete will remove significant amounts of environmental pollutants deemed harmful to human health.

.2 As manufactured by ESSROC Italcementi Group.

.1 Unilock Chicago is an authorized producer of TX Active products.

2.4 SUPPORT PEDESTAL SYSTEM

.1 Basis-of-Design Product: The Support Pedestal System is based on:

.1 Bison Deck Pedestal Systems: (Select product or products being used)

.1 Versadjust - Typical Height Range 2 ¼" -36 inches, Weight Bearing 1500 lbs/pedestal. Spacer Tabs: Specify 1/8 inch or 3/16 inch.

.2 Level-It

.2 As manufactured by:

.1 Bison Innovative Products, 1975 W. 13th Ave, P.O. Box 40246, Denver, CO, USA 80204, Toll-Free: 888-412-4766 Phone: (303) 628-7950, e-mail: Sales@BisonIP.com, URL: www.BisonIP.com.

.3 The specified products establish minimum requirements that substitutions must meet to be considered acceptable.

.2 Product requirements:

.1 Pre-manufactured adjustable deck pedestal support system conforms to the following standards and has the following requirements.

.1 Minimum performance requirements

.1 Weight Bearing Capacity 1250 lbf

.2 Height Range: 0 mm – 600 mm

.2 ASTM D 1238-04

.3 ASTM D 792-00

.4 ASTM D 638-03

.5 ASTM D 256-06

.6 ASTM D 648-06

.3 Provide a complete adjustable Support Pedestal System with a maximum cavity height of up to:

.1 Versadjust Pedestals maximum cavity height 24 inches (610 mm).

.2 Use Support Pedestal Brace System for excess height installations from 24-36 inches.

.4 Consult the Manufacturer regarding the following:

.1 When spacer tab condition or design requires spacing between Roof Concrete Pavers other than the standard spacing required by the manufacturer.

.2 When considering use for other than a raised decks (e.g. interior floors, stairs, etc.).

.3 When the required pedestal height exceeds the safe limits as determined by the Manufacturer.

.4 When pedestal load capacity exceeds the maximum listed.

.5 When anticipating installation of any items with excess weight on top of the Roof Concrete Paver surface.

.6 When using Support Pedestals System on grade (soil).

.7 When greater pedestal load capacity is required.

2.5 ACCESSORIES

.1 Cleaners

.1 Supplier: Unilock

.2 Material Type and Description: Any cleaner specifically designed for pavers may be
used for color restoration or general cleaning. Follow manufacturer's diluti on rates and application procedures. Always test a small area to make sure the results are as expected.

PART 3 EXECUTION

3.1 EXAMINATION

.1 Verify that site conditions are ready to receive work.

.2 Examine areas indicated to receive Support Pedestal System bases for compliance with requirements for installation tolerances and other conditions affecting performance for the following items before placing Roof Concrete Pavers.

.1 Verify location, type, and elevations of edge restraints, concrete collars around utility structures, and drainage inlets.

.2 Notify Engineer of unsatisfactory preparation before proceeding if substrate preparation is the responsibility of another installer.

.3 Verify all elevations, required pedestal heights and deck dimensions before commencing work.

.3 Do not begin installation until substrates have been properly prepared.

.1 Proceed with installation only after unsatisfactory conditions have been corrected.

.2 Setting of Support Pedestal units signifies acceptance of building roof membrane and protection board substrates.

3.2 PREPARATION

.1 Keep area where Roof Paver Pedestal System is to be constructed free from nails, screws, debris, etc. during entire job. Repair all damage to roof substrate.

.2 Complete construction of all roof drain inlets and other drainage structures before the commencement of Support Pedestal System installation.

.3 Do not damage roof drains, roof substrate, and/or other drainage appurtenances during installation. Report all damage immediately.

.4 Protect HVAC, ventilation pipes and other structures during Roof Concrete Paver and Support Pedestal System installation.

.5 Clean and free projections and debris impairing the performance of the pedestals or the total system from the substrate.

.6 Establish accurate lines, levels and pattern.

.7 Installation requirements vary for each individual project site. Provide Roof Concrete Pavers materials used, pattern, grid layout, starting point, and finished elevation on plan view shop drawings which have been prepared and approved.

.8 Establish a starting point and the finished elevation of the Roof Concrete Paver surface. Mark the Support Pedestal System elevation (finished elevation minus paver material thickness) around the perimeter using a transit “torpedo” water level or laser leveling device.

.9 Define the paver surface area by accurately taking precise measurements. Mark off and square all outside edges with control lines (chalk lines or spray paint). Install two (2) lines that are perpendicular to each other across the paver surface area. Continue to mark a grid of lines in both directions marking the location of each pedestal. Implement control lines as references to periodically check the layout during installation to assure a square layout.

3.3 INSTALLATION

.1 Pedestal system

.1 Install in accordance with manufacturer's instructions.

.2 If required, place a Floating Insulation Base (FIB) board or Floating Foundation Base (FFB) in the location on the grid of each pedestal.

.3 Place a Support Pedestal where each measured grid line meets the perimeter.

.1 Remove two (2) spacer tabs in line with one another on top of each pedestal placed around the perimeter.

.2 Remove all four (4) spacer tabs at corners.

.4 Adjust each Support Pedestal to a “top of pedestal” elevation marked around the perimeter. (Normally the deck support is positioned as close to the perimeter as possible, with the two remaining spacer tabs aligned with the grid line.) Stretch a string line along (or utilize a laser leveling device) and slightly ahead of the second row of Support Pedestals.

.5 Pre-sort and pre-set the Support Pedestals to the proper elevation and place in position prior to the installation of the Roof Concrete Pavers.

.6 Plumb Support Pedestals.

.7 Rotate the pedestal base or bottom to vertically adjust the Support Pedestal elevation while being loaded with pavers. Clockwise rotation of the pedestal base will raise the bearing surface and the paver units. Counter-clockwise rotation will lower the top bearing surface.

.8 Support Pedestal Systems have built in safety thread engagement 'bumps'. When pedestal is fully extended, thread engagement "bumps" will be felt and heard, indicating the maximum height of the pedestal.

.1 Do not extend pedestal beyond the thread engagement "bumps".

.2 Do not exceed maximum height listed on pedestal, use the next size pedestal. A VC2 coupling unit must be added to the V4 model to achieve greater heights.

.3 Always maintain adequate thread engagement. Never over extend any pedestal.

.9 Slight irregularities in Roof Concrete Paver thickness can be compensated for by using one to two shim segments. Place shims on top of the pedestal, under the corner(s) of the decking tile or paver. Never use more than two (2) shims on top of the pedestal and always adhere 1/4 wedges with construction adhesive.

.10 Stackable Fixed Height Pedestals: Complete grid layout as instructed above. Stack no more than four (4) fixed height pedestals together and place in lieu of adjustable pedestals where needed. Remove spacer tabs to accommodate perimeter and corner support locations.

.11 V Series Slope Compensation:

.1 The V Series has integrated base leveler disks that compensate for up to 1/2 inch per foot slope. Additional slope compensation can be added by placing two additional LD4 disks under the pedestal base to compensate for up to 1 inch per foot of slope.

.2 Place the thickest edge of the disk (located on the edge by a small finger tab) at the down slope side of the deck support, one disk compensates for 1/4 inch per foot of slope. Using two to four disks, rotate one in relation to the other to create a level deck support.

.3 Shims may be used in multiples, whole or segmented, and placed under the base to level the pedestal support.

.4 Under a pedestal: Adhere all shims under a pedestal to each other or the pedestal (NOT to the roofing membrane) with construction adhesive. Shim no more than 1/8 inch (3mm) beneath each pedestal.

.5 On top of a pedestal: Use no more than 2 shims.

.12 Versadjust Series Pedestal Bracing with Support Brace

.1 Excess Height: Required for added Stability for Installations 24"-36" in height

.2 For Installations requiring additional stability: Install one level of Support Pedestal Brace Collars at the mid-point height of the pedestal column. Maintain the same level of Collar placements once the standard height is established (i.e. 18" for 36" overall height).

.3 BB – S Short Bison Brace: Install around the outside perimeter of a walk surface where pedestals are installed where less than the typical 24” spacing occurs and shorter arms are required.

.4 BB – L Long Bison Brace: Install in the interior area of a walk surface where pedestals and 23 - 7/8” x 23 – 7/8” surfacing panels are installed providing uniform 24” spacing.

.5 Install Support Pedestal Braces by placing the two-hole brace ends over the self-locking pegs on Collar or base, fit brace arms together making sure all brace teeth are firmly interlocked and secure with Screw and Wing Nut. Install Braces as tightly as possible to create a rigid bracing system between each vertical pedestal column.

.6 Two Support Pedestal Brace arms extend outward from each corner pedestal in perpendicular rows. These results in a series of braces attached to Collars (BB – C) in each horizontal direction from one side of the Roof Concrete Pavers to the other and from one end to the other.

.7 Place the Roof Concrete Paver units once the horizontal perpendicular run(s) of Support Pedestal Braces are properly installed at the correct height(s) and as the decking system progresses.

.13 Support items (such as planters, concrete benches, sculptures, hot tubs, grills, or industrial equipment) directly with additional pedestals directly and independently of the main Roof Concrete Pavers and Support Pedestal System.

.2 Roof Concrete Pavers

.1 Do not use pavers with chips, cracks, voids, discolorations, and other defects that might be visible in finished work.

.2 Mix Pavers from a minimum of three (3) bundles simultaneously drawing the paver vertically rather than horizontally, as they are placed, to produce uniform blend of colors and textures.

.3 Exercise care in handling face mix pavers to prevent surfaces from contacting backs or edges of other units.

.4 Install Roof Concrete Pavers using pattern as indicated.

.5 Place the corner of the Roof Concrete Paver directly over the center of the Support Pedestal where more than one unit meets.

.6 Place units hand tight against spacer bars or pedestal spacer tabs. Adjust horizontal placement of laid pavers to align straight.

.7 Provide space between paver units of 1/32 in. (1 mm) wide to achieve straight bond lines.

.8 Set surface elevation of Roof Concrete Pavers 1/16 in. (1.5 mm) above adjacent drainage inlets, concrete collars or channels.

.9 Do not exceed joint (bond) lines more than ±1/2 in. (±15 mm) over 50 ft. (15 m) from string lines.

.10 Cut unit pavers with motor-driven masonry saw equipment to provide clean, sharp, unchipped edges. Cut units to provide pattern indicated and to fit adjoining work neatly. Use full units without cutting where possible. Hammer cutting is not acceptable.

.11 Remove any cracked or structurally damaged pavers and replace with new units.

.12 Tolerances: Do not exceed 1/32-inch (0.8-mm) unit-to-unit offset from flush (lippage). Do not exceed 1/8 inch in 10 feet (3 mm in 3 m) from level, or indicated slope, for a finished surface of the paving.

.13

3.4 SUPPORT PEDESTAL SYSTEM PLACEMENT AND FINAL ADJUSTMENT

.1 Place Support Pedestal System and the Roof Concrete Pavers per the manufacturer's written instructions. Utilizing labor-saving devices, such as paver lifters or vacuum devices where applicable, especially on large jobs.

.2 Support Pedestals are designed to be rotated for final slight adjustment when system is fully loaded. Level Support Pedestals in each succeeding row as the installation proceeds. Adjust final height or maintenance adjustments by rotating the base in a clockwise or counter-clockwise direction to raise or lower the surface material.

.3 Provide additional sections of shims for regular maintenance. Install Shims in multiples, whole or segmented, and placed under the base or on top the pedestal to level the Roof Concrete Pavers.

.4 On top of pedestal: Provide construction adhesive to adhere sections of shims. Construction adhesive is not required when using whole shims on top of a pedestal.

.5 Beneath a pedestal: Provide a small amount of construction adhesive to adhere sections of shims and/or whole shims to each other or to the pedestal. Unless specified to do so, DO NOT adhere pedestal or shims to insulation, roofing or waterproofing membrane.

3.5 PERIMETER CONTAINMENT

.1 Contain and ‘box-in’ any area of a Roof Concrete Pavers that are not restrained by a parapet or foundation wall. The Roof Concrete Paver panels will move if all sides are not adequately restrained. Restrain Roof Concrete Pavers on all sides and do not allow lateral movement in excess of one tab width.

3.6 FIELD QUALITY CONTROL

.1 Verify final elevations for conformance to the drawings after sweeping the surface clean.

.1 Prevent final surface finish grade elevations from deviating more than ±1/4 in. (±5 mm) under a 10 ft (3 m) straightedge or indicated slope, for a finished surface of Roof Concrete Pavers.

.2 Lippage: No greater than 1/32 in. (1 mm) difference in height between Roof Concrete Pavers or adjacent surfaces such as walkways and door thresholds.

.3 Inspect often during installation to ensure that grid spacer lines are being maintained in a straight and consistent pattern and that Roof Concrete Pavers are level and not rocking.

.4 Confirm that Support Pedestal height does not exceed the specified height for the V Series:

.1 24 inches (610mm) maximum pedestal height unless using the Support Pedestal Brace System.

.5 Unless otherwise specified in writing to allow for expansion, inspect to assure that all paver spacing between units and at perimeter containment does not exceed a tab width. Pay particular attention to assure that all pedestrian entry or access points to the Roof Concrete Pavers are level and that the surfaces are not randomly raised or uneven creating a tripping or safety hazard.

3.7 IMMEDIATELY FOLLOWING INSTALLATION

.1 Carefully inspect the Roof Concrete Paver and Support Pedestal System to ensure that:

.1 The new Roof Concrete Paver system is adequately blocked on all sides to contain the material and related components.

.2 There is no more than tab width spacing between any deck panels and at all sides of the deck perimeter.

.3 There is no ballasting rock used to fill in any perimeter voids.

.4 There is no ‘rocking’ of Roof Concrete Pavers as foot traffic is applied to the surface.

.5 All required spacer tabs are in place and visible.

3.8 REPAIRING, CLEANING AND SEALING

.1 Remove and replace Roof Concrete Pavers that are chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Provide new units to match adjoining units and install in same manner as original units, with same joint treatment and with no evidence of replacement.

.2 Cleaning: Remove excess dirt, debris, stains, grit, etc. from exposed Roof Concrete Paver surfaces; wash and scrub clean.

.1 Clean Roof Concrete Pavers in accordance with the manufacturer’s written recommendations.

.3 Seal as indicated:

.1 Apply Sealer for Permeable Concrete Pavers in accordance with the sealer and paver manufacturer's written recommendations.

.4 Clean in accordance with Section 01 74 00- Cleaning. For smaller projects that do not have a separate Division 01 Section for cleaning, add the following two paragraphs.

.1 Progress Cleaning: Perform cleanup as work progresses

.2 Leave work area clean at end of each day. Final cleaning: Upon completion, remove surplus materials, rubbish, tools, and equipment Waste Management: Collect recyclable waste and dispose of or recycle field generated construction waste created during construction or final cleaning related to work of this Section. Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.9 PROTECTION

.1 Protect completed work from damage due to subsequent construction activity on the site.

3.10 LIFE CYCLE ACTIVITIES

.1 Cleaning:

.1 Clean Roof Concrete Pavers as needed to remove staining, dirt, debris, etc.

.2 Clean per manufacturers recommendations.

.2 Maintenance:

.1 Provide information about performing routine maintenance of the Concrete Roof Paver and Support Pedestal System as part of the close out documents.

.2 Check for rocking pavers and adjust or shim immediately. Substrates can settle and pedestals may have to be readjusted. Failure to do so can cause a tripping hazard.

.3 Periodically check spacer tabs and immediately replace broken tabs to limit deck movement. Verify the edge restraint stays intact and structurally sound.

END OF SECTION

FIRE STOPPING

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

.1 Comply with requirements of Division 1 – General Requirements.

1.2 INTENT

.1 Include in work of this section all fire stopping required except for fire stopping and smoke seals within mechanical assemblies (i.e., inside ducts, dampers) and electrical assemblies (i.e., inside bus ducts) which shall be provided as part of work of Divisions 15 and 16 respectively. Fire stopping and smoke seals around outside of such mechanical and electrical assemblies, where they penetrate fire rated separations, shall be part of the work of this section.

.2 Fire stop and seal (draft-tight) gaps, control joints, expansion joints and penetrations in fire rated assemblies, including assemblies with a zero rating, against passage of fire, smoke, gasses, fire fighter's hose stream and, where designated, passage of liquids. Smoke seal at angle support at fire dampers.

1.3 RELATED SECTIONS

.1 In addition to the general project requirements in Division 1, the following sections are referenced in this section:

.1	Section 03 30 00	Cast-in-Place Concrete
.2	Section 04 05 00	Masonry Procedures
.3	Section 06 10 10	Rough Carpentry
.4	Section 07 21 20	Board Insulation
.5	Section 07 27 00	Self-Adhered Air Vapour Barrier Membrane
.6	Division 15	Mechanical
.7	Division 25-28	Electrical

1.4 REFERENCES

.1 ASTM E2174-20a - Standard Practice for On-Site Inspection of Installed Fire Stops

.2 CAN/ULC S115–2018- Standard Method of Fire Tests of Firestop System

.3 Underwriters Laboratories (UL) of Northbrook, IL runs ASTM E-814 under their designation of UL 1479 and publishes the results in their "FIRE RESISTANCE DIRECTORY" that is updated annually. UL tests that meet the requirements of ULC-S115-M are given a cUL listing and are published by UL in their "Products Certified for Canada (cUL) Directory.

.4 Test Requirements: UL 2079, “Tests for Fire Resistance of Building Joint Systems”. These test requirements provide more guidelines for testing moving joints than that given in CAN4-S115-M. UL tests that meet the requirements of ULC-S115-M are given a cUL listing and are published by UL in their “Products Certified for Canada (cUL) Directory.

.5 Canada Green Building Council (CaGBC). LEED Canada V4.0- Building Design and Construction, Interior Design + Construction (ID+C)

.1 Health Canada/ Workplace Hazardous Material Information System (WHMIS).

.6 Inspection Requirements: ASTM E 2174, “Standard Practice for On-site Inspection of Installed Fire Stops.”, and ASTM E2393 Standard Practice for On-Site Inspection of Installed Fire Resistive Joint Systems and Perimeter Fire Barriers.

.7 CAN/ULC-S102:2018, Standard Test Method for Surface Burning Characteristics of Building Materials and CAN/ULC-S101 Fire Endurance Tests of Building Construction and Materials.

.8 International Firestop Council Guidelines for Evaluating Firestop Systems Engineering Judgments.

.9 All major building codes: National Building Code (NBC), Ontario Building Code (OBC)

1.5 DEFINITIONS AND ABBREVIATIONS

.1 Fire Stop Material: device intended to close off opening or penetration during fire or materials that fill openings in wall or floor assembly where penetration is by cables, cable trays, conduits, ducts and pipes and poke-through termination devices, including electrical outlet boxes along with their means of support through wall or floor openings.

.2 Single Component Fire Stop System: fire stop material that has Listed Systems Design and is used individually without use of high temperature insulation or other materials to create fire stop system.

.3 Multiple Component Fire Stop System: exact group of fire stop materials that are identified within Listed Systems Design to create on site fire stop system.

.4 Tightly Fitted; (ref: OBC Part 3.1.9.1.1 and 9.10.9.6.1): penetrating items that are cast in place in buildings of noncombustible construction or have "0" annular space in buildings of combustible construction.

.5 Words "tightly fitted" should ensure that integrity of fire separation is such that it prevents passage of smoke and hot gases to unexposed side of fire separation.

1.6 QUALITY ASSURANCE

.1 Contractors Qualifications

.1 Work of this section shall be carried out by a firm specialized in the type of work specified herein. Use competent installers, experienced, trained and approved by material or system manufacturer for application of materials and systems being used. Installers shall have a minimum five (5) years experience in installation of fire stopping materials.

.2 Authorities having Jurisdiction:

.3 Provide certificate of compliance from authority having jurisdiction indicating approval.

.4 The contractor is expected to provide details as required by the documents as well as by the Municipal Building Inspector.

.1 For those firestop applications that exist for which no ULC or CUL tested system is available through the manufacturer, a manufacturer's engineering judgment derived from similar ULC or CUL system designs or other tests will be submitted to local authorities having jurisdiction for their review and approval prior to installation.

.2 Relationship to other trades:Sequence Work to permit fire stopping materials to be installed after adjacent and surrounding work is completed, and before gypsum wallboard track, fire proofing, and mechanical pipe insulation are installed.

.5 For those firestop applications that exist for which no ULC or cUL tested system is available through a manufacturer, a manufacturer's engineering judgment derived from similar ULC or cUL system designs or other tests will be submitted to local authorities having jurisdiction for their review and approval prior to installation. Engineering judgment drawings must follow requirements set forth by the International Firestop Council

1.7 SUBMITTALS

.1 Complete submittals in accordance with Specification Section 01 33 00.

.2 Product Data:

.1 Prior to start of work, submit list of proposed fire stopping and smoke seal materials, together with suitable documentation to verify that specified requirements will be met. Provide the following information as applicable to this project.

.1 ULC, UL or Intertek assembly number certification.

.2 Required temperature rise and flame rating.

.3 Hose stream rating (where applicable).

.4 Thickness.

.5 Manufactures approved standard detail for each installation method.

.6 Material of fire stopping and smoke seals, primers, reinforcements, damming materials, reinforcements and anchorages/fastenings.

.7 Size of opening.

.8 Adjacent material.

.2 Submit WHMIS and MSDS - Material Safety Data Sheets

.3 Shop Drawings:

.1 Submit shop drawings to show location, proposed material, reinforcement, anchorage, fastenings and method of installation.

.2 Indicate the ULC, UL or Intertek system number, the required temperature and flame rating, thickness, installation methods and materials of fire stopping and smoke seals, damming materials.

.3 Construction details should accurately reflect actual job conditions.

.4 Samples:

.1 Upon Engineer’s request, submit three duplicate 300 x 300 mm samples showing actual fire stop and smoke seal material proposed for project.

.5 Quality assurance submittals:

.1 Submit following in accordance with Section 01 45 00 - Quality Control.

.2 Test reports: in accordance with CAN-ULC-S101 for fire endurance, CAN-ULC-S102 for surface burning characteristics and CAN/ULC-S115 for firestop and construction joint systems.

.3 Submit certified test reports from approved independent testing laboratories, indicating compliance of applied fire stopping with specifications for specified performance characteristics and physical properties.

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

.5 Manufacturer's Instructions: submit manufacturer's installation instructions and special handling criteria, installation sequence and cleaning procedures.

.6 Manufacturer's Field Reports: submit to manufacturer's written reports within 3 days of review, verifying compliance of Work, as described in PART 3 - FIELD QUALITY CONTROL.

.7 Submit certificate by firestopping manufacturer that the products supplied comply with LEED requirements for indoor environmental quality credit including printed statement of VOC.

.6 Close-Out Submittal

.1 In accordance with Section 01 78 00 –Closeout Submittals and in addition:

.1 Submit a set of architectural plans, prepared after receipt of Mechanical and Electrical record drawings, showing locations of all fire stop seals on each floor.

.2 Prepare and submit a corresponding typewritten listing, indicating penetration, sizing, location on plan and applicable ULC listing card number.

.3

1.8 DELIVERY, STORAGE AND HANDLING

.1 Deliver materials to site in manufacturer's sealed and labelled containers.

.2 Coordinate delivery of materials with scheduled installation date to allow minimum storage time at job-site.

.3 Store materials in protected location prior to use, in accordance with manufacturer's directions.

.4 Comply with recommended procedures, precautions or remedies described in material safety data sheets as applicable.

1.9 ENVIRONMENTAL CONDITIONS

.1 Conform to manufacturer's recommended temperatures, relative humidity and substrate moisture content for storage, mixing, application and curing of fire stopping materials.

PART 2 PRODUCTS

2.1 DESIGN CRITERIA

.1 Fire stopping and smoke seal systems shall be:

.1 Tested in accordance with CAN/ULC S115.

.2 Listed by ULC, UL or Intertek or other fire testing agency approved by jurisdictional authorities.

.3 Capable of providing fire resistance rating not less than that required by surrounding assembly.

.4 Comply with F, T and H rating required.

.2 Fire stopping and smoke seals for vertical fire separations shall meet ULC designation PJ, JF and HW as required for respective location.

.3 Provide firestopping composed of components that are compatible with each other, the substrates forming openings, and the items, if any, penetrating the

firestopping under conditions of service and application, as demonstrated by the firestopping manufacturer based on testing and field experience.

.4 For combustible pipe penetrations through a Fire Separation provide a firestop system with a “F” Rating as determined by ULC or cUL which is equal to the fire resistance rating of the construction being penetrated.

.5 For those firestop applications that exist for which no ULC or cUL tested system is available through a manufacturer, a manufacturer's engineering judgment derived from similar ULC or cUL system designs or other tests will be submitted to local authorities having jurisdiction for their review and approval prior to installation. Engineering judgment drawings must follow requirements set forth by the International Firestop Council

2.2 APPROVED MANUFACTURERS

.1 HILTI, 2360 Meadowpine Boulevard, Mississauga, Ontario, Canada, L5N 6S2, Phone: (416) 434-8939, e-mail: tyrone.subhan@hilti.com, URL: www.hilti.ca.

.2 3M Canada, 300 Tartan Dr, London, Ontario, Canada, N5V 4M9, Phone: (800)-265-1840, e-mail: maheaps@mmm.com, URL: www.3mcanada.ca/3M/en_CA/company-ca/.

.3 Tremco, 220 Wicksteed Avenue, Toronto, Ontario, Canada, M5H 1G7, Phone: (800) 363-3213, e-mail: TORSCS@tremcoinc.com, URL: www.tremcosealants.com.

.4 Equivalent products may be submitted for Engineer’s approval providing the product submitted meets or exceeds the performance criteria of the products specified.

2.3 MATERIALS

.1 Fire stopping and smoke seal materials.

.1 Provide materials which are:

.1 PCB and asbestos-free.

.2 Easily identifiable colour, except where used in exposed location.

.3 Suitable for intended application.

.4 Compatible with adjacent materials.

.5 Flexible enough to allow for pipe vibration in through penetration application.

.6 Flexible enough to satisfy the movement in construction joint applications.

.2 Sealant type materials shall be non-sagging for vertical surfaces and self levelling for level floors.

.2 Primer: as recommended by fire stopping material manufacturer for specific substrate and use.

.3 Damming and back-up materials, support and anchoring devices: non-combustible, in accordance with tested assembly and as recommended by manufacturer.

.4 For penetrations by non-combustible items including steel pipe, copper pipe, rigid steel conduit and electrical metallic tubing (EMT), the following materials are acceptable:

.1 CFS-S SIL GG Hilti Firestop Silicone Sealant Gun Grade
.2 CFS-S SIL SL Hilti Firestop Silicone Sealant Self Leveling
.3 Hilti FS ONE High Performance Intumescent Firestop Sealant
.4 CP 620/ CP 660 Hilti Fire Foam
.5 3M Fire Barrier Silicone Sealant 1000 NS or 1003 SL
.6 3M Fire Barrier Sealant FD 150+
.7 3M Fire Barrier Sealant CP 25WB+
.8 Tremco TREMstop Fyre-Sil Sealant

.5 For fire rated construction joints, expansion joints, and other gaps, the following materials are acceptable:

.1 Hilti CFS-S SIL GG Hilti Firestop Silicone Sealant Gun Grade
.2 Hilti CFS-S SIL SL Hilti Firestop Silicone Sealant Self Leveling
.3 Hilti CP 606 Flexible Firestop Sealant.
.4 Hilti CFS-SP WB Firestop Joint Spray
.5 Hilti CFS-TTS Top Track Seal
.6 3M Fire Barrier Sealant FD 150+
.7 3M FireDam Spray 200
.8 Tremco TREMstop Fyre-Sil Sealant

.6 For penetrations by combustible items (penetrants consumed by high heat aflame) including insulated metal pipe, PVC jacketed, flexible cable or cable bundles and plastic pipe (closed piping systems) the following materials are acceptable:

.1 Hilti FS-ONE Intumescent Firestop Sealant
.2 Hilti CP 643N Firestop Collar
.3 Hilti CP 648E/648S Wrap Strips
.4 3M Fire Barrier CP25 WB+
.5 3M Fire Barrier FS 195+ Wrap/Strip
.6 Tremco TREMstop WS Intumescent Wrap Strip or Tremstop IA+

.7 For firestopping at Electrical Vboxes and Utility Outlets.

.1 Hilti Firestop Box Insert

.2 Hilti CP 617 Firestop Putty Pad

.3 3M Fire Barrier Mouldable Putty Pads MPP+

.4 Tremco TREMstop MP Moldable Putty Pad

.8 Pre-formed firestop devices for use with non-combustible and combustible pipes (closed and open systems), conduit and/or cable bundles penetrating concrete floors and/or gypsum walls, the following products are acceptable:

.1 Hilti Tub Box Kit (CP 681) for use with tub installations.

.2 Hilti Cast-In Place Firestop Device (CP 680-PX) for use with XFR pipe

.3 Hilti Cast-In Place Firestop Device (CP 680-M) for use with noncombustible penetrants.

.4 Hilti Speed Sleeve (CP 653) for use with cable penetrations.

.5 Hilti Firestop Drop-In Device (CFS-DID) for use with noncombustible and combustible penetrants.

.9 Hilti Firestop Block (CFS-BL)Non-curing, re-penetrable intumescent putty or foam materials for use with flexible cable or cable bundles, the following products are acceptable:

.1 Hilti CP 618 Firestop Putty Stick

.2 Hilti CFS-PL Firestop Plug

.10 Re-penetrable, round cable management devices for use with new or existing cable bundles penetrating gypsum or masonry walls, the following products are acceptable:

.1 Hilti Speed Sleeve (CP 653) with integrated smoke seal fabric membrane.

.2 Hilti Firestop Cable Collar (CFS-CC)

.3 Hilti Firestop Sleeve (CFS-SL SK)

.4 Hilti Retrofit Sleeve (CFS-SL RK) for use with existing cable bundles.

.5 Hilti Gangplate (CFS-SL GP) for use with multiple cable management devices.

.6 Hilti Gangplate Cap (CFS-SL GP CAP) for use at blank openings in gangplate for future penetrations.

.11 For blank openings made in fire-rated wall or floor assemblies, where future penetration of pipes, conduits, or cables is expected, the following products are acceptable:

.1 Hilti CFS-BL Firestop Block (for walls and floors)

.2 Hilti CFS-PL Firestop Plug (for walls and floors)

.3 Hilti CP 680 Cast-In Place Firestop Device (for floors only)

.12 All other penetrations that do not fall under one of the categories listed in previous sections, and where a standard detail or product will not resolve the fire separation penetration, the contractor is responsible for providing a manufactures approved proposed engineered solution for review and approval by the engineer.

.1 The proposed engineer solution must me signed and stamped by and engineer licensed and insured to practice in the province of Ontario, Canada.

2.4 MIXING

.1 Mix materials at correct temperatures and in accordance with manufacturer's directions.

PART 3 EXECUTION

3.1 PREPARATION

.1 Remove combustible material, loose material, or any other substance that may be detrimental to bond from edges of penetration. Clean, prime or otherwise prepare substrate material to manufacturer's recommendation.

.2 Do not apply fire stop material to surfaces previously painted or treated with sealer, curing compound, water repellent to other coatings unless tests have been performed to ensure compatibility of materials. Remove coatings as required.

.3 Verify openings, dimensions and surfaces conform to fire and smoke seal assembly.

.4 Protect adjacent surfaces with manufacturer's directions.

.5 Prime surfaces in accordance with manufacturer's directions.

.6 Remove insulation from area of insulated pipe and duct where such pipes or ducts penetrate fire separation unless ULC certified assembly permits such insulation to remain within assembly.

.7 Provide temporary damming, forming, packing and bracing materials necessary to contain fire stopping. Upon completion, remove forming and damming materials not required to remain as part of system.

.8 Examine sizes, anticipated movement and conditions of opening and penetration to establish correct system and depth of back-up materials and of fire stopping material required.

.9 Verify that items penetrating fire rated assemblies are securely attached, including sleeves, supports, hangers, and clips.

3.2 COORDINATION

.1 Coordinate construction of openings, penetrations and construction joints to ensure that the fire stop systems are installed according to specified requirements.

.2 Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate through-penetration fire stop systems. Coordinate construction and sizing of joints to ensure that fire-resistive joint systems are installed according to specified requirements.

.3 Coordinate fire stopping installation with other trades so that obstructions are not placed in the way prior to the installation of the fire stop systems and to protect the system from work done by other trades.

3.3 INSTALLATION

.1 Seal penetrations through and gaps in fire rated separations in accordance with ULC, UL or Intertek listing for tested system selected.

.2 Apply fire stopping materials in accordance with manufacturer's instruction and tested designs. Apply with sufficient pressure to properly fill and seal openings to ensure continuity and integrity of fire separation. Tool or trowel exposed surfaces as required.

.3 Remove excess compound promptly as work progresses and upon completion.

.4 Do not cover materials until full cure has taken place.

.5 Provide fire stopping and smoke seal systems at following locations, without being limited to:

.1 At all openings, voids and penetrations through all floor slabs except openings within shafts constructed with a fire resistance rating and slabs on granular fill.

.2 At all openings, voids, control joints and penetrations through fire rated masonry, concrete and gypsum board walls, partitions and shaft walls.

.3 At all openings, voids, penetrations installed for future use through fire rated masonry, concrete and gypsum board walls, partitions and shaft walls.

.4 Around mechanical and electrical assemblies penetrating fire rated assemblies.

.5 Between perimeter of all floor and roof slabs and exterior wall construction.

.6 Between tops of all fire rated walls and partitions and underside of floor or roof slabs.

.7 At building expansion joints.

.6 Curing: cure materials in accordance with manufacturer's directions.

.7 Protect materials from damage on surfaces subjected to traffic.

3.4 FIELD QUALITY CONTROL

.1 Upon Engineer's request, manufacturer's representative shall inspect work of this section and confirm in writing that it complies with specified requirements.

.2 Manufacturer's Field Services: The manufacturer's representative to be present during the first installation of every first firestop system. The manufacturer's technical representative to provide periodic walk-through. After every site visit the manufacturer's technical representative to submit site reports to indicate application reviewed, location and installer. Contractor to submit site reports by manufacturer to consultant within one week of each visit

.3 Request Engineer's review of installed systems before they are covered by other work.

.4 Owner may arrange and pay separately for inspection and testing of work of this section by independent agency as directed by Engineer.

.5 Inspection of through-penetration fire stopping shall be performed in accordance with ASTM E2174 or other recognized standard.

END OF SECTION

JOINT SEALANTS

PART 1 GENERAL

1.1 SECTION INCLUDES

.1 Labour, Products, equipment, and services necessary for sealants Work in accordance with Contract Documents.

1.2 RELATED SPECIFICATION SECTIONS

.1 In addition to the general project requirements in Division 1, the following sections are referenced in this section:

- .1 Section 03 30 00 Cast-in-place Concrete
- .2 Section 04 05 00 Masonry Procedures.
- .3 Section 07 84 00 Fire Stopping.

.2 . Refer to other sections for other caulking and sealants.

1.3 CODE AND REGULATORY REQUIREMENTS

.1 All products shall conform to the following standards and regulations:

- .1 ASTM International Inc.
  - .1 ASTM C510-16, Standard Test Method for Staining and Color Change of Single-or Multicomponent Joint Sealants.
  - .2 ASTM C834-17 – Specification for Latex Sealants
  - .3 ASTM C919-19, Standard Practice for Use of Sealants in Acoustical Applications.
  - .4 ASTM C920-18, Standard Specification for Elastomeric Joint Sealants.
  - .5 ASTM C1021-08(2019), Standard Practice for Laboratories Engaged in Testing of Building Sealants.
  - .6 ASTM C1184-18e1, Standard Specification for Structural Silicone Sealants.
  - .7 ASTM C1193-16, Standard Guide for Use of Joint Sealants.
  - .8 ASTM C1248-18, Standard Test Method for Staining of Porous Substrate by Joint Sealants.
  - .9 ASTM C1311-14 – Standard Specification for Solvent Release Sealants
  - .10 ASTM C1330-18, Standard Specification for Cylindrical Sealant Backing for Use with Cold Liquid-Applied Sealants.
  - .11 ASTM D5893/D5893M-16, Standard Specification for Cold Applied, Single Component, Chemically Curing Silicone Joint Sealant for Portland Cement Concrete Pavements.

.2 Canadian General Standards Board (CGSB)

.1 CGSB 19-GP-5M-1984, Sealing Compound, One Component, Acrylic Base, Solvent Curing (Issue of 1976 reaffirmed, incorporating Amendment No. 1).

.2 CAN/CGSB-19.13-M87, Sealing Compound, One-component, Elastomeric, Chemical Curing.

.3 CGSB 19-GP-14M-1984, Sealing Compound, One Component, Butyl-Polyisobutylene Polymer Base, Solvent Curing (Reaffirmation of April 1976).

.4 CAN/CGSB-19.17-M90, One-Component Acrylic Emulsion Base Sealing Compound.

.5 CAN/CGSB-19.24-M90, Multi-component, Chemical Curing Sealing Compound.

.3 Department of Justice Canada (Jus)

.1 Canadian Environmental Protection Act, 1999 (CEPA).

.4 General Services Administration (GSA) - Federal Specifications (FS)

.1 FS-SS-S-200-E(2)1993, Sealants, Joint, Two-Component, Jet-Blast-Resistant, Cold Applied, for Portland Cement Concrete Pavement.

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

.1 Material Safety Data Sheets (MSDS).

.6 Transport Canada (TC)

.1 Transportation of Dangerous Goods Act, 1992 (TDGA).

1.4 SUBMITTALS

.1 Submit in accordance with Section 01 33 00.

.2 Shop Drawing(s):

.1 Provide a summary chart listing all submitted products, applicable accessories, proposed application type, and sealant location. Include labels as outlined in this specification.

.2 Sealant type, composition, recommendations or directions for surface preparation, material preparation, and material installation.

.3 Quality Assurance Submittal(s):

.1 Submit pre-installation meeting reports.

.2 Submit field quality control inspection and test report results.

.3

1.5 QUALITY ASSURANCE

.1 Applicator qualifications:

.1 Execute Work by applicators trained and approved by the manufacturer and having 5 years proven experience.

.2 Independent inspection and testing agency:

.1 Qualification: In accordance with ASTM C1021.

.2 Conduct field inspection and testing of sealant with the manufacturer's representative for a minimum of **20%** of joints, including mixing of materials, joint preparation, priming, joint profile and thickness, application, adhesion, cohesion, and tooling.

.3 Prepare and submit inspection and test report results after each inspection. Include confirmation by the manufacturer that installation has been satisfactorily completed.

.3 Manufacturer's representative:

.1 Review Site conditions, joint design, and installer's qualifications. Report unsatisfactory conditions to Owner.

.2 Check container labels, inspect preparation of substrate materials and review installation procedures 48 hours in advance of installation, and randomly test installed Work.

.4 Mock-up:

.1 Construct mock-up for each type of sealant to show location, size, shape, colours, and depth of joints complete with bond breaker, joint backing, primer, and sealant. Accepted mock-up may become part of finished Work.

.2 Remove mock-ups that do not form part of Work from Site during final cleanup, or when directed by Owner.

.3 Allow 48 hours for Owner to review mock-up before proceeding with sealant Work.

.5 Pre-installation meetings:

.1 Conduct meetings 7 Days in advance of sealant installation.

.2 Include Owner, sealant manufacturer's representative, independent inspection and testing agency engaged by Contractor, and parties who are directly affected by the Work of this Section.

.3 Verify Contract requirements, substrate conditions, joint conditions and profile, weather conditions, and the manufacturer's installation instructions.

.4 Within 72 hours following the pre-installation meeting, prepare a pre-installation meeting report and issue to all parties in attendance.

.1 Clearly indicate the recommendations made during the pre-installation meeting, the required actions, and by whom.

1.6 DELIVERY, STORAGE, AND HANDLING

.1 Deliver materials to the Site in their original, unopened containers, with Product labels intact.

.1 Product labels: Identify the manufacturer's name, brand name, date of manufacture, grade, and type, application directions, and expiry date or shelf life.

.2 Store flammable materials in safe containers to eliminate fire hazards.

.3 Store materials in accordance with manufacturer’s recommendations.

.4 Maintain materials to prevent deterioration or contamination by foreign materials.

.5 Keep materials dry and free from snow, ice and frost.

1.7 SITE CONDITIONS

.1 Do not proceed with installation of joint sealants when:

.1 Ambient air temperatures are less than 5°C.

.2 Joint substrates and recesses are wet or damp.

.3 Where contaminates which may interfere with adhesion have not been removed from joint substrates.

.4 Site conditions do not meet manufacturer's recommendations.

PART 2 PRODUCTS

2.1 MATERIALS – SEALANTS

.1 Type A:

.1 Single component, non-sag, non-paintable, silicone joint sealant, in accordance with ASTM C920, Type S, Grade NS, minimum Class 25, and non-staining when tested in accordance with ASTM C510 or ASTM C1248.

.2 Colour:

.1 As selected by Engineer. Allow for more than one colour, for selection from the manufacturer’s full colour range, and for custom colours.

.3 Manufacturer’s Products:

.1 Dow Corning Contractors Weatherproofing Sealant (CWS) by Dow Corning Corp.

.2 Tremsil 400 by Tremco (Canada) Ltd., division of RPM Company.

.3 Sikasil-N plus by Sika Canada Inc.

.4 GE SWS by Momentive Performance Materials.

.5 Pecora PCS by Pecora Corporation.

.2 Type B:

.1 Silicone joint sealant, in accordance with ASTM D5893/D5893M and non-staining when tested in accordance with ASTM C510 or ASTM C1248.

.2 Colour:

.1 As selected by Engineer. Allow for more than one colour, for selection from the manufacturer's full colour range, and for custom colours.

Manufacturer's Products:

.2 Dow Corning Contractors Concrete Sealant (CCS) by Dow Corning Corp.

.3 Spectrum 900 SL by Tremco (Canada) Ltd., division of RPM Company.

.4 SikaSil 728 SL by Sika Canada Inc.

.5 Tosseal 817 by Momentive Performance Materials.

.6 300SL by Pecora Corporation.

.3 Type C:

.1 Anti-microbial (mildew-resistant), non-paintable, silicone joint sealant, in accordance with ASTM C920, Type S, Grade NS, minimum Class 25, and non-staining when tested in accordance with ASTM C510 or ASTM C1248.

.2 Colour:

.1 White.

.3 Manufacturer's Products:

.1 Dow Corning 786 Silicone Sealant by Dow Corning Corp.

.2 Tremsil 200 Silicone Sealant (with Fungicide) by Tremco (Canada) Ltd., division of RPM Company.

.3 Sikasil-GP by Sika Canada Inc.

.4 GE SCS1700 Sanitary by Momentive Performance Materials.

.5 898NST by Pecora Corporation.

.4 Type D:

.1 Silicone joint sealant, in accordance with ASTM C920, Type S, Grade NS, minimum Class 50, and non-staining when tested in accordance with ASTM C510 or ASTM C1248. Suitable for structural glazing in accordance with ASTM C1184.

.2 Colour:

.1 As selected by Engineer. Allow for more than one colour, for selection from the manufacturer's full colour range, and for custom colours.

.3 Manufacturer's Products:

.1 Dow Corning 795 Silicone Building Sealant by Dow Corning Corp.

.2 Spectrem 2 by Tremco (Canada) Ltd., division of RPM Company.

.3 Sikasil WS-295 by Sika Canada Inc.

.4 GE SCS2000 SilPruf Sealant by Momentive Performance Materials.

.5 Pecora 895NST by Pecora Corporation.

.5 Type E:

.1 Silicone joint sealant, in accordance with ASTM C920, Type S, Grade NS, minimum Class +100/-50, and non-staining when tested in accordance with ASTM C510 or ASTM C1248.

.2 Colour:

.1 As selected by Engineer. Allow for more than one colour, for selection from the manufacturer's full colour range, and for custom colours.

.3 Manufacturer's Products:

.1 Dow Corning 790 Silicone Building Sealant by Dow Corning Corp.

.2 Spectrem 1 by Tremco (Canada) Ltd., division of RPM Company.

.3 SikaSil WS-290 by Sika Canada Inc.

.4 GE SCS2700 SilPruf LM by Momentive Performance Materials.

.5 Pecora 890NST by Pecora Corporation.

.6 Type F:

.1 Low dirt pick-up, silicone joint sealant, in accordance with ASTM C920, Type S, Grade NS, minimum Class 50, and non-staining when tested in accordance with ASTM C510 or ASTM C1248.

.2 Colour:

.1 As selected by Engineer. Allow for more than one colour, for selection from the manufacturer's full colour range, and for custom colours.

.3 Manufacturer's Products:

.1 Dow Corning 756 SMS Building Sealant by Dow Corning Corp.

.2 Spectrem 3 by Tremco (Canada) Ltd., division of RPM Company.

.3 SikaSil WS-295 by Sika Canada Inc.

.4 GE SCS9000 Silpruf NB by Momentive Performance Materials.

.5 Pecora 864NST by Pecora Corporation.

.7 Type G:

.1 Silicone joint sealant, in accordance with ASTM C920, Type S, Grade NS, minimum Class 50, and non-staining in accordance with ASTM C510 or ASTM C1248. General purpose type.

.2 Colour:

.1 As selected by Engineer. Allow for more than one colour, for selection from the manufacturer's full colour range, and for custom colours.

.3 Manufacturer's Products:

.1 Dow Corning Contractors Weatherproofing Sealant (CWS) by Dow Corning Corp.

.2 Tremsil 200 Silicone Sealant (without Fungicide) by Tremco (Canada) Ltd., division of RPM Company.

.3 SikaSil WS-295 by Sika Canada Inc.

.4 GE SCS 1000 Contractors by Momentive Performance Materials.

.5 Pecora PCS by Pecora Corporation.

.8 Firestopping and Smoke Seals:

.1 Refer to Section 07 84 00.

2.2 ACCESSORIES

.1 Primers:

.1 Type recommended by sealant manufacturer for substrate, to promote adhesion and to prevent staining of adjacent surfaces for conditions encountered.

.2 Joint backing:

.1 Extruded, round, solid section, skinned surface, closed cell, soft polyethylene foam gasket stock, compatible with primer and sealant materials.

.2 30% to 50% oversized.

.3 Shore A hardness of 20, tensile strength 140 kPa to 200 kPa, in accordance with ASTM C1330.

.4 Bond breaker type surface.

.3 Bond breaker tape:

.1 Polyethylene tape or other plastic tape recommended by sealant manufacturer to prevent sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint.

.2 Provide self-adhesive, pressure sensitive tape where applicable.

.3 Do not use material impregnated with oil, bitumen, non-curing polymer or similar deleterious material.

.4 Cleaning agents:

.1 Recommended by sealant manufacturer.

.2 Free of oily residues or other substances capable of staining or harming joint substrates and adjacent surfaces.

.5 Masking tape:

.1 Non-staining, non-absorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 EXECUTION

3.1 EXAMINATION

.1 Verify substrate conditions and dimensions of previously installed Work upon which this Section depends.

.2 Report defects to Owner. Commencement of Work means acceptance of existing conditions.

3.2 PREPARATION

.1 Ensure joint sealants, primers, joint backing, bond breaker and cleaning agents are compatible with one another and with joint substrates.

.2 Prior to the commencement of sealant application, arrange for sealant manufacturer's representative to perform a site adhesion test on each substrate type to which each sealant will be applied.

.3 Ensure surface preparation and primer recommendation is compatible with each substrate type.

.4 Ensure masonry and concrete substrates have cured a minimum of 28 Days prior to proceeding with sealant Work.

.5 Clean joints to receive sealants in accordance with the manufacturer's recommendations and as specified in this Section.

.6 Remove foreign matter from joint substrates that could interfere with adhesion of joint sealant, including surface dirt, dust, old joint sealants, oil, grease, waterproofing, water repellents, water, sealers, curing compounds, mortar, loose material, frost, and other substances detrimental to sealant’s performance.

.7 Remove paints, except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer.

.8 Remove lacquer or other protective coatings from metal surfaces, without damaging metal finish, using oil-free solvents.

.9 Remove laitance and form-release agents from concrete.

.10 Remove rust, mill scale, and coatings from ferrous metals.

.11 Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants.

.1 Remove loose particles remaining after porous joint cleaning operations by vacuuming or blowing out joints with oil-free compressed air.

.2 Porous joint substrates include, but are not limited to the following:

.1 Cast-in-place concrete.

.2 Unit masonry.

.3 Unglazed surfaces of ceramic tile.

.12 Clean nonporous joint substrate surfaces with cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants.

.1 Wire brush, grinding, or sand blasting methods may be used on ferrous metals.

.2 Non-porous joint substrates include, but are not limited to the following:

.1 Metal.

.2 Glass.

.3 Porcelain enamel.

.4 Glazed surfaces of ceramic tile.

.13 Joint priming:

.1 Prime joint substrates and apply primer in accordance with sealant manufacturer's recommendations.

.2 Confine primers to areas of joint-sealant bond.

.3 Spillage or migration to adjoining surfaces is not permitted.

.14 Masking tape:

.1 Prior to performing Work, use masking tape of other means to protect adjacent exposed surfaces from damage including, but not limited to smearing and staining.

.2 Remove protection immediately upon completion and clean adjacent, exposed surfaces of any compound deposited upon such surfaces.

3.3 INSTALLATION

.1 Perform Work in accordance with manufacturer’s recommendations for Products and applications indicated, unless more stringent requirements apply.

.2 Use Products without additives or adulteration. Use one manufacturer's Product for each location in accordance with Article **Error! Reference source not found.**.

.3 Perform Work in accordance with ASTM C1193.

.4 Joint backing:

.1 Install joint backing to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

.1 Depth of recess: Maintain 2:1 joint width to depth ratio, up to a maximum of 13 mm, and not less than 6 mm at centre of joint.

.2 Where recess is less than specified depth, cut back surface of recess to specified depth.

.2 Do not leave gaps between ends of joint backings.

.3 Do not stretch, twist, puncture, or tear joint backings.

.4 Remove absorbent joint backings that have become wet before sealant application, and replace with dry materials.

.5 Support joint backing on horizontal surfaces against vertical movement which might result from pedestrian or vehicular traffic loads.

.5 Install bond breaker tape between sealant and back of joints where joint backing is not used.

.6 Apply sealant immediately after adjoining Work is in condition to receive sealant Work and as follows:

.1 Apply sealant in a continuous bead using gun with correctly sized nozzle. Use sufficient pressure to completely fill joint recess.

.2 Ensure sealant has full, direct uniform contact with, and adhesion to, side surfaces of recess. Superficial pointing with skin bead is not acceptable.

.7 Tooling:

.1 Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified to form smooth, uniform sealant bead, free from ridges, wrinkles, sags, air pockets, embedded impurities, dirt, stains, or other defects.

.2 At recesses in angular surfaces, finish sealant with flat profile, flush with face of material at each side.

.3 At recesses in flush surfaces, finish sealant with concave face and flush with face of material at each side.

.8 Immediately remove excess sealant and droppings.

.9 Ensure sealant bead is uniform in colour.

.10 Cure in accordance with the sealant manufacturer's recommendations. Do not cover up sealants until proper curing has taken place.

.11 Remove defective sealant and reapply.

3.4 FIELD QUALITY CONTROL

.1 Retain an independent inspection and testing agency to conduct field inspection and testing of sealant.

.2 Prepare and submit inspection reports to Owner.

3.5 CLEANING

.1 Clean surfaces adjacent to joints. Immediately remove sealant smears or other soiling resulting from application of sealants.

.2 Remove masking tape and other residue.

.3 Do not mar or damage finishes on materials adjacent to joints. Repair or replace marred or damaged materials.

3.6 PROTECTION

.1 Protect joint sealants:

.1 During and after curing period from contact with contaminating substrates.

.2 From damages by construction operations or other causes.

.2 If damage or deterioration occurs, cut out, remove, and repair damaged or deteriorated sealants immediately.

3.7 SEALANT LOCATIONS SCHEDULE

Sealant Locations Schedule

Type A	**Above grade level, vertical applications**
	- General perimeter caulking (window, doors and frames, louver frames, shelf angles, thresholds, bedding of mullions, precast and tilt-up panels). - Vertical expansion, control, lap joints application. - Painted metals. - Mullion joints. - Interior partition head to structure above. - Interior metal frames joints. - Exterior metal flashing. - Locations not indicated on Contract Drawings and required sealant for Work.

Type B	**Above grade level, horizontal applications**
	- Horizontal expansion joints. - Saw cut horizontal joints. - Precast slab horizontal joints. - Horizontal expansion and control joints in parking garages, plazas, terraces, decks, floors, and sidewalks.

Type	Above grade level, horizontal and vertical applications
C	
	- Around sinks, urinals, and bathroom fixtures. - Tiled areas' horizontal and vertical control and expansion joints. - Between vanity and mechanical fixtures/fittings. - Between access panels and tiles. - At corners of tiled walls.

Type	Above grade level, horizontal and vertical applications
D	
	- Structural glazing, horizontal and vertical. - Structural attachment of panel systems, horizontal and vertical. - Panel stiffener applications. - Suitable for wood, vinyl, and aluminum surfaces.

Type	Above grade level, vertical applications
E	
	- Precast wall vertical expansion joints. - Precast concrete panel vertical joints.

Type	Above grade level, horizontal and vertical applications
F	
	- Required non-staining to building materials. - Expansion and control joints in concrete panels, non-staining to building materials is required. - Metal curtain wall. - Porous surface including marble, granite, stone, and concrete, where non-staining to building materials is required. - EIFS. - Exterior and interior metal panels. - Masonry, where non-staining to building materials is required.

Type	Above grade level, both vertical and horizontal
G	
	- Glazing but not structural glazing. - Conventional glazing and replacement glazing of glass and plastic. - Aluminum sheet cover for insulation on metal pipes in exterior locations.

END OF SECTION

DIVISION 08 INDEX

METAL DOORS AND FRAMES

PART 1 GENERAL

1.1 SCOPE OF WORK

.1 Work supplied under this section includes the supply and installation of metal doors and frames

1.2 RELATED SECTIONS

.1 Division 1

.2 Section 03 20 00 – Concrete Reinforcement

.3 Section 03 30 00 – Cast-in-Place Concrete

.4 Section 08 71 00 – Door Hardware

1.3 DESIGN REQUIREMENTS

.1 Design exterior frame assemblies to accommodate expansion and contraction when subjected to minimum and maximum surface temperature of 35 degree C to 35-degree C.

.2 Maximum deflection for exterior steel entrances, screens and transoms under wind load of 1.2 kPa not to exceed 1/175th of span.

1.4 QUALITY ASSURANCE

.1 Fabrication and Installation: Comply with requirements of Canadian Steel Door Manufacturers' Association.

.2 Source Limitations: Obtain doors and frames through one source from a single manufacturer.

1.5 REQUIREMENTS OF REGULATORY AGENCIES

.1 Fire Protection Rated Assemblies: Labelled and listed by a nationally recognized testing agency having factory inspection service in conformance with CAN/ULC S104 and CAN/ULC S105 for fire protection ratings indicated.

.2 Oversize Fire Protection Rated Assemblies: For units exceeding sizes of tested assemblies, provide certification by a testing agency acceptable to authorities having jurisdiction that doors comply with construction requirements for tested and labeled fire protection rated assemblies except for size.

1.6 SUBMITTALS

.1 Make submittals in accordance with Section 01 33 00 – Submittals.

.2 Shop Drawings: Indicate each type of door and frame, material, steel core thicknesses, mortises, reinforcements, location of exposed fasteners, anchorage to each type of wall opening, arrangement of hardware and fire protection rating.

1.7 DELIVERY, STORAGE AND HANDLING

.1 Brace and protect doors and frames to prevent distortion during shipment. Store in a secure dry location.

.2 Store doors vertically, resting on planks, with blocking between to allow air to circulate.

PART 2 PRODUCTS

2.1 MATERIALS

.1 Metallic Coated Steel Sheet: ASTM A653/A653M, Commercial Steel (CS), Type B; with minimum ZF180 zinc-iron-alloy (galvannealed) coating designation.

.1 Doors and Panels, Stiffened Hollow Steel Construction

.2 Face Sheets: 1.519 mm (0.060”).

.3 Vertical Stiffeners: 0.912 mm (0.036”).

.2 Doors and Panels, Honeycomb Core Construction:

.1 Face Sheets: 1.2 mm (0.047”).

.3 Lock and Strike Reinforcements: 2.66 mm (0.1”).

.4 Hinge and Pivot Reinforcements: 3.416 mm (0.134”) thick by 38 mm (1-1/2”) wide by 150 mm (6”) longer than hinge and pivot, secured by not less than 6 spot welds.

.5 Flush Bolt Reinforcement: 2.66 mm (0.1”).

.6 Surface Applied Hardware Reinforcements: 2.66 mm (0.1”).

.7 Closer or Holder Reinforcements: 2.66 mm (0.1”).

.8 Glazing Stops: 0.912 mm (0.036”).

.9 Top and Bottom End Channels and Caps: 1.6 mm (0.060”).

.10 Mortar Guard Boxes: 0.759 mm (0.03”).

.11 Floor Anchors: 1.6 mm (0.060”).

.12 Jamb Spreaders: 0.912 mm (0.036”).

.13 Frame Anchors:

.1 Masonry T-Strap: 1.214 mm (0.048”).

.2 In-Place Masonry/Concrete: 0.912 mm (0.036”).

.3 Masonry Stirrup-Strap: 50 mm x 250 mm x 1.6 mm (2” x 10” x 0.060”).

.4 Steel Stud: 0.912 mm (0.036”).

.14 Honeycomb Core: Structural kraft paper, 2.5 mm (1”) maximum cell, weight: 36.3 kg per ream minimum, minimum density 16.5 kg/cu.m., sanded to required thickness.

PART 3 EXECUTION

3.1 FABRICATION GENERAL

.1 Stainless Steel Doors and Frames: Fabricate assemblies with all stainless steel components.

.2 Blank, reinforce, drill and tap units for mortised, templated hardware, and electronic hardware using templates provided by the hardware suppliers. Reinforce units for surface mounted hardware.

.3 Do welding to CSA W59.

.4 Factory apply touch up primer to doors and frames manufactured from metallic coated steel where coating has been removed during fabrication.

.5 Provide appropriate anchorage to floor and wall construction.

.6 Make provisions in doors and frames to suit requirements of Section providing security devices.

.7 Fabricate fire protection rated assemblies to ULC requirements and bearing ULC, cUL or Warnock-Hersey International Ltd., label, as acceptable to authorities having jurisdiction.

.8 Locate fire protection rating labels on the inside of the frame hinge jamb and door hinge edge midway between the top hinge and the head of the door.

3.2 FABRICATION - FRAMES AND SCREENS

.1 Fabricate frames to profiles and maximum face sizes as required to suit design, welded construction.

.2 Cut mitres and joints accurately and weld continuously on inside of frame profile.

.3 Grind welded corners and joints to flat plane, fill with metallic paste filler and sand to uniform smooth finish.

.4 Protect mortised cutouts with mortar guard boxes in masonry and concrete constructions. Conceal fastenings except where exposed fastenings are required.

.5 Fabricate metal screens to profiles required. Supply jamb and mullion extensions and anchors required to secure screens to the structure or framing provided under other construction. Fabricate anchorage to prevent transfer of load from support framing to the screens when deflection of structure occurs. Provide concealed reinforcement for screens to receive handrails. Provide closely fitted steel glass stops where required. Mitre corners. Drill and countersink fasteners symmetrically at min 150 mm (6") o.c. Screw stops in place.

.6 Provide jamb anchors for fixing at floor.

.7 Provide three door silencers on strike jamb for each single door, and two bumpers at head of frame for each door leaf in double doors.

.8 Fabricate thermally broken frames for exterior doors, separating exterior portion of frame from interior portion with polyvinyl chloride thermal breaks.

.1 Reinforce strike and hinge jambs with crimped 100 mm x 1.519 mm thick (4” x 0.060” thick) steel reinforcement spot welded to jamb returns at locations corresponding to hinge heights. Weld reinforcement to inside of jambs. Set reinforcement flush with outside of jambs.

3.3 FABRICATION – DOORS AND PANELS

.1 General: Fabricate swing type doors, flush, with provision for glass and/or louvre openings as required.

.2 Fabricate work with longitudinal edges seamless, continuously welded, welds ground smooth, filled and sanded flush.

.3 Stainless Steel Doors: Longitudinal edges mechanically interlocked and adhesive reinforced.

.4 Stiffened Hollow Steel Construction, Interior Assemblies: Form each face from single piece sheet steel. Reinforce doors with internal vertical stiffeners, securely laminated or welded to each face sheet at 150 mm (6”) on centre maximum. Fill voids between stiffeners of exterior assemblies with fibreglass insulation core.

.5 Honeycomb Core Construction:

.1 Interior Assemblies: Form each face from single piece sheet steel with honeycomb core laminated under pressure to face sheets.

.6 Stiffened Hollow Steel Construction: Form each face from single piece sheet steel. Reinforce doors with internal vertical stiffeners, securely laminated or welded to each face sheet at 150 mm (6”) on centre maximum.

.1 Interior Assemblies: Fill voids between stiffeners temperature rise rated core.

.7 Fabricate work with top and bottom full width steel channels, continuously welded, welds ground smooth, filled and sanded flush. Provide flush steel top edge on exterior assemblies.

3.4 EXECUTION

.1 Installation - General

.1 Install fire protection rated assemblies in accordance with NFPA 80.

.2 Touch up galvanized finish damaged during installation with galvanizing paint.

.2 Installation - Frames

.1 Set frames plumb, square, level and at correct elevation.

.2 Provide suitable anchors to suit construction. Use one base anchor and two wall anchors per jamb side for frames up to 1500 mm (60") and one additional wall anchor per jamb side for each additional height of 750 mm (30") or fraction thereof.

.1 In-Place Concrete or Masonry Construction: Secure frames in place with post-installed expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.

.3 Secure anchorages and connections to adjacent construction.

.4 Brace frames rigidly in position while building-in. Install temporary horizontal wood spreader at third points of door opening to maintain frame width. Remove temporary spreaders after frames are built-in.

.5 Make allowances for deflection of structure to ensure structural loads are not transmitted to frames.

.3 Installation - Doors

.1 Provide even clearance, measured from the pull face of doors:

.1 Between Top and Vertical Edges of Door and Frames: 3 mm plus/minus 1.6 mm (1/8" plus/minus 1/16”).

.2 Between Meeting Edge of Doors Swinging in Pairs: 3 mm plus/minus 1.6 mm (1/8" plus/minus 1/16”)

.3 Between Door Bottom to Finished Floor, Non-Rated Assemblies: 12 mm (1/2"), unless otherwise indicated.

.4 Between Door Bottom of Finished Floor, Fire Protection Rated Assemblies: To NFPA 80 requirements.

.5 Between Door Bottom to Thresholds: 6 mm (1/4”).

.2 Adjust operable parts for correct function.

.4 Cleaning

.1 Clean and make good all surfaces soiled or otherwise damaged in connection with work. Upon completion of work and remove debris, equipment, and excess material from site.

END OF SECTION

PART 1 GENERAL

1.1 INTENT

.1 This section describes the materials and procedures for FRP Frame Products installed by trades in relation to building veneers and all openings through walls that will facilitate a door assembly.

1.2 SCOPE OF WORK

.1 Work supplied under this section includes FRP Frame Products including frames, transom frames, side light and window assemblies, fire labelled and non-labelled, accessories as indicated on drawings and door schedule.

.2 FRP doors, swing type, flush, glazed or louvered, fire labelled, with or without temperature rise ratings and rated louvers, and non-labelled as indicated on drawings and door schedule

1.3 RELATED SPECIFICATIONS SECTIONS

.1 In addition to the general project requirements in Division 1, the following sections are referenced in this section:

.1 Section 07840 Fire Stopping.

.2 Section 07900 Joint Sealants

.3 Section 08710 Door Hardware

.4 Section 08800 Fire Rated Wire and Safety Glass

.5 Section 08810 Insulated Glass Units

.6 Division 9 Finishes

1.4 CODE AND REGULATORY REQUIREMENTS

.1 All products shall conform to the following standards and regulations:

.1 American Society of Testing and Materials (ASTM):

.1 ASTM C665-12 – Standard Specification for Mineral-Fibre Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing

.2 ASTM D638-14 - Standard Test Method for Tensile Properties of Plastics

.3 ASTM D695-10 - Standard Test Method for Compressive Properties of Rigid Plastics

.4 ASTM D696-08e1 - Standard Test Method for Coefficient of Linear Thermal Expansion of Plastics Between −30°C and 30°C with a Vitreous Silica Dilatometer

.5 ASTM D790-10 - Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials

.6 ASTME E84-15b – Standard Test Method for Surface Burning Characteristics of Building Materials

.2 Canadian Standards Association (CSA):

.1 CAN/CSA A440.4-07 (R2012) – Window, Door and Skylight Installation

.3 National Fire Protection Association (NFPA):

.1 NFPA 80-2007 - Fire Doors and Other Opening Protectives

.2 NFPA (Fire)-252 - Fire Tests of Door Assemblies, 2012 Edition

.4 Underwriters' Laboratories of Canada (ULC):

.1 CAN/ULC S104-10 – Fire Tests of Door Assemblies

.2 CAN/ULC S105-09 – Standard Specification for Fire Door Frames Meeting Performance Required by CAN/ULC S104.

.3 CAN/ULC 702-09 –Mineral Fibre Thermal Insulation for Buildings

.2 ANSI Door and Frame Preparations for Hardware

.3 DHI Recommended Locations for Builders Hardware

1.5 QUALITY ASSURANCE

.1 Fire rated doors and frames, glazing stops, and fire door hardware shall bear ULC labels. Refer to architectural drawings for locations of fire rated assemblies. All FRP work in fire separations and fire walls shall be in accordance with NFPA 80 – latest edition of Standard for Fire Doors and Windows and CAN/ULC S104. See schedule for doors requiring a temperature rise limit.

.2 Defective materials or quality of work whenever found at any time prior to final acceptance of the work, shall be rejected regardless of previous inspection. Inspection will not relieve responsibility, but is a precaution against oversight and error. Remove and replace defective materials, and the work of other trades affected by this replacement, at no additional cost.

1.6 SUBMITTALS

.1 General: Complete submittals in accordance with Specification Section 01330.

.2 Product Data: Materials and details of design and construction, hardware locations, reinforcement type and locations, anchorage and fastening methods.

.3 Samples: Submit in accordance with Section 01330 – Submittal Procedures.

.4 Shop Drawings: Submit in accordance with Section 01330 – Submittal Procedures.

.1 Details of each opening, showing elevations, glazing, louvered, frame profiles and identifying location of different finishes, if any.

.2 Indicate each type of door and frame, material, steel core thickness, mortises, reinforcements, stops, location of anchors, location of exposed fasteners, arrangement of hardware and fire rating.

.3 Include schedule identifying each unit with door marks and numbers relating to numbering on drawings and door schedule.

.5 Colour: Submit manufacturer's samples of standard colours.

.6 Warranty: Submit manufacturer's standard warranty.

1.7 DELIVERY STORAGE AND HANDLING

.1 Shipping and Delivery

.1 Doors and frames shall be shipped pre-hung in containers such as to prevent damage to finish.

.2 Doors and frames shall be delivered by common carrier with shipping containers intact and door manufacturer's name clearly identifiable. Manufacturers must be notified if shipping containers arrive damaged. Acceptance of damaged shipment may void warranty.

.3 Containers shall be labelled clearly identifying opening door mark.

.4 Co-ordinate delivery schedule of materials with the suppliers.

.2 Handling and Storage

.1 Doors and frames shall be stacked in such a way as to prevent failing and damage. Do not stack higher than indicated on shipping container. Do not stack on top of other material.

.2 Protect face of first door by placing plywood or cardboard between supports and door. Cover top door and edges in a similar manner.

.3 Store doors in a dry, well ventilated area. Doors stored for an extensive period of time shall have top and bottom edges sealed.

.4 Lift doors on and off piles, never drag across each other to prevent surface damage and scratching. Do not stand doors on end for storage

1.8 WARRANTY

.1 In addition to the contractual warranty terms, the manufacturer shall provide a lifetime warranty for the door and frame against failure due to corrosion, and a 15-year warranty.

.1 The warranty shall cover: Defects in material or workmanship, delaminating, core expansion and warp

PART 2 PRODUCTS

2.1 DESIGN CRITERIA

.1 Design exterior frame assembly to accommodate for expansion and contraction when subjected to minimum and maximum surface temperature of –35°C to 35°C.

.1 FRP fire rated doors and frames: labelled and listed by an organization accredited by Standards Council of Canada in conformance with CAN/ULC S104 NFPA 252 for ratings specified or indicated.

.2 Provide fire labelled frames for openings requiring fire protection ratings. Test products in conformance with CAN/ULC S104 or NFPA 252 and listed by nationally recognized agency having factory inspection services.

.2 Maximum U-value of exterior door assemblies is to comply with the OBC supplementary standard SB-10.

.3	Tensile Strength	55,000 psi	ASTM D638
.4	Compressive Strength	50,000 psi	ASTM D695
.5	Flexural Strength	50,000 psi	ASTM D790
.6	Modulus of Elasticity	3.5 x 10 (6)	ASTM D790
.7	Coefficient of Thermal Expansion	5.5 x 10 (-5)	ASTM D696

.8 Surface Burning Characteristics, Class 1 Flame Spread = 25

.9 Thermal Conductivity 0.1 – 0.24 btu-ft/hr-ft(2)-F

2.2 APPROVED MANUFACTURERS

.1 Edgewater Door (Neenah, Wisconsin, USA): https://edgewaterdoor.com/

.2 Jersey Architectural Door & Supply Co. (Atlantic City, New Jersey, USA): https://jerseyarchitectural.com/universal-pultrusions/

.3 Substitutions: Reference Section 01200 – Alternatives.

2.3 MATERIALS

.1 Fire Rated Door assemblies and fire rated glazing stops, material and construction approved by ULC

2.4 DOORS AND FRAMES

.1 Requirements for all doors and frames.

.1 General: All door and frame sections shall be chemically welded at the factory.

.2 Reinforcing: FRP chemically welded at factory. All structural members shall utilize a chemically resistant UV stabilized resin system.

.3 Hardware Preparation: In accordance with DHI A115 Series, or as indicated on drawings. All door stiles shall have integral FRP reinforcement, chemically welded in place, and shall not contain corrosive material embedded as reinforcing for hinge locations. Doors and frames shall be factory drilled and mortised for all hardware indicated on drawings. Hardware provided by others. See Specification Section 08710 – Door Hardware.

.4 Finish: Factory finish with manufacturer's standard colour.

2.5 DOORS

.1 Exterior and interior (non-rated).

.1 General: Panels shall be manufactured of fibreglass reinforced plastic (FRP). Use polymers tailored to the specific (corrosive) environment and have a reinforced content of 65 percent by weight.

.2 Door Thickness: 45 mm (1¾ inches) of flush construction. Door shall be FRP, pultruded as a one piece monolithic panel, with integral stiles.

.3 Profile: Square. Panel shall fit flush with frame on all sides.

.4 Texture: Smooth

.5 Panel Thickness: 3 mm (1/8 inch) thick solid FRP faces free of seams and cracks. Stile edges shall be 14 mm (9/16 inch) thick solid FRP.

.6 Insulation Factor: R-9 total

.7 Top Rail: Pultruded tube profile designed to fit flush inside the door and be chemically welded with a two part adhesive.

.8 Bottom Rail: Pultruded inverted "U" channel profile designed to fit inside the door allowing for field trimming if needed. Pultruded tube profile to fit flush with bottom of door.

.2 Core

.1 Material: High density, closed cell, Poly-isocyanurate sheets.

.2 Thickness: 38 mm.

.3 Compressive Strength: 16 psi minimum

2.6 FRAMES

.1 Exterior and interior (non-rated).

.1 Fabricate fire rated doors and frames in accordance with details, approved shop drawings and ULC requirements.

.2 Material: 6 mm thick solid pultruded FRP profiles having no corrosive components or reinforcement.

.3 Width: 50 mm faces.

.4 Depth: 146 mm standard.

.5 Style: One piece chemically welded at factory.

.6 Door Stop: 13 mm x 59 mm.

.7 Corner Construction: Mitered with 102 x 102 x 10 mm pultruded FRP angle reinforcement with interlocking “L” shaped pultruded FRP brackets.

.8 Reinforcing: 8 mm pultruded FRP chemically welded at all hinge, strike and closer locations.

.9 Anchors: Furnished with six total wall anchors, type as specified on drawings.

.10 Fasteners: Type 316 CRSS (18-8 series corrosion resistant stainless steel).

.11 Blank, reinforce, drill and tap frames for mortised, templated hardware and electronic hardware using templates provided by finish hardware supplier. Reinforce frames from surface mounted hardware.

.12 Protect mortised cut-outs with FRP guard boxes.

.13 Prepare frame for door silencers, three (3) for single door, two (2) at head for double door.

.14 Manufacturer’s nameplates on frames and screens are not permitted.

.15 Conceal fastenings, except where exposed fastenings are indicated.

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

.17 Insulate exterior frame components with polyurethane insulation.

.18 Prepare frames for electrical devices, including operators and security devices.

.19 Reinforce head of frames wider than 1200 mm.

2.7 FRAME ANCHORAGE

.1 Provide appropriate anchorage to floor and wall construction.

.2 Locate each wall anchor immediately above or below each hinge reinforcement on hinge jamb and directly opposite on strike jamb.

.3 Provide 1.5 mm angle clips, with two holes for floor anchorage welded to frame.

.4 Provide two (2) anchors for rebate opening heights up to 1520 mm and one (1) additional anchor for each additional 760 mm of height or fraction thereof.

.5 Provide three (3) jamb anchors per jamb for frames in masonry up to 2286 mm high and one (1) additional for each 600 mm over 2886 mm high for doors up to 900 mm wide.

.6 Provide five (5) jamb anchors per jamb for frames in masonry up to 2286 mm high and one (1) additional for each 400 mm over 2286 mm for doors over 900 mm wide, unless noted otherwise.

.7 Locate anchors for frames in existing openings not more than 150 mm from top and bottom of each jambs and intermediate at 660 mm on centre maximum.

.8 Provide frames with manufacturer's proprietary anchorage system suitable to secure frame rigidly to wall assembly. Secure frames set into previously constructed concrete or masonry openings by countersunk expansion bolts at same centres as for adjustable Tee anchors. Reinforce frame at fastening location to prevent indentation of frame by fastening device.

2.8 ADHESIVES

.1 Select adhesives that are accompanied by:

.1 detailed instructions for proper application, so as to minimize health concerns and maximize performance; and

.2 information describing proper disposal methods for containers.

2.9 FINISHES

.1 Doors and frames shall be supplied with coated with manufacturer’s standard colours as indicated by Engineer.

.1 Finish: Two-part aliphatic polyurethane, low VOC, industrial coating.

.2 Thickness: 5 mils.

.3 Sheen: Gloss.

.4 Impact Resistance: 140 in-lbs.

.5 Electrical Resistant: less than 10 megohms.

2.10 ACCESSORIES

.1 Door silencers: single stud rubber/neoprene type.

.2 Specialty trims: "J" shaped electrogalvanized steel trims, to cover cut ends of concrete blocks where new doors cut into existing walls. Trims shall be custom shaped and sized to suit door and wall conditions.

.3 Fire labels: FRP chemically welded.

.4 Floor Anchors, Channel Spreaders and Wall Anchors: Minimum 1.6 mm base thickness steel.

.5 Guard Boxes: Minimum 0.8 mm base thickness steel.

.6 Corrugated Steel Frame Tee Anchors: Thickness and design approved by ULC.

.7 Door bottom seal: to Section 08710 - Door Hardware.

.8 Sealant: to Section 07900 – Joint Sealers.

.9 Glazing: to Section 08800 – Glazing.

.10 Fabricate glazing stops as formed channel, minimum 16 mm height, accurately fitted, butted at corners and fasteners to frame sections with counter-sunk oval head sheet metal screws.

.11 Make provisions for glazing as indicated and provide necessary glazing stops.

.1 Provide removable stainless steel glazing beads for use with glazing tapes and compounds and secured with countersink stainless steel screws.

.2 Glazing Stops Fire Rated Doors and Frames: Commercial grade 16 Gauge sheet steel thickness and design approved by ULC.

.3 Glazing Stops Non Fire Rated Doors and Frames: Minimum 0.9 mm base thickness sheet steel with zinc finish as per door, tamperproof on exterior doors, screw fixed on interior doors.

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, datasheets and using non-corrosive materials. Installation shall be in strict accordance with local codes.

3.2 EXAMINATION

.1 All doors and frames shall be verified to comply with approved production drawings and meet the requirements for type, size, location and swing.

3.3 INSTALLATION GENERAL

.1 Install labelled FRP fire rated doors and frames to NFPA 80, except where specified otherwise.

3.4 FRAME INSTALLATION

.1 Install doors/frames plumb, level, square, true to line and without warp or rack. Anchor doors securely in place. Install doors to swing freely. After installation make final adjustments to hardware to allow for proper operation and latching.

.2 Coordinate frame anchor placement with wall construction.

.3 Brace frames rigidly in position while building-in. Install temporary horizontal wood spreader at third points of door opening to maintain frame width. Provide vertical support at centre of head for openings over 1200 mm wide. Remove temporary spreaders after frames are built-in.

.4 Make allowances for deflection of structures to ensure structural loads are not transmitted to frames.

.5 Caulk perimeter of frames between frame and adjacent material.

.6 Maintain continuity of air barrier and vapour retarder.

.7 Install trims to cover cut concrete block ends in walls where new doors installed in existing block walls. Do not impede installation of finish floor and base to make good materials to match typical existing condition.

3.5 DOOR INSTALLATION

.1 Install doors and hardware in accordance with hardware templates and manufacturer's instructions and Section 08710 - Door Hardware. Install fire rated doors to NFPA-80, latest edition.

.2 Provide even margins between doors and jambs and doors and finished floor and thresholds as follows:

.1 Hinge side: 1.0 mm.

.2 Latch side and head: 1.5 mm.

.3 Finished floor, top of thresholds: 13 mm.

.3 Adjust operable parts for correct function.

.4 Install louvres.

3.6 FINISH REPAIRS

.1 Touch-up with primer finishes damaged during installation.

.2 Fill exposed frame anchors and surfaces with imperfections with metallic paste filler and sand to a uniform smooth finish.

3.7 GLAZING

.1 Install glazing for doors and frames in accordance with Section 08800 - Glazing.

3.8 CLEANING

.1 Clean exposed surfaces of FRP doors and frames with a mild, non-abrasive cleaner and water.

.2 Do not use harsh cleaning materials or methods that would damage finish.

.3 Progress Cleaning: Perform cleanup as work progresses in accordance with Section 01740 Cleaning.

.1 Leave work area clean at end of each day.

.4 Final cleaning: Upon completion, remove surplus materials, rubbish, tools, and equipment in accordance with Section 01740 – Cleaning.

.5 Waste Management:

.1 Collect recyclable waste and dispose of or recycle field generated construction waste created during construction or final cleaning related to work of this Section.

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

END OF SECTION

ACCESS HATCHES

PART 1 GENERAL

1.1 SCOPE OF WORK

.1 Work included: Furnishing and installing factory fabricated access hatches and safety grates.

1.2 RELATED WORK

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

.2 Section 05 50 00 – Metal Fabrications

1.3 REFERENCES

.1 All products shall conform to the following standards and regulations:

- .1 American Society for Testing and Materials (ASTM):
  - .1 ASTM A53/A53M-20 - Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
  - .2 ASTM A123/A123M-17 – Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
  - .3 ASTM A276/A276M-17 – Specification for Stainless Steel Bars and Shapes
- .2 Canadian Standards Association (CSA):
  - .1 CAN/CSA G40.20-13/G40.21-13 (R2018) - Structural Quality Steels
  - .2 CAN/CSA-G164-18 - Hot-Dipped Galvanizing of Irregularly Shaped Articles
  - .3 CSA S16-19 - Design of Steel Structures
  - .4 CSA 157-17 – Strength Design in Aluminum
  - .5 CSA W59-18 - Welded Steel Construction (Metal Arc Welding)
- .3 Master Painters Institute (MPI):
  - .1 MPI #18 – Primer, Zinc Rich, Organic
  - .2 MPI #79 – Primer, Alkyd, Anti-Corrosive for Metal
  - .3 MPI #35 – Bituminous Coating

1.4 SUBMITTALS

.1 Product Data: Provide manufacturer's product data for all materials in this specification.

.2 Samples: Manufacturer to provide upon request; sized to represent material adequately.

.3 Shop Drawings: Show profiles, accessories, location and dimensions. Stamped by a Professional Engineer licensed to practice in the Province of Ontario.

.4 Contract Closeout: Access door manufacturer shall provide the manufacturer's warranty, prior to the contract closeout.

1.5 PRODUCT HANDLING

.1 All materials shall be delivered in manufacturer's original packaging.

.2 Store materials in a dry, protected, well-vented area. The Contractor shall thoroughly inspect product upon receipt and report damaged material immediately to delivering carrier and note such damage on the carrier's freight bill of lading.

.3 Remove protective wrapping immediately after installation (if applicable).

1.6 SUBSTITUTIONS

.1 Proposals for substitution products may be submitted for review following the award of the Contract, as per specification Section 01200 Alternatives. Contractor guarantees that proposed substitution shall meet the performance and quality standards of this specification.

1.7 JOB CONDITIONS

.1 Verify that other trades with related work are complete before installing access hatch(s).

.2 Mounting surfaces shall be straight and secure; substrates shall be of proper width.

.3 Refer to the construction documents, shop drawings and manufacturer's installation instructions.

1.8 WARRANTY

.1 Manufacturer's standard warranty: Materials shall be free of defects in material and workmanship for a period of 10 years from the date of purchase. Should a part fail to function in normal use within this period, manufacturer shall furnish a new part at no charge. Special finishes and other special accessories (if applicable) shall be warranted separately by the manufacturers of those products.

PART 2 PRODUCTS

2.1 GENERAL

.1 Hatches shall be pre-assembled from the manufacturer and delivered to site ready to be installed.

2.2 APPROVED MANUFACTURERS

.1 BILCO, P.O. Box 1203, New Haven, CT 06505, Phone: (800)366-6530.

.2 MSU Mississauga Ltd., 2222 South Sheridan Way, Mississauga, Ontario, L5J 2M4, Phone: (905) 823-4340.

.3 Maxam Metal Products Limited Unit 5 - 7978 North Fraser Way Burnaby, B.C. Canada V5J 0C7, Phone (604) 433-4243

2.3 FLOOR DRAINAGE ACCESS HATCH

.1 Furnish and install where indicated on plans.

.2 Acceptable Products:

.1 Bilco Type 'J-AL'

.2 MSU Type 'M'

.3 MSU Type 'M CL-625'

.3 Performance characteristics:

.1 Cover: Shall be reinforced to support a minimum live load of 14.40 kPa with a maximum deflection of 1/150th of the span.

.2 CL-625-ONT Cover: Where specified, shall be reinforced to support CAN/CSA S6 CL-625-ONT wheel load with an impact factor of 15% and a maximum deflection of 1/150th of the span.

.3 Manufacturer to provide structural calculations, stamped by a Professional Engineer registered in the Province of Ontario, upon request.

.4 Operation of the cover shall be smooth and easy with controlled operation throughout the entire arc of opening and closing.

.5 Operation of the cover shall not be affected by temperature.

.6 Entire door, including all hardware components, shall be highly corrosion resistant.

.7 Mullion in the middle of the hatch required to support cover shall be removable

.4 Cover:

.1 Shall be 6.3 mm aluminum diamond pattern.

.2 Cover shall be equipped with a hold open arm that automatically locks the cover in the open position.

.3 Cover shall be fitted with the required number and size of compression spring operators. Springs shall have an electrocoated acrylic finish. Spring tubes shall be constructed of a reinforced nylon 6/6 based engineered composite material.

.4 A Type 316 stainless steel snap lock with fixed handle shall be mounted on the underside of the cover.

.5 Frame: Channel frame shall be 6.3 mm extruded aluminum with bend down anchor tabs around the perimeter. A continuous EPDM gasket shall be mechanically attached to the aluminum frame to create a barrier around the entire perimeter of the cover and significantly reduce the amount of dirt and debris that may enter the channel frame.

.6 Hinges: Shall be heavy forged aluminum hinges, each having a minimum 6.3 mm diameter Type 316 stainless steel pin and shall pivot so the cover does not protrude into the channel frame. They shall be specifically designed for horizontal installation and shall be through bolted to the:

.1 cover with tamperproof Type 316 stainless steel lock bolts; and

.2 frame with Type 316 stainless steel bolts and locknuts.

.7 Drain Coupling: Provide a 38 mm drain coupling located in the right front corner of the channel frame, unless noted otherwise.

.8 Lifting Mechanisms: Manufacturer shall provide the required number and size of compression spring operators enclosed in telescopic tubes to provide, smooth, easy and controlled cover operation throughout the entire arc of opening and to act as a check in retarding downward motion of the cover when closing. The upper tube shall be the outer tube to prevent accumulation of moisture, grit and debris inside the lower tube assembly. The lower tube shall interlock with flanged support shoe fastened to a formed 6.3 mm gusset support plate.

.9 A removable exterior turn/lift handle with a spring-loaded ball detent shall be provided to open the cover and the latch release shall be protected by a flush, gasketed, removable screw plug.

.10 Hardware: Type 316 stainless steel.

.11 Finishes: Factory finish shall be mill finished aluminum with bituminous coating applied to the exterior of the frame.

PART 3 EXECUTION

3.1 GENERAL

.1 Contractor shall coordinate cast-in hatches with concrete pours. Ensure all embedded items are installed prior to placing concrete.

3.2 EXAMINATION

.1 Verify that site conditions are ready to receive work, substrate is dry, clean and free of foreign matter.

.2 Verify that the access hatch installation will not disrupt other trades.

.3 Verify that the access door accessories such as hold-open arms are in an accessible location that does not put the Operator in adverse risk.

.4 Examine openings to receive access hatch unit. Verify opening size, location, and that opening is square and plumb, and ready to receive work of this Section.

.1 Inform Engineer of unacceptable conditions immediately upon discovery.

.2 Proceed with installation after unacceptable conditions have been remedied and after receipt of written approval from Engineer.

.5 Beginning of installation means acceptance of site conditions.

3.3 INSTALLATION

.1 The installer shall check as-built conditions and verify the manufacturer's access hatch details for accuracy to fit the application prior to fabrication. The installer shall comply with the access door manufacturer's installation instructions.

.2 The installer shall furnish mechanical fasteners consistent with the access door manufacturer's instructions.

3.4 CLEANING

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

.2 Progress Cleaning:

.1 Perform cleanup as work progresses.

.2 Leave work area clean at end of each day.

.3 Final cleaning: Upon completion, remove surplus materials, rubbish, tools, and equipment

.4 Waste Management:

.1 Collect recyclable waste and dispose of or recycle field generated construction waste created during construction or final cleaning related to work of this Section.

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

END OF SECTION

PART 1 GENERAL

1.1 INTENT OF SECTION

.1 This Section covers the design, labour, products, equipment, and services necessary for electrically operated insulated, coiling metal door Work in accordance with Contract Documents.

1.2 RELATED SECTIONS

.1 In addition to the general project requirements in Division 1 – General Requirements, the following sections are referenced in this section:

.1 Section 08710 – Door Hardware

.2 Section 09900 – Painting

.3 Division 26 – ELECTRICAL

1.3 REFERENCE STANDARDS

.1 ASTM International Inc.

.1 ASTM A123 / A123M-08 – Zinc (Hot Dip Galvanized) Coatings on Iron and Steel Products

.2 ASTM A653 / A653M-08 –Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

.2 Canadian Standards Association (CSA):

.1 CAN/CSA G40.20/G40.21-13 – Structural Quality Steels

.2 CSA G40.21-04 – General Requirements for Rolled or Welded Structural Quality Steel

.3 National Fire Protection Agency (NFPA)

.1 NFPA 80-2013, Standard for Fire Doors and Other Opening Protectives.

.4 Electrical and Electronic Manufacturers' Association of Canada (EEMAC)

1.4 QUALITY ASSURANCE

.1 In addition to the requirements of Section 01450 – Quality Control, the following measures are required.

.2 Pre-installation meetings: comply with Section 01120 - Coordination and Sequence of Work. Conduct pre-installation meeting one week prior to commencing work of this Section and on-site installations to:

.1 Notify attendees 2 weeks prior to meeting and ensure meeting attendees include as minimum:

.1 Owner;

.2 Engineer;

.3 All Affected Subcontractors;

.4 Manufacturer's Technical Representative.

.2 Coordinate with related specification listed in article 1.3 - Related Sections

.3 Verify project requirements, including mock-up requirements.

.4 Verify substrate conditions.

.5 Co-ordinate products, installation methods and techniques.

.6 Sequence work of related sections.

.7 Co-ordinate with other building sub-trades to ensure proper installation and site preparation.

.8 Review manufacturer's installation instructions.

.9 Review warranty requirements.

1.5 SUBMITTALS

.1 Complete submittals in accordance with Section 01330 – Submittals.

.2 Shop Drawings:

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

.2 Indicate type of coiling doors, arrangement of hardware, required clearances, materials and finishes electrical characteristics including voltage, size of motors, auxiliary controls and wiring diagrams.

.3 Indicate assembly details and dimensions of fabrication, required clearances and electrical connections.

.4 Colour: Submit manufacturer's samples of standard colours.

.3 Samples:

.1 Submit for review and acceptance of each unit.

.2 Samples will be returned for inclusion into work.

.3 Submit duplicate 300 mm long pieces of grille rod and each selected insert sections.

.4 Closeout Submittals:

.1 Provide operation and maintenance data for cleaning and maintenance for overhead coiling doors and grilles, and hardware incorporation into operations manual.

.5 Warranty: Submit unexecuted warranty for review.

1.6 DELIVERY STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with specification Section 01610 – Basic Product Requirements and with manufacturer's written instructions.

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

.3 Storage and Handling Requirements:

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

.2 Store and protect overhead coiling doors and grilles from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

PART 2 PRODUCTS

2.1 DESIGN CRITERIA

.1 Design rolling door curtain and assembly to withstand wind load of 1.55 kPa within door opening area or wind pressure load in accordance with OBC, whichever is greater. Design door assembly to withstand minimum 100,000 cycles for motor operated doors and 50,000 cycles for manually operated doors per annum and 25 years total life cycle.

.2 Importance Category – Post-Disaster

2.2 ELECTRICAL

.1 Door shall be electrically operated with the following accessories and controls:

.1 Motor: 600 V, 3-phase, 2hp.

.2 Electro-mechanical Reversing Weatherstrip.

.3 Electro-Pneumatic Instant Stop or Reverse System.

.4 Reversing Time Delay.

.5 Open-Close-Stop Push-Button Station in a NEMA 7 enclosure c/w NEMA 7 rated pushbuttons.

.2 Electric operators on doors located in a hazardous environment, as defined by NFPA 70, shall have an enclosure rated for NEMA 7.

.3 One (1) 600V, 3 phase feed will be provided for the electrical operator. The 600V feed shall terminate at the disconnect switch. Wiring from the disconnect switch shall be by the electrical contractor, terminated at the junction box for the electrical operator supplier to tie into.

.1 Electric Operator controller/push-button station is to be powered internally via a control transformer provided from the electrical operator package.

.4 Electrical Requirements: Coordinate wiring requirements and power characteristics of the Work with the building electrical system. Do wiring in strict conformity with the requirements of the Electrical Code and Electrical Sections.

.1 Work of Electrical Sections: Supply and installation of disconnect switch/junction box and power to the disconnect switch/junction box.

.2 Work of this Section: Wiring and connection at and from disconnect switch/junction box to motors, starters, switches, controls, safety devices and other items requiring power.

.5 All wiring of the coiling metal doors shall be installed in accordance with the latest edition of the Ontario Electrical Safety Code (OESC). All insulated wire shall be heat resisting and shall be insulated for 600V and within rigid aluminum conduits. The power feeder circuit for the electrical operator will be furnished and installed under the electrical section to the location indicated on the drawings and will be wired to the operator junction box via the feeder disconnect switch.

.6 Employ a licensed electrician to wire and interconnect all operational and safety components for the Work. Terminate wiring required for connection to control circuitry and power at NEMA enclosures. Ground all control wiring.

.7 Electrical Components, Devices, and Accessories: CSA Listed and labelled.

.8 All electrical components to comply with, or be approved by, EEMAC, IEEE, CSA and shall be suitable for Class 1, Division 1 hazardous environment and shall be suitable for a wet and corrosive environment.

2.3 APPROVED MANUFACTURERS

.1 Amstel Manufacturing Inc., 128 Centre Street East, Richmond Hill, Ontario, Canada, L4C 1A6, Phone: (800) 663-6206, URL: www.amstel-doors.com.

.2 Atlas Roll-Lite Co. Ltd., 40 Sovereign Court, Woodbridge, Ontario, Canada L4L 8M1, Phone: (905).264.1986 URL: www.atlasrollingentry.com.

.3 Cookson Co., 1901 South Litchfield Road, Goodyear, AZ, USA 85338, Phone: (800) 294-4358, URL: www.cooksondoor.com.

.4 Dynamic Closures Ltd., P.O. Box 1296 Station Main, Cornwall, Ontario, Canada, K6H 5V4, Phone: (800) 663-4599, URL: www.dynamicclosures.com.

.5 Wayne Dalton, 2501 S. State Highway 121 Business, Suite 200, Lewisville, TX, USA, 75067, Phone: (800) 827-3667, e-mail: info@wayne-dalton.com, URL: www.wayne-dalton.com.

.6 Overhead Door Corp; 2501 S. State Hwy-121 Suite 200 Lewisville, TX 75067 Ph -800 275 3290, www.overheaddoor.com

.7 Or Agency Approved Equal

2.4 MATERIALS

.1 Sheet steel:

.1 Commercial grade to ASTM A653 / A653M-08 – Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; ASTM A123 / A123M-08 Standard Specification for Zinc (Hot Dip Galvanized) Coatings on Iron and Steel Products.

.2 Steel angles, bars, plate: CAN/CSA-G40.20/G40.21, Grade 300W.

.3 Shop primer: CAN/CGSB-1.40-97.

.2 Aluminum sheet metal: mill finish utility sheet.

.1 Aluminum sheet metal: mill finish embossed utility sheet.

.2 Aluminum extrusions: Aluminum Association alloy AA 6063-T5.

.3 Mounting Brackets, Guides and Bottom: Galvanized steel, size and thickness to suit conditions.

.4 Insulation:

.1 Door to be insulated with 20 mm thick urethane insulation R6.05.

2.5 FABRICATION

.1 Fabricate rolling metal fire doors to ANSI/NFPA 80 with 1.5 hours fire rating and bearing label.

.2 Curtain:

.1 Interior doors: interlocking flat hop-dipped galvanized steel slat sections minimum 1.2 mm thick nominally 65 mm high.

.2 Exterior doors: 1.2 mm thick hot-dipped galvanized, 65 mm high flat face slat with 0.6 mm thick hot-dipped galvanized back slat; space between slats filled with foamed-in-place polyurethane insulation (RSI 1.28).

.3 Rivet continuous end locks to slat ends.

.4 Rivet continuous wind locks to slat ends.

.3 Bottom Bar:

.1 Provide double angle bottom bar matching material of curtain with electric sensing edge.

.4 Guides:

.1 Provide roll formed angle guides of metal matching curtain, unless otherwise indicated, for installation as indicated. Provide flexible weatherstripping on both sides of curtain.

.5 Counterbalance Shaft Assembly:

.1 Construct of heat-treated torsions spring with 25 percent overload factor, rated for 100,000 cycles. Enclose spring in steel pipe to support door curtain and counterbalance mechanism with maximum deflection of 1/360th of opening wide. Provide ball bearings at rotating points. Provide spring tension adjusting wheel, accessible for setting.

.6 Brackets:

.1 Support counterbalance assembly on 5 mm minimum thickness steel plate brackets.

.7 Hood:

.1 Enclose counterbalance assembly with square shaped hood, minimum 1.2 mm thick of metal matching curtain, unless otherwise indicated.

.8 End locks:

.1 Provide slide bolt locking mechanism with motor interlock.

.9 Weatherstripping:

.1 Bottom Bar:

.1 Manually Operated Doors: Replaceable, bulb-style, compressible EDPM gasket extending into guides.

.2 Motor Operated Doors: Sensing/weather edge within neoprene astragal extending full width of door bottom bar

.2 Guides: Vinyl strip sealing against fascia side of curtain.

.3 Hood: Neoprene/rayon baffle to impede air flow above coil.

.4 Lintel Seal: Nylon brush seal fitted at door header to impede air flow.

2.6 OPERATION

.1 Equipment coiling doors for electric operation. Provide:

.1 Jack shaft type operator with electric motor of size recommended by door manufacturer.

.2 Pre-wired control panel, housing fused disconnect, starter and transformer.

.3 Precision micro switches.

.4 Adjustable automatic friction clutch.

.5 Electro-mechanical safety bar at bottom of door activating instant reverse action if doors meet an obstruction.

.6 Include hand chain interlocked incorporated through auxiliary operator to disconnect motor mechanically and electrically when engaged and allow manual operation of door.

.7 Slide bolt with interlock.

2.7 ELECTRICAL OPERATOR

.1 Electrical motors, controller units, remote pushbutton stations, relays and other electrical components: to CSA and ULC approval.

.2 The motors shall be explosion proof and shall be suitable for Class I, Division 1 locations.

.3 Power supply: 600V/3/60.

.4 Motor: high starting torque, instant reversing, capacity to operate door at 300 mm per second, removable without affecting emergency chain device or setting of limit switches. Equip motor with overload protection, centrifugal clutch and electric brake. Refer to Division 16 for motor specifications.

.5 Motor size matching gear reducer with gears running in oil bath.

.6 Controller units with integral motor reversing starter, 3 heater elements for overload protection, including pushbuttons and control relays as applicable.

.7 Pushbuttons: NEMA 7 rated keyed control station with stainless steel face plate and pilot light, 3 button stations, momentary “OPEN”, and constant pressure “CLOSE”. Include “STOP” pushbutton to stop door movements instantly when button is pressed. OPEN and CLOSE pushbuttons to resume door movements.

.8 Design brake to stop and hold doors in any position.

.9 Safety switch: electromechanical or electro pneumatic device full length of bottom rail of bottom section of door, to reverse door to open position when coming in contact with object on closing cycle.

.10 When slide bolts or keyed cylinders are required provide electric interlocks to prevent operation of door when lock bolts are engaged in the guides.

.11 Door speed: 300 mm/s minimum.

.12 Mounting brackets: galvanized steel, size and thickness to suit conditions.

.13 Control circuit: 24 VAC.

.14 Install fusible link activated automatic closing device to close door at controlled slow even speed in case of fire.

.15 Arrange automatic closing device to permit manual lifting of curtain for emergency exit after automatic closing with curtain returning to closed position when released.

.16 Connect automatic closing device to heat and smoke detection equipment.

2.8 FINISHES

.1 Exposed surfaces: pre-treated and coated with thermosetting powder coating; colour selected by engineer.

.2 Concealed surfaces: shop primed.

PART 3 EXECUTION

3.1 EXAMINATION

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

.1 Visually inspect substrate in presence of Engineer.

.2 Inform Engineer 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 Engineer.

3.2 INSTALLATION

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

.2 Coordinate with Division 16 for required power connections.

.3 Install electrical motors, controller units, pushbutton stations, relays and other electrical equipment required for door operation.

.4 Install electric wiring from power supply located near door.

.5 Install master keyed cylinder specified in Section 08710 – Door Hardware.

.6 Adjust door operating components to ensure smooth opening and closing of doors.

.7 Field Quality Control

.1 Test labelled coiling doors for proper operation by activating fusible link. Test coiling door in presence of Engineer.

.2 Have manufacturer of products supplied under this Section review Work involved in handling, installation, protection and cleaning of its products, and submit written reports in acceptable format to verify compliance of Work with Contract.

.3 Manufacturer's Field Services:

.1 Obtain written reports from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product within 3 days.

.4 Submit manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

.5 Ensure manufacturer's representative is present before and during critical periods of installation and testing.

.6 Schedule site visits to review Work at stages listed:

.1 After delivery and storage of products, and when preparatory Work on which Work of this Section depends is complete, but before installation begins.

.2 Twice during progress of Work at 25% and 60% complete.

.3 Upon completion of Work, after cleaning is carried out.

3.3 CLEANING

.1 Perform cleaning of aluminum components in accordance with: AAMA 609.

.2 Progress Cleaning: clean in accordance with Section 01740- Cleaning.

.1 Leave Work area clean at end of each day.

.3 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01740- Cleaning.

.1 Clean aluminum and stainless steel with damp rag and approved non-abrasive cleaner in accordance with manufacturer's instructions.

.2 Remove traces of primer, caulking, clean doors and frames.

.3 Clean glass and glazing materials with approved non-abrasive cleaner.

3.4 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by overhead coiling door and grille installation.

END OF SECTION

FIBERGLASS WINDOWS

PART 1 GENERAL

1.1 SCOPE AND DEFINITIONS

.1 Furnish and install fixed sashes of FRP composite construction in accordance with details and schedule shown on the project drawings and as specified herein. Fixed sash products of aluminum, steel or wood constructions are strictly excluded.

.2 FRP is defined as “Fiberglass Reinforced Polyester”

1.2 RELATED SECTIONS

.1	Section 04 00 00	Masonry mortar
.2	Section 05 50 00	Steel lintels
.3	Section 06 20 00	Finish Carpentry
.4	Section 08 80 00	Glazing

1.3 QUALITY ASSURANCE

.1 Referenced Standards

.1 American Society for Testing and Materials (ASTM)

.2 Society of Automotive Engineers (SAE)

.3 International Building Code, Plastics (Chapter 26)

.2 Experience: Manufacturer shall be engaged in the manufacture of FRP door and frame systems for a minimum of twenty-five (25) years documented experience prior to the start of this work, and who has a history of successful production acceptable to the Architect.

.3 Referenced Standard: Where labeled fixed sashes or fixed windows are required, fiberglass fixed sashes shall be UL listed and shall be tested successfully to UL9 / UBC 7-4 (1997) standards.

.4 Warranty: Provide written limited guarantee for FRP Fixed Sash as follows:

.1 Fiberglass fixed sash (fixed windows): Fiberglass fixed sashes and windows are guaranteed for the life of the product against failure due to corrosion from the specific chemical environment named at the time of purchase. Furthermore, all products are inspected prior to shipment and guaranteed against defective workmanship for a period of ten (10) calendar years after the date of purchase.

1.4 SUBMITTALS

.1 Product Data: Provide catalog cut of FRP fixed sashes detailing internal construction, reinforcements and material used.

.2 Shop Drawings: To include the following specific information:

.1 Specifications relating to method of construction, finish color, type of glass and glazing, anchor systems, joint construction and complete warranty information.

.2 Complete schedules or drawings of FRP fixed sashes showing identifying mark numbers, door and frame types, typical elevations, nominal sizes, handing, actual dimensions and clearances, and required hardware preps and reinforcements.

.3 Supporting reference drawings pertaining to fixed sash mounting details.

.3 Color Samples: Provide a complete set of available finish colors from the manufacturer for color selection upon request.

.4 Installation instructions: Include manufacturer's specific information describing procedures, sequence and required fasteners for frame and door installation.

.5 Production of FRP fixed sashes shall not proceed until final approval of submittals and all necessary manufacturing information is received from customer.

1.5 DELIVERY, STORAGE AND HANDLING

.1 FRP fixed sashes are delivered to your site in adequate crating with foam sheet separations.

Upon receipt of shipment, remove and inspect the fixed sashes for damage. Note any damage on the shipping papers prior to accepting. If there is any noted (visible or concealed) damage, notify Tiger Door at: 1-888-891-4416, immediately.

.2 Handling and storage of the fixed sashes after receipt is the responsibility/liability of the customer. It is recommended that the fixed sashes be stored indoors in a vertical position, clear of the floor, with blocking between the fixed sashes to permit air circulation between the fixed sashes and prevent damage. Rain/water or condensation must not be allowed to collect or lay between stored fixed sashes. Do not wrap in plastic sheeting as it will promote condensation formation within. Permanent discoloration can result. Failure to comply with the receiving and reporting instructions shall void the Tiger Door LLC warranty.

.3 Use care in handling FRP fixed sashes to prevent damage to factory finishes. Wear protective gloves and do not slide or drag fixed sashes against one another.

PART 2 PRODUCTS

2.1 MANUFACTURER

.1 FRP fixed sashes shall be as manufactured by Tiger Door, 5224 FM 802 Brownsville, TX 78521 ph 888.891.4416 website: www.tigerdoor.com

2.2 HARDWARE ITEMS

.1 Non-fire rated FRP Fixed Sashes and Window Walls:

.1 Design: FRP Fixed Sashes and Window Walls furnished under this specification shall utilize a high modulus pultruded structural FRP shape. The fixed sash and window frame section shall be standard double rabbeted 5-3/4" deep x 2" face, 3/16" thick, with integral 5/8" stops to match typical hollow metal configurations. Additional jamb profiles and widths are available.

.2 Corner Joints: Frame jambs and header shall be joined at corners via miter connections with hidden FRP angle clips and associated fasteners. Post and beam corners will not be acceptable.

.3 Butt Joints: All mechanically fastened butt joints shall be secured with hidden fasteners and internal FRP tube blocking.

.4 Hardware Reinforcements: FRP reinforcing shall be chemically welded to fixed sash and window frame material at required locations. Mechanically fastened reinforcements are not permitted.

.5 Anchors:

.1 BOLT-IN: Provide manufacturer's required number of 3/8" diameter x 4" long flat head stainless steel sleeve anchors for masonry openings, 3/8" diameter x 4" machine screw with nut and washers for structural steel openings, #14 x 4" stainless steel flat head sheet metal screws for wood or steel stud openings. Include extra anchors for additional frame height in two foot increments above 8'-0". Provide single bolt anchor at center of all headers over four feet in nominal width. Stainless Steel fasteners shall be furnished by the factory.

.2 GROUT-IN: Provide manufacturer's required number of wire or strap type masonry anchors for installation into block wall. Fill frame cavity with grout.

.6 Finish: Fixed sash shall have a 3-4 mils (wet) factory applied two-part aliphatic polyurethane fully cured coating of industrial urethane. Industrial urethane chemical coating color topcoat, to match the color and sheen of the doors, for superior weatherability. Gelcoat may not be sprayed onto the frame as a secondary coating.

.2 Fire rated FRP Fixed Sashes:

.1 Design: Fire rated FRP fixed sash furnished under this specification shall utilize a high modulus pultruded structural FRP shape. Standard frame profile is a double rabbeted 5¾" depth x 2" face, 3/16" thick, with integral 5/8" doorstop. The minimum frame section shall be limited to a 4" jamb depth, 1" face. Four-inch header and expanded profiles are acceptable. Frame cavities shall be filled with a proprietary fire-resistant composite formulation with a minimum density of 25 lb/ft3. Hollow metal or Stainless-Steel frames are not acceptable

.2 Corner Joints: KD jambs and header shall be joined at corners via miter connections. Post and beam corners will not be acceptable.

.3 Hardware Reinforcements: FRP reinforcing shall be chemically welded to fixed sash and window frame material at required locations. Mechanically fastened reinforcements are not permitted.

.4 Anchors:

.1 Provide manufacturer's required number of 3/8" diameter x 4" long flat head stainless steel sleeve anchors for masonry openings, grouted wire anchors for grouted installations. Stainless Steel bolts shall be furnished by the factory.

.5 Finish: Fixed sash shall have a 3-4 mils (wet) factory applied two-part aliphatic polyurethane fully cured coating of industrial urethane. Industrial urethane chemical coating color topcoat, to match the color and sheen of the doors, for superior weatherability. Gelcoat may not be sprayed onto the frame as a secondary coating.

2.3 MECHANICAL PROPERTIES AND TEST PERFORMANCE

.1 Pultruded structural shapes shall exhibit the following minimum longitudinal coupon properties (per ASTM):

.1 Tensile strength (D638) 30,000 psi
.2 Comprehensive strength (D695) 30,000 psi
.3 Flexural strength (D790) 30,000 psi
.4 Flexural modulus (D790) 1,600,000 psi
.5 Shear strength (D2846) 4,500 psi
.6 Impact, notched (D256) 25 ft-lb/in
.7 Barcol hardness (D2853) 50
.8 Fire Resistance (E-84) Class I

.2 Adhesive shall exhibit the following minimum coupon properties (per SAE)

.1 Tensile Strength (D882-83A modified) minimum 2000 psi
.2 8-day 25º C at 100% humidity Cross Peel (SAE J1553) minimum 330 psi
.3 7-day immersion in seawater Cross Peel (SAE J1553) minimum 330 psi
.4 30-day immersion in saltwater Cross Peel (SAE J1553) minimum 330 psi
.5 72-hour immersion in gasoline Cross Peel (SAE J1553) minimum 330 psi
.6 72-hour immersion in 20% sulfuric acid Cross Peel (SAE J1553) minimum 300 psi

2.4 FASTENERS

.1 All fasteners for all hardware shall be type 304 CRSS (18-8 series corrosion resistant stainless steel) with no exception. No carbon steel or aluminum components shall be used.

PART 3 EXECUTION

3.1 IDENTIFICATION

.1 Factory mark all fixed sashes using a chemical resistant plastic tag or indelible marker with identifying number, keyed to shop drawings, prior to shipment.

3.2 INSTALLATION

.1 Fixed Sash: Install in strict accordance with manufacturer's printed instructions. Set plumb and square, using shims for bolt-in of existing openings, or wood bracing prior to grouting of jambs. Use at least two 2x6 wood spreaders inside frame to maintain critical opening dimensions during grouting.

.2 Glazing: Install glazing per industry standard methods and procedures. Glass, gasketing and glazing blocks will be furnished by others and field installed unless quoted as factory furnished.

3.3 CLEANING

.1 Clean exposed surfaces of FRP doors and frames with a mild, non-abrasive cleaner and water.

END OF SECTION

ALUMINIUM WINDOWS

1. GENERAL

1.1 General

1.1.1 Conform to sections of Division 1 – General Requirements as applicable.

1.2 Related Sections

1.2.1 Section 08800 – Fire Rated Wire and Safety Glass

1.3 Intent

1.3.1 This section describes the materials and procedures for the installation of aluminum windows installed by specialized trades including work in relation to building interior walls and finishes.

1.4 Scope of Work

1.4.1 Work supplied under this section includes Aluminum Window Frame Products including lights and accessories as indicated on drawings and window schedule.

1.5 References

1.5.1 Aluminum Association (AA):

.1 AA DAF 45-03(R2009), Designation System for Aluminum Finishes.

1.5.2 American Society for Testing and Materials (ASTM):

.1 ASTM A123/A123M-15, Standard Specification for Zinc (Hot-Dip galvanized) Coatings on Iron and Steel Products.

.2 ASTM E1748-95(2009), Standard Test Method for Evaluating the Engagement Between Windows and Insect Screens as an Integral System.

1.5.3 Canadian Standards Association (CSA):

.1 AAMA/WDMA/CSA 101/I.S.2/A440-11(R2016), NAFS - North American Fenestration Standard for Windows, Doors, and Skylights.

.2 CSA A440S1-09, Canadian Supplement to AAMA/WDMA/CSA 101/1.S.2/A440, NAFS - North American Fenestration Standard for Windows, Doors, and Skylights.

.3 CAN/CSA-A440.4-07(R2016), Window, Door and Skylight Installation

.4 CAN/CSA-A440.2-14/A440.3-14, F1enestration energy performance/User guide to CSA A440.2-14, Fenestration energy performance.

.5 CAN/CSA G40.20/G40.21-13, Structural Quality Steels / General Requirements for Rolled or Welded Structural Quality Steel

.6 CAN/CSA-Z91-02(R2013), Health and Safety Code for Suspended Equipment Operations.

1.5.4 Canadian General Standards Board (CGSB):

.1 CAN/CGSB-12.3-M91 Flat, Clear Float Glass

.2 CAN/CGSB-12.8-M97 Insulating Glass Units

1.5.5 Ontario Building Code 2012

1.6 Work Supplied but Not Installed

1.6.1 Supply to other sections anchors, inserts and items required to be built into work of other sections.

1.6.2 Ensure accurate setting of built-in items. Where necessary provide templates, diagrams or other suitable means of instruction.

1.7 Design and Performance Requirements

1.7.1 Design window systems to withstand, without any detrimental effects to appearance and performance, wind loads and temperature range expected in geographical area of this project (OBC climatic information 30 year probability), unless specified otherwise.

1.7.2 Prevent water penetration in any form.

1.7.3 Design window systems based on rain screen principles, with all glazing cavities vented and drained to exterior.

1.7.4 Design systems to accommodate, without detrimental effects on appearance and performance of system:

.1 Thermal expansion and contraction of systems components; and

.2 Movement, deflection and creep of building structural frame.

1.7.5 Limit deflection of component parts under maximum design load to $1/175^{th}$ of span or less if required by glass manufacturer.

1.7.6 Windows and vents: meet following requirements when tested in accordance with CAN/CSA A440/A440.1:

.1 Air tightness: A3.

.2 Water tightness: B7.

.3 Wind load resistance: C5.

.4 Temperature index:

.1 Frame: I f 56 minimum.

.2 Glass: I g 65 minimum.

1.8 Quality Assurance

1.8.1 In addition to the requirements of 01450 – Quality Control, the following measures are required:

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

1.8.3 Defective materials or quality of work whenever found at any time prior to final acceptance of the work, shall be rejected regardless of previous inspection. Inspection will not relieve responsibility but is a precaution against oversight and error. Remove and replace defective materials, and the work of other trades affected by this replacement, at no additional cost.

1.8.4 Source Quality Control:

.1 Windows supplied under this specification shall have been tested by an independent testing agency indicating compliance with the performance requirements of CAN/CSA A440/A440.1. This qualification shall be prerequisite for tendering.

1.8.5 Manufacturers Qualifications:

.1 A firm with not less than 10 years experience in manufacture of similar type aluminum windows.

1.8.6 Contractors Qualifications:

.1 Work of this section shall be executed by fabricator and installer approved by manufacturer and with a minimum of five (5) years experience in the type of work specified herein, having adequate equipment and skill to expediently complete the work in an efficient manner. Only products from manufacturers listed will be accepted unless written approval is issued by the Engineer.

1.8.7 Fabrication Tolerances: overall height, width and diagonal dimensions of frames shall be within the following tolerances:

.1 Dimension of 2m and less: ± 2mm.

.2 Dimension of more than 2m: ± 3.5mm.

1.8.8 Sealant: comply with requirements of Section 07900 – Joint Sealers, except where specifically stated otherwise herein.

1.8.9 Glazing: comply with requirements of Section 08810 – Insulating Glass Units, except where specifically stated otherwise herein.

1.9 Submittals

1.9.1 Complete submittals in accordance with Specification Section 01330.

1.9.2 Prior to preparing shop drawings, submit a letter from the manufacturer certifying that the Sub-Contractor has issued a purchase order, letter of intent or otherwise entered into a contract with the manufacturer. The letter shall be dated and include:

.1 Name of the project.

.2 Name of the Sub-Contractor.

.3 Complete list of products.

.4 Manufacturers contact with telephone and facsimile numbers.

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

.6 Indicate materials and details in full size scale for head, jamb and sill, profiles of components, interior and exterior trim, junction between combination units, elevations of unit, anchorage details, location of isolation coating, description of related components and exposed finishes fasteners, and sealant. Indicate location of manufacturer's nameplates.

1.9.3 Product Data: Materials and details of design and construction, hardware locations, reinforcement type and locations, anchorage and fastening methods.

1.9.4 Shop Drawings:

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

.2 Details of each opening, elevations showing rough-opening dimensions, glazing, frame profiles, and identifying location of different finishes, if any.

.3 section details, fastenings, methods of installation and anchorage, connections with other work, type of wall construction, method of glazing, types and locations of operating hardware, mullion details, weather-stripping details, screen details,

.4 Indicate each type of window frame, material, steel core thickness, stops, location of anchors, location of exposed fasteners, arrangement of hardware and fire rating.

.5 Include schedule identifying each unit with window marks and numbers relating to numbering on drawings and window schedule and indicting compliance with fire safety code, where required.

.6 Submit glass manufacturers thermal stress analysis for insulating glass.

.7 Manufacturer’s preprinted installation instructions and cleaning instructions.

.8 Colour: Submit manufacturer’s samples of standard colours.

1.9.5 Samples:

.1 Upon Engineer’s request, submit sample section and assemble corner of each framing system used.

.2 Include frame, sash, sill, glazing and weatherproofing method, insect screens, surface finish and hardware. Show location of manufacturer's nameplates.

.3 Include 150mm long samples of head, jamb, sill, meeting rail, mullions to indicate profile.

.4 Samples will be returned for inclusion into work.

1.9.6 Test and Evaluation Reports:

.1 Submit test reports from approved independent testing laboratories, certifying compliance with specifications.

.2 All test reports that reference the NAFS must include, on the first page, a summary of the results including, at minimum:

.1 The product manufacturer.

.2 The type of product.

.3 The model number/series number.

.4 The primary product designation.

.5 The secondary product designation:

.1 Positive design pressure.

.2 Negative design pressure.

.3 Water penetration resistance test pressure.

.4 Canadian air infiltration and exfiltration levels.

.6 The test completion date.

.3 The report will also contain the following information:

.1 Test dates.

.2 Report preparation dates.

.3 Test information retention period.

.4 Location of testing facilities.

.5 Full description of test samples, including:

.1 Anodized finish.

.2 Condensation resistance.

.3 Safety drop - vertical sliding windows only.

.4 Block operation - sliding windows only.

.5 Sash strength and stiffness.

.6 Sash pull-off - vinyl windows.

.7 Forced entry resistance.

.8 Mullion deflection - combination and composite windows.

.6 Complete description of amendments, as applicable.

.7 Conclusion.

.8 Drawings signed by the testing laboratory, if provided.

1.10 Operations & Maintenance Manuals

1.10.1 Submit in accordance with Section 01780 Closeout Submittals.

1.10.2 Operation and Maintenance Data: submit operation and maintenance data for windows for incorporation into manual.

1.11 Delivery Storage and Handling

1.11.1 Shipping and Delivery:

.1 Deliver and handle materials in accordance with Section 01610 – Basic Product Requirements and with manufacturer's written instructions.

.2 Windows shall be delivered by common carrier with original packaging unopened, undamaged, intact and manufacturer’s name and address clearly identifiable. Manufacturers must be notified if shipping containers arrive damaged. Acceptance of damaged shipment may void warranty.

.3 Co-ordinate delivery schedule of materials with the suppliers.

1.11.2 Storage and Protection:

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

.2 Windows shall be stacked in such a way as to prevent failing and damage. Do not stack higher than indicated on shipping container. Do not stack on top of other material.

.3 Store materials protected from exposure to harmful weather conditions and at temperature and humidity conditions recommended be manufacturer

.4 Store windows to prevent damage or marring of finish.

1.12 Environmental and Site Conditions

1.12.1 Refer to Specification Section 01610 – Basic Product Requirements.

1.12.2 Verify actual openings by field measurements before fabrication, show recorded measurements on shop drawings.

1.12.3 Coordinate field measurements and fabrication schedule with construction progress to avoid construction delays.

1.13 Warranty

1.13.1 In addition to the contractual warranty terms, the manufacturer shall provide a lifetime warranty for the window unit against failure due to corrosion, and a 5-year warranty on defects, from the date of substantial performance. For the purpose of this paragraph, defects shall include but not necessarily be limited to:

.1 Water infiltration in excess of requirements specified.

.2 Air infiltration/exfiltration in excess of requirements specified.

.3 Deflection of system components in excess of requirements specified.

.4 Failure of joint seal.

.5 Cracked glass (except where caused by vandalism).

.6 Delamination, cracking, blistering, excessive fading of metal finishes.

1.13.2 At no cost to Owner, replace factory-sealed insulating window units should cracking of glass or any other breakdown or failure of glass units occur or should obstruction of visions develop due to dust or

film forming on inner glass surfaces within a period of 10 years from date of substantial performances.

2. PRODUCTS

2.1 Design Criteria

2.1.1 Fixed lite aluminum windows shall be designed to meet F-C30 voluntary specifications in AAMA/NWWDA 101/I.S.2-97 and be designed to meet the following performance requirements:

.1 Air Infiltration: Air infiltration shall not exceed .3 SCFM per square foot of window area at a static air pressure difference of 1.57 PSF as established by AAMA/NWWDA 101/I.S.2-97 when tested in accordance with ASTM E 283.

.2 Water Resistance: When tested in accordance with ASTM E 547, there shall be no water leakage at a static air pressure difference of 4.50 PSF.

2.1.2 Life Safety Criteria: Windows shall conform to NFPA 101 Life Safety Code when rescue and/or second means of escape are indicated.

2.2 Systems

2.2.1 Window framing: one (1) of the following systems:

.1 Series 516 Isoport by Kawneer

.2 Series 4000 by Fulton

.3 Series 900 by Alumicor

.4 Agency Approved Equal

2.3 Materials

2.3.1 Framing Components:

.1 Aluminum extrusions: AA 6063-T5 alloy.

.2 Aluminum plate and sheet: AA 1100 alloy.

.3 Steel sections and plate: CAN/CSA G40.20/G40.21-04, Grade 300W.

.4 Steel tubes: CAN/CSA G40.20/G40.21-04, Grade 350W, Class H.

.5 Screws, bolts, nuts, washers, rivets and other fasteners incorporated into aluminum sections: aluminum or ANSI Series 300 stainless steel or hot-dipped galvanized steel.

.6 Anchoring devices: aluminum, non-magnetic stainless steel or hot-dipped galvanized steel.

2.3.2 Glass and Glazing Materials:

.1 Setting blocks: Neoprene, Shore “A” Durometer hardness of 70 to 90 points; spacer shims, 40 to 50 points, as recommended by glass manufacturers.

.2 Glazing Sealant: one-part polysulphide meeting requirements of CAN/CGSB-19.13-M87 or as recommended by window and glass manufacturer.

.3 Glazing Tape: pre-shimmed polyisobutylene: Polyshim Tape by Tremco.

.4 Glazing wedges and splines: solid extruded neoprene or EPDM having Shore “A” Durometer hardness of 50 to 70 points as recommended by window manufacturer.

.5 Float Glass: CAN/CGSB 12.3-M91, clear, glazing quality, minimum 6 mm thick, heat strengthened where required by thermal stress analysis.

.6 Low emissivity (Low-E) glass: PPG Solarban 60 clear.

.7 Insulating Glass: factory-sealed double glazed to CAN/CGSB 12.8-M97:

.1 Nominal thickness: 25mm.

.2 Clear float glass, inside and outside; heat strengthened where required; low emissivity coating on No. 2 surface.

2.3.3 Caulking Materials:

.1 Sealant: one-part low modulus silicone to CAN/CGSB-19, 18-M97: Dow Corning 790. Colours selected by Engineer, not necessarily from standard colours.

.2 Primer: as recommended by sealant manufacturer.

.3 Joint backing: non-gassing foam rope, compressed minimum 25 percent when installed: Sof-Rod by Tremco.

2.3.4 Miscellaneous Materials:

.1 Bituminous paint: alkali resistant asphaltic enamel.

.2 Bedding compound: non-hardening and non-skinning.

2.4 Fabrication

2.4.1 Aluminum components shall be extruded sections and shapes unless otherwise specified.

2.4.2 Window framing shall consist of thermally broken sections with fixed stop on exterior side and snap-in glass stop on interior side.

Use mullion type section at jambs and head; cut off outside glazing leg. Open sections are not acceptable.

2.4.3 Size units to allow for structural deflection of surrounding construction.

2.4.4 Design work so that it will not be distorted, nor fasteners overstressed, from expansion and contraction of metal.

2.4.5 Reinforce members as required to withstand loads and to maintain deflection within allowable limited.

2.4.6 Internally reinforce framing members where work of other sections is to be fastened thereto.

2.4.7 Fastenings shall be concealed.

2.4.8 Mechanically joined sections shall have hairline joints.

2.4.9 Fabricate extruded or formed aluminum sills to profiles indicated to suit wall conditions and minimum 3mm thick. Provide drip deflectors at sill ends and at abutting vertical surfaces. Open ends of sills shall be filled with neatly applied closure plates. Anchors shall be designed not to work loose after installation. Unless otherwise detailed, provide flush slip joint at intermediate sill joints.

2.4.10 Closures, covers and trim shall be extruded or formed to profiles shown and unless otherwise shown, minimum 3m thick.

2.4.11 Make provisions to drain to exterior any moisture entering or forming inside systems.

2.5 Metal Finishes

2.5.1 Exposed aluminum surfaces: fluoropolymer coating PPG Duranar, colour selected by Engineer.

2.5.2 Contact surfaces of aluminum components with dissimilar building components shall be coated with bituminous paint.

2.6 Aluminium Finishes

2.6.1 Finish exposed surface of aluminium components in accordance with Aluminium Association Designation System for Aluminium Finishes – 1997:

.1 Exterior exposed aluminium surfaces and exterior exposed infill panel surfaces: conform to AAMA605.2 fluoropolymer coating to colour as selected by Consultant.

.2 Interior exposed aluminium surfaces and interior surface of infill panel surfaces: conform to A41 anodized to clear AA-M12C22A41 colour.

.3 Touch-up primer for galvanized steel surfaces: SSPC20 paint zinc rich.

.4 Conceal steel items: galvanized in accordance with ASTM A123/A123M to 600 g/m^2.

.5 Apply one (1) coat of bituminous paint to concealed aluminium and steel surfaces in contact with cementitious or dissimilar materials.

.6 Colour and finish: colour to match Consultant's sample and match Curtain Walls under Section 08920.

2.7 Isolation Coating

2.7.1 Isolate aluminium from following components, by means of isolation coating:

.1 Dissimilar metals except stainless steel, zinc, or white bronze of small area.

.2 Concrete, mortar and masonry.

.3 Wood.

2.8 Glazing

2.8.1 Glaze windows in accordance with CAN/CSA A440/A440.1 and Section 08800 – Fire Rated Wire and Safety Glass.

2.9 Air Barrier and Vapour Barrier

2.9.1 Equip window frames with factory air barrier and vapour retarder material for sealing to building air barrier and vapour retarder as follows:

.1 Material: identical to, or compatible with, building air barrier and vapour retarder materials to provide required air tightness and vapour diffusion control throughout exterior envelope assembly.

.2 Material width: adequate to provide required air tightness and vapour diffusion control to building air barrier and vapour retarder from interior.

2.10 Hardware

2.10.1 Hardware: stainless steel or white bronze sash locks and aluminum handles to provide security and permit easy operation of units.

2.10.2 Locks: provide operating sash with spring loading extruded aluminum sash locks, to provide automatic locking in closed position. Provide CMR sweep locks at meeting rail.

2.10.3 Where windows latching devices are located in excess of 1600 mm above floor level:

.1 Equip vertical sliding units with ring pull at top sash. Provide operating pole of length required, complete with appropriate tip to suit ring pull. Provide one (1) pole for each room where vent sash occurs.

2.10.4 Vertical slider windows are not required to have inward tilt action. All vertical slider windows provided for this project are to have the inward tilt action mechanism disabled prior to delivery to the project site.

3. EXECUTION

3.1 Window Installation

3.1.1 Install in accordance with CAN/CSA A440/A440.1.

3.2 Framing

3.2.1 Erect and secure framing plumb, square and level, free from warp, twist and superimposed loads.

3.2.2 Anchor intermediate vertical frame members to structure above as required. Where support for intermediate vertical frame members is not available directly above head, provide frame extensions to structure above. Provide flexible connection at structure to allow for movement.

3.2.3 Provide necessary inserts to be built into work of other sections as required for anchorage of framing.

3.2.4 Set frame members in bedding compound to ensure watertight assembly.

3.2.5 Metal to metal joints between abutting components shall be sealed weathertight.

3.2.6 Use concealed fastenings and anchorages in all locations. Exposed fastenings, where unavoidable, must be clearly identified on shop drawings and require Engineer’s approval prior to fabrication of work.

3.3 Glazing

3.3.1 Glaze openings in accordance with window and glass manufacturer’s recommendation so as to achieve weathertight installation. Provide sealant heel bead at all locations.

3.3.2 Provide insulating glass at all locations unless otherwise shown.

3.3.3 Provide vision glass at all locations, except where translucent glass is required.

3.4 Sills

3.4.1 Provide aluminum sills, complete with chairs, anchors, expansion plates, drip deflectors as detailed.

3.4.2 Provide sills in longest practicable lengths. Provide flush slip joints at maximum 3m on centre.

3.4.3 Align intermediate joints with mullions as directed by Engineer.

3.4.4 Install metal sills with uniform wash to exterior, level in length, straight in alignment with plumb upstands and faces. Use one-piece lengths at each location.

3.4.5 Cut sills to fit window opening.

3.4.6 Secure sills in place with anchoring devices located at end joints of continuous sills and evenly spaced 600mm on centres in between.

3.4.7 Fasten expansion joint cover plates and drip deflectors with self tapping stainless steel screws.

3.4.8 Maintain 6mm to 9mm space between butt ends of continuous sills. For sills over 1200mm in length, maintain 3mm to 6mm space at each end.

3.5 Sealants

3.5.1 Seal joints in accordance with window and sealant manufacturer's recommendations. Prime contact surfaces prior to installation of sealant.

3.5.2 Provide caulking between framing members and adjoining work and where required to render work of this section weathertight.

3.5.3 Provide for continuity of air and vapour barrier in all locations; join up with air/vapour barrier components of adjacent systems.

3.5.4 Fill voids between framing and surrounding building elements with a low pressure build polyurethane foam insulation.

3.6 Covers, Closures and Trim

3.6.1 Provide stools, covers, closures and trim as indicated and as required to provide complete and finished installation.

3.6.2 Provide cap flashings matching finish and colour of framing.

3.6.3 Wherever possible, provide concealed fastenings unless approved otherwise by Engineer.

3.6.4 Align intermediate joints with mullions/horizontal rails as directed by Engineer.

3.7 Cleaning

3.7.1 Clean in accordance with Section 01740 - Cleaning.

3.7.2 Progress Cleaning: Perform cleanup as work progresses:

.1 Leave work area clean at end of each day.

3.7.3 Final cleaning: Upon completion, remove surplus materials, rubbish, tools, and equipment:

.1 Remove protective elements and thoroughly clean aluminum and glass surfaces with solution of mild domestic detergent in warm water. Exercise care in removing dirt from corners. Wipe surfaces dry using soft cloths.

.2 Just prior to takeover of building by Owner, check test door hardware and weatherstripping and, if necessary, adjust or replace components to ensure proper and smooth operation and weathertight closure.

3.7.4 Waste Management:

.1 Collect recyclable waste and dispose of or recycle field generated construction waste created during construction or final cleaning related to work of this Section.

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

3.8 Protection

3.8.1 Protect installed products and finished surfaces from damage during construction.

3.8.2 Touch-up any abraded surface of the window finish with air-dry paint furnished by the window manufacturer.

END OF SECTION

DOOR HARWARE

PART 1 GENERAL

1.1 INTENT

.1 To establish the technical, functional, jurisdictional, or regulatory and quality requirements for the implementation of door hardware installed by trades including work in relation to doors and frames. These technical specifications define the supply and installation of the door hardware and identify approved manufacturers and models.

.1 Supply of finish hardware for all pedestrian doors, complete with all fixing and anchoring devices.

.2 Supply templates and information necessary for installation of hardware.

1.2 SCOPE OF WORK

.1 Supply all labour, material, equipment and supervision necessary to complete the installation of door hardware.

1.3 RELATED WORK

.1 In addition to the general project requirements in Division 1, the following sections are referenced in this section:

.1 Section 05 50 00 Metal Fabrications

.2 Section 07 90 00 Sealants

.3 Section 08 11 00 Steel Doors and Frames

.4 Section 08 36 00 Sectional Metal Overhead Doors

1.4 CODE AND REGULATORY REQUIREMENTS

.1 Standard hardware location dimensions in accordance with Canadian Metric Guide for Steel Doors and Frames (Modular Construction) prepared by Canadian Steel Door and Frame Manufacturer's Association.

.2 American National Standards Institute (ANSI):

.1 ANSI/BHMA A156.1-2016 – Butts and Hinges

.2 ANSI/BHMA A156.2-2017 - Bored and Pre-assembled Locks and Latches

.3 ANSI/BHMA A156.3-2014 - Exit Devices

.4 ANSI/BHMA A156.4-2019 - Door Controls (Closers)

.5 ANSI/BHMA A156.36-2016 – Auxiliary Locks

.6 ANSI/BHMA A156.6-2015 - Architectural Door Trim

.7 ANSI/BHMA A156.7-2016 - Template Hinge Dimensions

.8 ANSI/BHMA A156.8-2015 - Door Controls – Overhead Stops and Holders

.9 ANSI/BHMA A156.10-2017 - Power Operated Pedestrian Doors.

.10 ANSI/BHMA A156.12-2018 - Interconnected Locks and Latches.
.11 ANSI/BHMA A156.13-2017 - Mortise Locks and Latches
.12 ANSI/BHMA A156.14-2019 - Sliding and Folding Door Hardware.
.13 ANSI/BHMA A156.15-2015 - Closer/Holder Release Device
.14 ANSI/BHMA A156.16-2018 - Auxiliary Hardware
.15 ANSI/BHMA A156.17-2014 - Self-closing Hinges and Pivots.
.16 ANSI/BHMA A156.18-2016 - Materials and Finishes
.17 ANSI/BHMA A156.19-2019 – Power Assist and Low Energy Power Operated Doors
.18 ANSI/BHMA A156.20-2017 - Strap and Tee Hinges and Hasps.
.19 ANSI/BHMA A156.21-2019 - Thresholds.
.20 ANSI/BMHA A156.22-2017 - Door Gasketing and Edge Seal Systems.

.3 Canadian Steel Door and Frame Manufacturers' Association (CSDFMA)

.1 CSDFMA Recommended Dimensional Standards for Commercial Steel Doors and Frames - 2009.

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

1.5 QUALITY ASSURANCE

.1 In addition to the requirements of 01 45 00 – Quality Control, the following measures are required:

.1 Regulatory Requirements:

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

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

1.6 SUBMITTALS

.1 General:

.1 Complete submittals in accordance with Specification Section 01 33 00

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for door hardware and include product characteristics, performance criteria, physical size, finish, limitations and order code.

.3 Samples:

.1 Submit for review and acceptance of each unit.

.2 Samples will be returned for inclusion into work.

.3 Identify each sample by label indicating applicable specification paragraph number, brand name and number, finish and hardware package number.

.4 Hardware List:

.1 Submit contract hardware list.

.2 Indicate specified hardware, including make, model, material, function, size, finish and other pertinent information.

.5 Test Reports:

.1 Certified test reports showing compliance with specified performance characteristics and physical properties.

.6 Manufacturer's Instructions:

.1 Submit manufacturer's installation instructions.

.7 Closeout Submittals:

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

.2 Operation and Maintenance Data: submit operation and maintenance data for door hardware for incorporation into manual.

.8 Warranty:

.1 Submit manufacturer’s standard warranty.

1.7 MAINTENANCE MATERIALS

.1 Extra Stock Materials:

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

.2 Tools:

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

1.8 DELIVERY AND STORAGE

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

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

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

.4 Storage and Handling Requirements:

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

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

.3 Protect prefinished surfaces with wrapping and strippable coating.

.4 Replace defective or damaged materials with new.

.5 Clearly label cartons and packages designating contents and locations for which each item is intended. Indicate on packing memos carton in which each item is packed.

PART 2 PRODUCTS

2.1 APPROVED MANUFACTURERS

.1 Allegion, 11819 N. Pennsylvania St., Carmel, Indiana, United States 46032, Phone: (317) 810-3700, URL: www.allegion.com.

.2 ASSA ABLOY Entrance Systems, 4020B Sladeview Crescent. Unit 3&4, Toronto, Ontario, Canada, L5L 6B1, Phone: (905) 608-9242, email: service.ca.aaes@assaabloy.com, URL: http://www.sargentlock.com

.3 Best, 6161 East 75th Street, Indianapolis, IN, USA 46250, Phone: (855) 365-2407, e-mail, URL: www.bestaccess.com.

.4 Canaropa, 1866 Kipling Avenue, Rexdale, Ontario, Canada M9W 4J1, Phone: (416) 241-4445, e-mail: salestor@canaropa.com, URL www.canaropa.com.

.5 Door Security Solutions of Canada, 160 Four Valley Drive, Vaughan, Ontario, Canada V4K 4T9, Phone: (866)-243-9816, URL: www.pemko.com

.6 Gallery Specialty, 676 Petrolia Road, Toronto, Ontario, Canada M3J 2V2, Phone: (416) 667-9593, e-mail: info@galleryspecialty.com, URL: www.galleryspecialty.com.

.7 Hager, P.O. Box 124, Kitchener, Ontario, Canada N2C 1K1, Phone: (314) 772-4400, URL: www.hagerco.com.

.8 Horton Automatics of Ontario, 1150 Blai Road, Unit 1N, Burlington, Ontario, Canada L7M 3T4, Phone: (905) 331-7491, email: brian@hortonontario.com, URL: www.hortonontario.com

.9 K.N. Crowder MFG Inc., 1220 Burloak Drive, Burlington, Ontario, Canada L7L 6B3, Phone: (905) 315-9788, e-mail: paiken@dmbsales.ca, URL: www.kncrowder.com.

.10 McKinney Products Company, 225 Episcopal Road, Berlin, Connecticut, USA 06037, Phone: (800)-888-2772, email: ed.soloski@assaabloy.com, URL: http://www.mckinneyhinge.com/en/site/mckinney-hinge/

.11 Sargent Manufacturing Company, 100 Sargent Drive, New Haven, Connecticut, United States 06536-0915, Phone: (800) 727-5477, e-mail: webmaster@sargentlock.com URL: www.sargentlock.com.

.12 Standard Metal Hardware Mfg Ltd., 29 Rangemore Road, Toronto, Ontario, Canada M8Z 5H8, Phone: (416)-744-1510, URL: www.smhardware.com

.13 Stanley Hardware, 711 Ontario St., Cobourg, Ontario, Canada K9A 4L3, Phone: (800)-667-7466, email: HDW-NAT-CustomerService-CBG@spectrumhhi.com, URL: http://ca.stanleyhardware.com/

.14 Medeco Security Locks, 3625 Alleghany Drive, Salem, USA VA 24153, Phone: (800)-839-3157, email: customerservice.medeco@assaabloy.com , ULR: https://www.medeco.com/en/m/en/

2.2 HARDWARE ITEMS

.1 Only door locksets and latches listed on CGSB Qualified Products List are acceptable for use on this project.

.2 Use one (1) manufacturer's product only for all similar items.

2.3 DOOR HARDWARE

.1 Provide new materials in perfect condition, free from defects impairing durability or appearance. In every case hardware shall be of high quality design and finish suitable for the purpose for which it is intended.

.2 Locks and latches

- .1 Bored and preassembled locks and latches: to ANSI/BHMA A156.2.
- .2 Interconnected locks and latches: to ANSI/BHMA A156.12.
- .3 Mortise locks and latches: to ANSI/BHMA A156.13.
- .4 Normal strikes: box type, lip projection not beyond jamb.
- .5 Cylinders: key into keying system as outlined in section 2.6 Keying.

.3 Operators

- .1 Exit devices: to ANSI/BHMA A156.3.
- .2 Exterior Operators:
  - .1 Finish to 630 (US32D) Satin stainless steel.
  - .2 Acceptable products:
    - .1 Exterior exit device with rim latch – (EO1)

.1	Sargent	8813 x ETJ 32D
.2	Von Duprin	98L x 996L-R/V 03 LEVER - 32D
.3	Precision	2108 x V4908C x 630

.2 Exterior fire rated exit device with rim latch – (EO2)

.1	Sargent	8813 x ETJ 32D
.2	Von Duprin	98L-F x 996L-R/V 03-32D
.3	Precision	FL2108 x V4908C x 630

.3 Exterior exit device with concealed vertical rods - (EO5)

.1	Sargent	MD8606 x ETJ x 32D
.2	Von Duprin	9848-NL-03-32D
.3	Precision	2803 x V4908C x 630

.4 Exterior fire rated exit device with concealed vertical rods - (EO6)

.1	Sargent	MD86-CVR-MD8610 32D
.2	Von Duprin	9848-EO-F-32D
.3	Precision	FL2801 x V4908C x 630

.5 Exterior fire rated exit device with concealed vertical rods, exit only trim - (EO7)

.1	Sargent	MD86-CVR-MD8610 32D
.2	Von Duprin	9849-EO-32D
.3	Precision	2801 630

.3 Interior Operators:

.1 Finished to 626 (US26D) Satin Chromium plated.

.2 Acceptable product:

.1 Interior exit device with rim latch and lever trim (IO1)

.1	Sargent	80 Series 12-8813 x ETJ
.2	Von Duprin	98-L-BE-03-F
.3	Precision	FL2114 x 4900C x 626

.2 Interior fire rated exit device with rim latch and lever trim (IO2)

.1	Sargent	80 Series 12-8815 x ETJ
.2	Von Duprin	98-L-BE-03-F
.3	Precision	FL2114 x 4900C x 626

.3 Interior exit device with rim latch and night trim – (IO3)

.1	Sargent 26D	80 Series MD 8610 X PTB
.2	Von Duprin	98-NL
.3	Precision	2803 X 1700A X 626

.4 Interior fire rated exit device with rim latch and night trim – (IO4)

.1	Sargent 26D	80 Series MD 8810 X PTB
.2	Von Duprin	98-F-NL

	.3	Precision	2103 X 1700A X 626

.5 Interior exit device with concealed vertical rod and lever trim – (IO6)

.1	Sargent 26D	80 Series 12-MD 8613 X ETJ
.2	Von Duprin	9848-L-03
.3	Precision	2808 X 4900C X 626

.6 Interior fire rated exit device with concealed vertical rod and lever trim – (IO7)

.1	Sargent 26D	80 Series 12-MD 8613 X ETJ
.2	Von Duprin	9848-L-F-03
.3	Precision	FL2808 X 4900C X 626

.7 Interior fire rated exit device with concealed vertical rod and night trim – (IO8)

.1	Sargent PTB 26D	80 Series 12-MD 8610 X
.2	Von Duprin	9848-NL-F
.3	Precision	FL2803 X 1700A X 626Entrance Locksets - (I10)
.1	Schlage # 626	ND50PD X RHO X ASA X
.2	Best	9K37AB15C STK 626
.3	Sargent	28-10G05 LL 26D

.9 Passage Set - (I11)

.1	Schlage #	ND10S X RHO X ASA X 626
.2	Best	9K30N15C STK 626
.3	Sargent	28-10U15 LL 26D

.10 Store Room - (I13)

.1	Schlage # 626	ND80PD X RHO X ASA X
.2	Best	9K37D15C STK 626
.3	Sargent	28-10G04 LL 26D.

.11 Privacy set with occupancy indicator - (I14)

.1	Schlage .	ND85PD x RHO x ASA x 626
.2	Indicator Lock Co.	C3FN Brushed Nickel

.3 Auxiliary Locks – (AL01)

.1 Auxiliary locks and associated products: to ANSI/BHMA A156.5, as listed below.

.1 Latch bolt, type as directed by Consultant,. Key into keying system as directed.

.2 Cylinders: type as directed by Consultant, for installation in deadlocks provided with special doors as listed in door Schedule. Key into keying system as directed.

.3 Falcon D100 X Single cylinder X thumb turn X 26D

.4 Best 8T3 7 K S5 626 CS

.5 Sargent 10-48-485 X 26D

.4 Mortise Operators:

.1 Mortise/Rim Cylinder: (M01)

.1 Primus UL437

.2 Best Cormax

.3 Sargent V10 Series

.2 Electronic Cylinder – (M02):

.1 Medeco XT Small Format Interchangeable Core

.2 Medeco XT Rim & Mortise Cylinders

.3 Medeco XT KIK/KIL Cylinders

.3 Finishes to match the door hardware

.4 No Equals will be accepted to above locks and latches due to the special keying system listed herein.

.5 Butts and Hinges:

.1 As listed in drawing Door Schedule.

.1 Butts and hinges: to ANSI/BHMA A156.1.

.2 Exterior doors to be with non-removable pins.

.3 Provide one (1) hinge for every 760 mm of door height and one (1) extra hinge for doors over 900 mm wide to 1200 mm width.

.4 Acceptable product:

.1 Hinges on locked doors: (H1)

.1 Hager BB1191 X 114 X 101 X NRP X 630

.2 Stanley FBB191 X 114 X 101 NRP X 32D

.3 McKinney TA2314 X 114 X 101 NRP X 32D

.2 Standard Hinges: (H2)

.1 Hager BB1279 X 114 X 101 X 626

.2 Stanley FBB179 X 114 X 101 X 26D

.3 McKinney TA2714 X 114 X 101 X 26D

.6 Door Closers and Accessories:

.1 As listed in drawing door schedule,

.2 Door closers: to ANSI/BHMA A156.4.

.3 Door controls - overhead holders: to ANSI/BHMA A156.8.

.4 Closer/holder release devices: to ANSI/BHMA A156.15.

.5 Door co-ordinator: surface for pairs of doors with overlapping astragal.

.6 Finished to 628 or 689 if 628 is unavailable.

.7 Acceptable products:

.1 Exterior Closers - (CL1)

.1 LCN 4040xp Series

.2 Stanley D-4551

.3 Sargent 351 Series

.2 Interior Closers - (CL2)

.1 LCN #1461 Series

.2 Stanley D-3551

.3 Sargent 351 Series

.8 Door requiring hold opens and overhead stops are to be incorporated into closer arms.

.1 option not required.

.9 Include drop plates where required when door head has wall opening wider than frame width or where ceiling is at door head.

.7 Concealed vertical rod by same manufacturer as exit device.

.8 Door Coordinators

.1 Required on all exterior double doors listed in door schedule.(DC1)

.1 Acceptable products:

.1 Dorma SR 390

.2 Ives COR9G

.2 Acceptable products for smoke and fire rated doors: (DC2)

.1 Dorma SR 392

.9 Architectural Door Trim:

.1 As listed in door Schedule.

.2 Finished to 630 (US32D) Satin stainless steel.

.3 Length of Kick plate:

.1 25mm, less than door width on double doors.

.2 40mm, less than door width on single doors

.4 Door protection plates (Stainless steel_0.05” gauge):

.1 Kickplates (DT1)

.1	Hager	#190S X 203 X LENGTH
.2	Standard Metal	K10A 200 X LENGTH.
.3	IVES	8400 S 200 X B4E

.2 Mop plate - (DT2)

.1	Hager	#224S X 100 X LENGTH
.2	Standard Metal	K30
.3	IVES	8400 S 100 X B4E

.3 Push plates - (DT4)

.1	Hager	A30S X 152 X 406.
.2	Standard Metal	K11A 152 X 406.
.3	IVES	SC8200 152 X 406

.4 Pull units - (DT5)

.1	Hager	34G X 152 X 406.
.2	Standard Metal	9009 No. 2.
.3	IVES	8303 / 8103, 152 X 406, G mounting

.5 Surface bolts: spring (chain) bolt: type & finish as directed by Consultant

.6 Accessory item: door pulls, handles, stops, guides or latch type as directed by consultant.

.10 Auxiliary Hardware: to ANSI/BHMA A156.16

.1 As listed in Hardware Requirements Schedule.

.2 Finished to 630 (US32D) Satin stainless steel.

.1 Door Stop

.1 Floor Stops - (DS1)

.1	Hager	#259F & 259H.
.2	Standard Metal	S108 & S107
.3	IVES	FS17

.2 Wall Stop - (DS2)

.1	Hager	#234W
.2	Standard Metals	S121
.3	IVES	WS404CVX

.3 Overhead stops - (DS3)

.1	Hager	300D
.2	Glynn-Johnson	100 Series
.3	Canaropa	3562
.4	Glynn Johnson	100S

.2 Flush bolts:

.1 Externally mounted - (FB1)

.1 Hager #281D & 282D.
.2 Standard Metal F67UL

.2 Internally mounted – (FB2)
.1 Standard Metal F65UL
.2 Hagger 8770N

.11 Thresholds - (TH1)

.1 Non-Thermally Broken (TH1):

.1 101 mm wide x full width of door opening, extruded aluminum.

.2 Finished to 628 (US28) Satin aluminum, clear anodized

.3 Acceptable material:

.1 Crowder #CT-64.

.2 Pemko 270A.

.3 Hagger 8770N

.2 Thermally Broken (TH2):

.1 125 mm wide x full width of door opening, extruded aluminum, thermally broken with non-conducting rigid pvc thermal separator.

.2 Finished to 628 (US28) Satin aluminum, clear anodized

.3 Acceptable material:

.1 Crowder #CT-45.

.2 Pemko 253x3AFG

.12 Weatherstripping:

.1 Head and jamb seal - (WS1)

.1 Extruded aluminum frame and closed cell neoprene insert.

.2 Acceptable material:

.1 Crowder

.2 Pemko

.3 Allegion

.2 Door bottom seal - (WS2)

.1 Extruded aluminum frame and closed cell neoprene insert.

.2 Acceptable material:

.1 Crowder

.2 Pemko

.3 Allegion

.3 Fire Rated Door head and jamb seal - (WS1F)

.1 Extruded aluminum frame and closed cell neoprene insert.

.2 Acceptable material:

.1 Crowder #W13.

.2 Pemko 319CR.

.3 Allegion 139AA

.4 Fire Rated Door bottom seal - (WS2F)

.1 Extruded aluminum frame and closed cell neoprene insert.

.2 Acceptable material:

.1 Crowder # W13S .

.2 Pemko 315CN

.3 Allegion 339AA

.13 Astragal:

.1 Astragal - (AS1)

.2 Adjustable compensating, overlapping, extruded aluminum frame with vinyl pile insert, finished to match doors.

.1 Acceptable material:

.1 Crowder W-8P

.2 Pemko 355CP

.3 Allegion 47AA

.3 Fire Rated Astragal - (AS2)

.4 Extruded aluminum frame with nylon insert, finished to match doors

.1 Acceptable material:

.1 Crowder: W-25

.14 Removable Mullions:

.1 Fire labelled steel type, with top retainer and bottom retainer and stabilizer by same manufacturer as exit device.

.15 Electric Door Strikes

.1 Provide electric door strikes for all doors scheduled for security systems in door schedule and coordinate with Division 16 to provide all power and control components for a complete operational system.

.2 The electric strikes shall be CSA or ULC listed, having a holding strength of greater than 2,000 lbs. Latch bolts, switches and strike locked switches shall be monitored. Coordinate exact unit with door and frame style and configuration as required.

.3 Provide the electric strike power supplies, consisting of a CSA or ULC listed transformer with 120/347VAC input and regulated and filtered 24VDC output. The power supply shall have individual zoned outputs to each lock or set of locks. The power supply shall be complete with manual reset capability and low voltage ground fault circuitry. The power supply shall be rated to deliver 150% of the actual connected load.

.4 The new door strike make and model shall match existing. Prior to ordering, the Contractor is responsible for verification of the existing door strike make and model and determining the quantity of door strikes based on architectural drawing set.

.5 The new door strikes will replace existing and be connected to the same source as existing door strikes. Contractor shall coordinate with Division 16 to re-use existing wires and conduits for old strikes and re-connecting new strikes to existing wires and conduits.

.16 Pneumatic Door Operator:

.1 Barrier Free Pneumatic Door Operator: to CSA B651-12.

.2 Power-operated pedestrian doors: to ANSI/BHMA A156.10.

.3 Power assist and low energy power operated doors: to ANSI/BHMA A156.19.

.4 Heavy duty pneumatically assisted door closer, capable of multi-door operation, complete with actuators, control boxes, pneumatic tubing and compressed air source.

.5 Self contained control box/compressor combination for independent operation of two door leaves.

.6 Control boxes: complete with electric strike relay.

.7 Mount operators on either push or pull sides of doors as required to place them inside rooms.

.8 Actuation of operators by card readers.

.9 Electrical box and actuator: Hardwired low voltage actuator with stainless steel 114 mm round plate, engraved blue filled with handicap symbol. Box 51 mm wide x 102 mm high x 50 mm deep single gang electrical box, flush mounted in wall, locations indicated.

.10 Supply switched line voltage to control box. Locate switch adjacent to box.

.11 Supply low voltage wiring to each actuator and 6 mm diameter air tubing to each operator.

.12 Mount control box in location as directed by Consultant.

.1 Swing doors - (DPO1)

.1	LCN	Model 4622 – 689
.2	Horton Operators	Series 7100
.3	ASSA ABLOY Entrance Systems	SW200i

.17 Electric Door Operator:

.1 Barrier Free Door Operator: to CSA B651-12.

.2 Power-operated pedestrian doors: to ANSI/BHMA A156.10.

.3 Power assist and low energy power operated doors: to ANSI/BHMA A156.19.

.4 Heavy duty electric door closer.

.5 Mount operator on interior side of door.

.6 Actuation of operators by push button with handicap symbol on black face with red button (Horton C521-2 Series or approved equal).

.7 Supply 120VAC line voltage to door operator from LP-MCC3, CCT #36 as shown on the contract documents.

.8 Supply low voltage wiring to each push button station in ½" conduit.

.9 Mount control box in location as directed by consultant.

.1 Swing doors - (DPO1)

.1	Horton Operators	Series 7100
.2	ASSA ABLOY Entrance Systems	SW200i
.3	Approved equal	

2.4 MISCELLANEOUS HARDWARE

.1 Miscellaneous Trim Hardware shall be as manufactured in Canada, wherever possible, in 630 stainless steel #316.

.2 Indexed key control system: to ANSI/BHMA A156.5, wall mounted, type as directed by Consultant colour enamel paint finish.

2.5 FASTENINGS

.1 Use only fasteners provided by manufacturer. Failure to comply may void warranties and applicable licensed labels.

.2 Supply screws, bolts, expansion shields and other fastening devices required for satisfactory installation and operation of hardware.

.3 Exposed fastening devices to match finish of hardware.

.4 Where pull is scheduled on one side of door and push plate on other side, supply fastening devices and install so pull can be secured through door from reserve side. Install push plate to cover fasteners.

.5 Use fasteners compatible with material through which they pass.

2.6 KEYING

.1 Lay out the keying system for the building in consultation with the Engineer and Client. Keying system shall include keying alike in groups, locks as required.

.2 Keying chart and related explanatory data shall be prepared and submitted to the Engineer for approval, and lock work shall not be commenced until written confirmation of keying arrangements is received from the Engineer.

.3 Provide keys in duplicate for every lock in this contract.

.4 Supply 3 master keys for each master key or grand master key group.

.5 Stamp keying code numbers on keys and cylinders.

.6 Supply construction cores.

.7 Hand over permanent cores and keys to Region.

PART 3 EXECUTION

3.1 INSTALLATION INSTRUCTIONS

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

.2 Supply metal door and frame manufacturers with complete instructions and templates for preparation of their work to receive hardware.

.3 Supply manufacturer’s instructions for proper installation of each hardware component.

.4 Install hardware to standard hardware location dimensions in accordance with CSDFMA Canadian Metric Guide for Steel Doors and Frames (Modular Construction).

.5 Where door stop contacts door pulls, mount stop to strike bottom of pull.

.6 Install key control cabinet.

.7 Use only manufacturer's supplied fasteners.

.1 Use of "quick" type fasteners, unless specifically supplied by manufacturer, is unacceptable.

.8 Remove construction locks when directed by the Engineer.

.1 Install permanent cores and ensure locks operate correctly.

3.2 ADJUSTING

.1 Adjust door hardware, operators, closures and controls for optimum, smooth operating condition, safety and for weather tight closure.

.2 Lubricate hardware, operating equipment and other moving parts.

.3 Adjust door hardware to ensure tight fit at contact points with frames.

3.3 CLEANING

.1 Progress Cleaning:

.1 Leave Work area clean at end of each day.

.2 Clean hardware with damp rag and approved non-abrasive cleaner, and polish hardware in accordance with manufacturer's instructions.

.3 Remove protective material from hardware items where present.

.4 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01740 Cleaning.

.5 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01740 Cleaning.

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

3.4 DEMONSTRATION

.1 Keying System Setup and Cabinet:

.1 Set up key control system with file key tags, duplicate key tags, numerical index, alphabetical index and key change index, label shields, control book and key receipt cards.

.2 Place file keys and duplicate keys in key cabinet on their respective hooks.

.3 Lock key cabinet and turn over key to Engineer.

.2 Maintenance Staff Briefing:

.1 Brief maintenance staff regarding:

.1 Proper care, cleaning, and general maintenance of projects complete hardware.

.2 Description, use, handling, and storage of keys.

.3 Use, application and storage of wrenches for door closers, locksets and fire exit hardware.

.2 Demonstrate operation, operating components, adjustment features, and lubrication requirements.

.3 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by door hardware installation.

END OF SECTION

DIVISION 09 INDEX

METAL STUD SYSTEM

1. GENERAL

1.1 Intent of Section

1.1.1 This Section describes the Work required for metal stud systems.

1.2 Related Work

1.2.1 Conform to Division 1 - General Requirements.

1.2.2 Section 07213 – Batt and Blanket Insulation

1.2.3 Section 09250 – Gypsum Board

1.2.4 Section 09252 – Exterior Sheathing

1.3 Reference Standards

1.3.1 All products shall conform to the following standards and regulations:

.1 ASTM International Inc:

.1 ASTM A653/A653-15e1 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy- Coated (Galvannealed) by the Hot-Dip Process

.2 Canadian General Standards Board (CGSB):

.1 CGSB 19-GP-.22-M89 - Mildew Resistant Sealing Compound for Tubs and Tile

.3 Canadian Standards Association (CSA):

.1 CAN/CSA – S136-12 PACKAGE - North American Specifications for the Design of Cold Formed Steel Structural Members (using the Appendix B provisions applicable to Canada)

2. PRODUCTS

2.1 Materials

2.1.1 Steel strength: to ASTM A653/A653M, Grade A.

2.1.2 Galvanizing: to G 90 (Z275).

2.1.3 Structural properties: to CSA Standard CAN/CSA – S136 – M89 cold formed steel structural members (limit states design).

2.1.4 Non-load bearing channel stud framing: 150mm stud size, as noted, roll formed from 1.22mm thickness hot-dipped galvanized steel sheet, for screw attachment of gypsum board. Knock-out service holes at 460mm centres. Use double studs at jambs.

2.1.5 Top and bottom tracks: to ASTM C645-83, in widths to suit stud sizes, 32mm flange height.

2.1.6 Metal channel stiffener: 19mm x 38mm size, 1.4mm thick cold rolled steel, coated with rust inhibitive coating.

2.1.7 Acoustical sealant: to CGSB 19-GP-21M.

3. EXECUTION

3.1 Erection

3.1.1 Align tracks at top and bottom and secure as noted on the design drawings.

3.1.2 Place studs at 400mm on centre, not more than 50mm from abutting walls and at each side of openings and corners. Position studs in tracks at top and bottom. Brace steel studs as required to provide rigid installation to manufacturer's instructions.

3.1.3 Erect metal studding to tolerance of 1:1000.

3.1.4 Attach studs to bottom track using screws.

3.1.5 Coordinate simultaneous erection of studs with installation of service lines. When erecting studs ensure web openings are aligned.

3.1.6 Provide two (2) studs extending from lower to upper structural member at each side of openings wider then stud centres specified. Secure studs together, 50mm apart, using column clips or other approved means of fastening placed alongside frame anchor slips.

3.1.7 Erect track at head of openings and sills of openings to accommodate intermediate studs. Secure track to studs at each end, in accordance with manufacturer's instructions. Install intermediate studs above and below openings in same manner and spacing as wall studs.

3.1.8 Frame openings and around built-in equipment on four (4) sides.

3.1.9 Install steel studs or furring channel between studs for attached electrical boxes, mechanical equipment and handrails.

3.1.10 Install two (2) continuous beads of acoustical sealant and insulating strip between studs and tracks and adjacent materials around perimeter of wall sections.

END OF SECTION

GYPSUM BOARD

1. GENERAL

1.1 Intent of Section

1.1.1 This Section describes materials and procedures for gypsum board products installed including all accessories materials to complete finished drywall systems.

1.2 Related Sections

1.2.1 Conform to sections of Division 1 – General Requirements as applicable.

1.2.2 Section 06101 – Rough Carpentry

1.2.3 Section 07900 – Joint Sealants

1.2.4 Section 09111 – Metal Stud Systems

1.3 References Standards

1.3.1 Canadian General Standards Board (CGSB):

.1 CAN/CGSB-51.34-M86 (amended 1988) - Vapour Barrier, Polyethylene Sheet for Use in Building Construction

1.3.2 Underwriters Laboratories of Canada (ULC):

.1 CAN/ULC-S102-10 - Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies

.2 CAN/ULC-S102.2-10 - Standard Method of Test for Surface Burning Characteristics of Flooring, Floor Coverings, and Miscellaneous Materials and Assemblies

1.3.3 American Society for Testing and Materials (ASTM):

.1 ASTM C11-04 Standard Terminology Relating to Gypsum and Related building Materials and Systems

.2 ASTM C36/C36M-03 Standard Specification for Gypsum Wallboard

.3 ASTM C79/C79M-04 Standard Specification for Treated Core and Non-Treated Core Gypsum Sheathing Board

.4 ASTM C442/C442M-04 Standard Specification for Gypsum Backing Board, Gypsum Core board and Gypsum Shaft Liner Board.

.5 ASTM C475/C475M-15 - Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board

.6 ASTM C630/C630M-03 Standard Specification for Water-resistant Gypsum Backing Board

.7 ASTM C645-04a Specification for Non-structural Steel Framing Members

.8 ASTM A653/A653M-13 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

.9 ASTM C754-04 Standard Specification for installation of Steel Framing Members to receive Screw Attached Gypsum Panel Board

.10 ASTM C840M-13 - Standard Specification and Finishing of Gypsum Board

.11 ASTM C842-05(2010)e1 – Standard Specification for Application of Interior Gypsum Plaster

.12 ASTM C919-02 Standard Practice for Use of Sealants in Acoustical Application

.13 ASTM C931/C931M-04 Standard Specification for Exterior Gypsum Soffit Board

.14 ASTM C954-15 - Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs from 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness

.15 ASTM C955-15 - Standard Specification for Load-Bearing (Transverse and Axial) Steel Studs, Runners (Tracks), and Bracing or Bridging for Screw Application of Gypsum Panel Products and Metal Plaster Bases

.16 ASTM C960/C960M-01 Standard Specification for Predecorated Gypsum Board.

.17 ASTM C1002-04 Standard Specification for Steel Self-Piercing, Tapping screws for The Application of Gypsum Panel Products or Metal Plaster Base to Wood Studs or Steel Studs

.18 ASTM C1047-14a - Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base

.19 ASTM C1063-14d – Standard Specification for Installation of Lathing and Furring to Receive Interior and Exterior Portland Cement Based Plaster

.20 ASTM C1177/C1177M-04e1 Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing.

.21 ASTM C1178/C1178M-04e1 Standard Specification for Glass Mat Water-resistant Gypsum Backing Panel

.22 ASTM C1280-13a - Standard Specification for Application of Exterior Gypsum Panel Products for Use as Sheathing

.23 ASTM C1396/C1396M-14a - Standard Specification for Gypsum Board

.24 ASTM D 3273-00Standard Tests Method for The Resistance to Growth of Mould on the Surface of Interior Coatings in The Environment Chamber

.25 ASTM E84-05 Standard Test Method for Surface Burning Characteristics of Building Materials.

.26 ASTM E90-04 Standard Tests Methods for Laboratory Measurement of Airborne Sound Transmission Loss of Buildings, Partitions and Elements.

.27 ASTM E413 –04 Classification for Rating Sound Insulation

.28 CAN/CGSB-51.33-M89 Vapour Barrier Sheet, Excluding Polyethylene, for Use in Building Construction.

.29 CAN/ULC-S101-M89 Standard Methods of Fire Endurance Tests of Building Construction and Materials

.30 CAN/ULC-S102-M88 Surface Burning Characteristics of Building Materials and Assemblies

.31 CAN/ULC-S702-97 Thermal Insulation, Mineral Fibre, for Buildings

.32 ULC Underwriters' Laboratories of Canada

1.4 Submittals

1.4.1 Complete submittals in accordance with Section 01330 - Submittals.

1.4.2 Indicate design, construction and relevant details of furring, enclosures and partitions, which require fire rating.

1.4.3 Certification: Submit certification from Structural Engineer certified to practice in the Province of Ontario, who shall affix his/her seal and signature to certificate, stating that installed suspended ceiling system is capable of supporting its own weight and weight of lighting, grilles and other mechanical and electrical fixtures required by Mechanical and Electrical Divisions.

1.4.4 Approval: Obtain approval of electrical utility authorities having jurisdiction for support of light fixtures, by ceiling grid and supports, to satisfy inspection requirements of the Electrical Safety Authority. Adjust grid, fixing devices and support hangers as required to obtain approval.

1.5 Delivery, Storage and Handling

1.5.1 Deliver materials to Site with manufacturers original labels intact. Do not remove wrappings until ready for use.

1.5.2 No outside storage permitted. Store in clean, dry area, off ground.

1.5.3 Stack gypsum board flat on level and dry surface without overhanging boards. Prevent sagging and damage to edges, ends and surfaces. Protect bagged products from excessive moisture or wetting.

1.6 Environmental and Site Conditions

1.6.1 Maintain temperature minimum 10ºC, maximum 21ºC for 48 hours prior to and during application of gypsum boards and joint treatment and for at least 48 hours after completion of joint treatment.

1.6.2 Apply board and joint treatment to dry, frost-free surfaces.

2. PRODUCTS

2.1 Materials

2.1.1 Standard board: to ASTM C1396/C1396M regular 16mm thick and Type X, 16mm thick, 1200mm wide x maximum practical length, ends square cut, edges rounded.

2.1.2 Metal furring runners, hangers, tie wires, inserts, anchors: to ASTM C1063 and ASTM C842, galvanized.

2.1.3 Steel drill screws: to ASTM C954

2.1.4 Casing beads, corner beads, control joints and edge trim: to ASTM C1047, 0.5mm base thickness, perforated flanges, one piece length per location.

2.1.5 Sealants: to Section 07900 – Joint Sealants.

2.1.6 Polyethylene: to CAN/CGSB-51.34, Type 2.

2.1.7 Joint compound: to ASTM C475M, asbestos-free.

2.2 Finishes

2.2.1 Texture finish: asbestos-free standard white texture coating and primer-sealer, recommended by gypsum board manufacturer.

3. EXECUTION

3.1 Erection

3.1.1 Application and finishing of gypsum board shall be in accordance with ASTM C840M, except where specified otherwise.

3.1.2 Application of gypsum sheathing shall be in accordance with ASTM C1280.

3.1.3 Install work level to tolerance of 1:1200.

3.1.4 Frame with furring channels, perimeter of openings for access panels, light fixtures mechanical penetrations and electrical penetrations.

3.2 Application

3.2.1 Do not apply gypsum board until bucks, anchors, blocking, electrical and mechanical work is approved.

3.2.2 Apply single layer gypsum board to wood furring or framing using screw fasteners. Maximum spacing of screws 300mm on centre.

3.2.3 Apply 12mm diameter bead of acoustic sealant continuously around periphery of the ceiling to seal gypsum board/structure junction where ceiling abuts fixed building components. Seal full perimeter of cut-outs around electrical boxes, ducts and electrical cables.

3.3 Installation

3.3.1 Erect accessories straight, plumb or level, rigid and at proper plane. Use full length pieces where practical. Make joints tight, accurately aligned and rigidly secured. Mitre and fit corners accurately, free from rough edges. Secure at 150mm on centre or using contact adhesive for full length.

3.3.2 Install casing beads around perimeter of ceiling.

3.3.3 Install casing beads where gypsum board butts against surfaces having no trim concealing junction. Seal joints with sealant.

3.3.4 Install access doors to electrical and mechanical fixtures specified in respective sections:

.1 Rigidly secure frames to furring or framing systems.

3.3.5 Finish face panel joints and internal angles with joint system consisting of joint compound, joint tape and taping compound installed according to manufacturer’s directions and feathered out onto panel faces.

3.3.6 Finish corner beads, control joints and trim as required with two (2) coats of joint compound and one (1) coat of taping compound, feathered out onto panel faces.

3.3.7 Fill screw head depressions with joint and taping compounds to bring flush with adjacent surface of gypsum board, so as to be invisible after surface finish is completed.

3.3.8 Sand lightly to remove burred edges and other imperfections. Avoid sanding adjacent surface of board.

3.3.9 Completed installation to be smooth, level or plumb, free from waves and other defects and ready for surface finish.

3.3.10 Apply one (1) coat of white primer sealer over surface to be textured. When dry, apply textured finish in accordance with manufacturer's instructions.

3.3.11 Mix joint compound slightly thinner than for joint taping.

3.3.12 Remove ridges by light sanding or wiping with damp cloth.

3.4 Cleaning

3.4.1 Clean in accordance with Section 01740 - Cleaning:

.1 Leave work area clean at end of each day.

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

END OF SECTION

ACOUSTIC PANEL CEILINGS

1 GENERAL

1.1 Intent of Section

1.1.1 Design, labour, Products, equipment and services necessary for acoustical ceilings Work in accordance with the Contract Documents.

1.2 Related Specification Sections

1.2.1 In addition to the general project requirements in Division 1, the following sections are referenced in this section:

.1 Section 01 33 00 Submittals.

.2 Section 01 45 00 Quality Control.

.3 Divisions 15 and 16 Mechanical & Electrical

1.3 Code and Regulatory Requirements

1.3.1 All products shall conform to the following standards and regulations:

.1 ASTM International Inc.

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

.2 ASTM C423, Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.

.3 ASTM C635, Specification for the Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings.

.4 ASTM C636, Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels.

.5 ASTM C645, Specification for Non-Load Bearing (Axial) Steel Studs, Runners (Tracks), and Rigid Furring Channels for Screw Application of Gypsum Board.

.2 Canadian General Standards Board (CGSB):

.1 CAN/CGSB-92.1-M, Sound Absorptive Prefabricated Acoustical Units.

1.4 Submittals

1.4.1 Submit in accordance with Section 01 33 00.

1.4.2 Product Data, and Shop Drawings Package:

.1 Product Data:

.1 Submit manufacturer's Product data for all Products listed in this Section indicating:

.1 Suspension system and acoustic tiles.

.2 Shop Drawings:

.1 Submit Shop Drawings in accordance with Section 01 33 00, indicating:

.1 Suspension system layout including hangers.

.2 Conditions at abutting, intersecting, and penetrating construction.

.3 Dimensioned locations of lighting fixtures, diffusers, sprinkler heads and other items piercing ceiling plane.

.3 Alternatives

.1 Submit evidence that alternative materials meet or exceed performance characteristics of product requirements, as well as documentation for an approved independent testing laboratory.

.2 Submit requests for alternatives to this specification a minimum of 14 working days before issued for construction closing for evaluation. Include a list of 25 projects executed over the past 15 years.

.3 Acceptable alternatives will be confirmed by addendum. Substitute materials not approved in writing prior to tender closing shall not be permitted for use on this project

1.4.3 Quality Assurance Submittals:

.1 Submit test results for suspension anchor inserts; include data on design loading per anchor and tensile strength of hangers.

1.5 Delivery Storage and Handling

1.5.1 Refer to Specification Section 01 61 00 – Common Product Requirements

1.5.2 Deliver materials to the job site in undamaged and original packaging indicating the name of the manufacturer and product.

2 PRODUCTS

2.1 Design requirements

2.1.1 Design acoustical ceiling suspension system in accordance with ASTM C636 and manufacturer's printed directions.

2.1.2 Design suspended ceiling system for adequate support of electrical fixtures as required by current bulletin of Electrical Inspection Department of Ontario Hydro.

.1 Design hanger anchor and entire suspension system static loading not to exceed 25% of their ultimate capacity including lighting fixture dead loads.

.2 Design suspension system to support weight of mechanical and electrical items such as air handling boots and lighting fixtures, and with adequate support to allow rotation / relocation of light fixtures.

2.1.3 Design ceiling system to withstand positive and negative wind loads, uplift of piston effect of up to 1.25 kPa, and train wind load of 44 m/s.

2.1.4 Design subframing as necessary to accommodate, to avoid conflicts and interferences where ducts or other equipment prevent regular spacing of hangers.

2.2 Approved Manufacturers

.1 Bailey Metal Products Limited, 1 Caldari Road, Concord, Ontario, Canada, L4K 3Z9, Phone: 800-668-2154, e-mail: info@bmp-group.com, URL: www.bmp-group.com.

.2 CGC Inc, 350 Burnhamthorpe Rd W, Mississauga, Ontario, Canada, L5B 3J1, Phone: (905) 803-5600, e-mail: webmaster@cgcinc.com, URL: www.usg.com.

.3 Armstrong World Industries Canada Ltd., P.O. Box 3001 Lancaster, PA USA, 17603, Phone: 877-276-7876, URL: www.armstrongworldindustries.com.

2.3 Materials

2.3.1 Suspension system: ASTM C635.

.1 B-E Safe-T-Lock by Bailey Metal Products Limited.

.2 Donn DX Fast-Loc by CGC Inc.

.3 Prelude by Armstrong World Industries Canada Ltd.

2.3.2 Suspension system for high humidity areas: ASTM C635.

.1 Baily Lanc-Lock 700 by Bailey Metal Products Limited.

.2 Donn ZXA Fast-Loc by CGC Inc.

.3 Prelude Plus by Armstrong World Industries Canada Ltd.

2.3.3 Galvanized steel sheet: ASTM A653/A653M, G90; cold rolled, galvanized steel sheet.

2.3.4 Main carrying channels: ASTM C645; Channels formed from galvanized steel sheet, 38 x 19 mm cold rolled.

2.3.5 Subframing: ASTM C645; Channels formed from galvanized steel sheet, dimensions and spans as required.

2.3.6 Hangers: 2.6 mm minimum diameter, galvanized steel wire.

2.3.7 Tie wire: 1.6 mm minimum diameter, soft annealed galvanized steel wire.

2.3.8 Wall mouldings and accessories: Including but not limited to, corner caps, edge mouldings, panel hold over clip, metal closures, and trim. Finish and colour: same as main tees.

2.3.9 Exposed main, cross tees, and relocatable cross tees: 25 mm exposed face x 38 mm high steel, bulb tee design double steel web, rectangular single spans without exceeding deflection of 1/360 of span. Splices integral and reversible; cross tee interlocking into main tee.

.1 Colour and finish: Baycoat 5000 Series baked on enamel finish, special white.

2.3.10 Acoustic tile (ACT1): CAN/CGSB-92.1-M.

.1 Georgian Minaboard by Armstrong World Industries Canada Ltd.; Donn by CGC Interiors Div of CGC Inc.

.2 Pattern: random fissured

.3 Flame spread rating: 25 or less.

.4 Smoke developed: 15 or less.

.5 Noise reduction coefficient (NRC) designation (ASTM C423): 0.50 - 0.60.

.6 Edge type: Square

.7 Colour: white

.8 Size:

.1 610 x 1220 x 16 mm thick.

.2 610 x 610 x 16 mm thick.

2.3.11 Acoustic tile (ACT2) at high humidity areas (Washrooms, Locker Room and other areas shown): CAN/CGSB-92.1-M.

.1 Dune Humiguard by Armstrong World Industries Canada Ltd.; Donn Radar ClimaPlus by CGC Interiors Div of CGC Inc.

.2 Pattern: random fissured

.3 Flame spread rating: 25 or less.

.4 Smoke developed: 15 or less.

.5 Noise reduction coefficient (NRC) designation (ASTM C423): 0.50 - 0.60.

.6 Edge type: Square

.7 Colour: white

.8 Size: 610 x 1220 x 16 mm thick.

2.3.12 Eggcrate grille: Luma Cell Type 60 by American Louvre Ltd.

2.3.13 Wall mouldings: Match acoustical ceiling suspension system.

3 EXECUTION

3.1 Site conditions

3.1.1 Do not install the Work of this Section until:

.1 Wet Work including concrete, masonry, plaster, stucco, and terrazzo finishes complete.

.2 Mechanical and electrical Work above ceiling complete.

.3 Relative humidity below 80%.

.4 Ventilation adequate to remove excess moisture.

3.1.2 Install temporary protection and facilities to maintain Product manufacturer's, and above specification, environmental requirements 24 hr before, during, and after installation.

3.2 Suspension system

3.2.1 Coordinate locations and openings of mechanical and electrical services support, and penetration through acoustical ceilings. Coordinate field conditions, clearances, measurements, and mechanical and electrical services testing and commissioning, above acoustical ceilings.

3.2.2 Install hanger wires plumb and securely anchored to building structural framing, independent of walls, pipes, ducts, and metal deck; install additional framing and hangers to bridge interference items.

3.2.3 Install acoustical ceiling systems in accordance with manufacturer's written instructions, reviewed Shop Drawings, and ASTM C636, listed in order of precedence.

3.2.4 Install hanger wires at 1200 mm maximum centres along carrying channels, not less than 25 mm, and not more than 150 mm from channel ends.

3.2.5 Install additional hangers at lighting fixture and air distribution ductwork locations. Do not attach hanger wires to mechanical or electrical equipment. Do not support mechanical and electrical fixtures and fitting on ceiling without ceiling manufacturer's written acceptance.

3.2.6 Install acoustical ceiling suspension system to tolerance of 1:1200 of span and 0.4 mm maximum between adjacent metal members. Tolerances not cumulative. Refer to Electrical Contract Drawings for fixture layout.

3.2.7 Do not bend or twist hangers as means of levelling. Form double loops tightly and lock to prevent vertical movement or rotation within loop.

3.2.8 Install edge moulding at intersection of ceiling and vertical surfaces.

3.2.9 Centre acoustical ceiling suspension systems on room axis; install equal border pieces. Install hangers onto ends of main tee runners at not more than 150 mm from ends of runners, adjacent and perpendicular to walls.

3.2.10 Support suspension system independently of walls, columns, ducts, pipes and conduits.

3.2.11 Install main runners in maximum available lengths. Layout joints in suspension members to avoid perimeters of recessed fixtures. Lock grid members to form rigid assembly. Install additional tee, suspension system framing around recessed fixtures, diffusers, grilles and other items for complete assembly.

3.3 Acoustic tiles

3.3.1 Carefully cut and trim acoustic tiles to accommodate Work of Divisions 20, 21, 23, 25, 26, 27, & 28

3.3.2 Fit acoustic tiles carefully into place. Remove and replace acoustic tiles with broken edges, or damaged, marked, discoloured, soiled, or stained faces.

3.4 Eggcrate grilles

3.4.1 Install moulding continuous around perimeter and level.

3.4.2 Install eggcrate grilles with inconspicuous butt and mitred corner joints and seat evenly.

3.5 Field quality control

3.5.1 Arrange, pay for, and execute Site load tests at location selected by Engineer, on anchor inserts by independent, certified testing company. Perform ten (10) random anchor tests at commencement of Work. Pay for additional tests, required if pull out strength not acceptable as requested by Engineer.

3.6 Cleaning

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

.1 Leave work area clean at end of each day.

END OF SECTION

EPOXY COATING

PART 1 GENERAL

1.1 INTENT

.1 Provide labour, materials, tools and equipment required to install complete resinous flooring system specified in this Section including surface preparation.

1.2 RELATED SPECIFICATION SECTIONS

.1 In addition to the general project requirements in Division 1, the following sections are referenced in this section:

.1 Section 03 10 20 Surface Preparation and Repairs.

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

.3 Section 03 90 50 Concrete Repairs

1.3 CODE AND REGULATORY REQUIREMENTS

.1 All products shall conform to the following standards and regulations:

.1 American Society for Testing and Materials (ASTM)

.1 ASTM C307-18 Standard Test Method for Tensile Strength of Chemical-Resistant Mortar, Grouts, and Monolithic Surfacing's.

.2 ASTM C413-18, Standard Test Method for Absorption of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes.

.3 ASTM C579-18, Standard Test Methods for Compressive Strength of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing, and Polymer Concretes.

.4 ASTM C580-18, Standard Test Method for Flexural Strength and Modulus of Elasticity of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing's, and Polymer Concretes.

.5 ASTM C884/C884M-16 Standard Test Method for Thermal Compatibility Between Concrete and an Epoxy-Resin Overlay.

.6 ASTM D635-18, Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position.

.7 ASTM D638-14, Standard Test Method for Tensile Properties of Plastics.

.8 ASTM D695-15 Standard Test Method for Compressive Properties of Rigid Plastics.

.9 ASTM D696-16 Standard Test Method for Coefficient of Linear Thermal Expansion of Plastics Between −30°C and 30°C with a Vitreous Silica Dilatometer.

.10 ASTM D2240-15e1, Standard Test Method for Rubber Property-Durometer Hardness.

.11 ASTM D2369-10, Standard Test Method for Volatile Content of Coatings.

.12 ASTM D2794-93(2019) Standard Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact).

.13 ASTM D3273-16 Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber.

.14 ASTM D4060-19, Standard Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser.

.15 ASTM D4541-17, Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers.

.16 ASTM F2170-19a Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes.

.17 ASTM F2659-10 (2015), Standard Guide for Preliminary Evaluation of Comparative Moisture Condition of Concrete, Gypsum Cement and Other Floor Slabs and Screeds Using a Non-Destructive Electronic Moisture Meter.

.18 ASTM G21-15, Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.

.2 Canadian Standards Association (CSA)

.1 CSA A23.1-19/A23.2-19 Concrete Materials and Methods of Concrete Construction / Test Methods and Standard Practices for Concrete.

.3 International Concrete Repair Institute (IRCI)

.1 ICRI Guideline No. 310.2R-2013, Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings and Polymer Overlays.

.4 United States Department Defence

.1 MIL-PRF-24613A (SH) 11-2007, Performance Specification: Deck Covering Materials, Interior, Cosmetic Polymeric

1.4 DEFINITIONS AND ABBREVIATIONS

.1 w.f.t.: Wet film thickness.

1.5 QUALITY ASSURANCE

.1 In addition to the requirements of 01 45 00 – Quality Control, the following measures are required:

.1 Perform work in accordance with the printed requirements of the resinous flooring manufacturer and this specification. Advise Engineer of any discrepancies prior to commencement of the work.

.2 Maintain one (1) copy of the specification and manufacturer’s literature on site throughout the execution of the work.

.3 At the beginning of the work and, at all times during the execution of the work, allow access to the site by the resinous flooring manufacturer's representative.

.2 Single Source Responsibility: Obtain primary protective resins including primers, resins, hardening agents, finish or sealing coats from a single manufacturer with not less than 10 years of successful experience in manufacturing the principle materials described in this section. Provide secondary materials only of type and from source recommended by manufacturer of primary materials.

.3 Manufacturer Qualifications:

.1 No request for substitution shall be considered that would change the generic type of system specified. Equivalent materials of other manufacturers may be substituted only on approval of the Engineer. Requests for substitution will be considered only if submitted 10 days prior to bid date. Requests shall include the respective manufacturer's technical literature for each product giving the name, generic type, descriptive information, recommended dry film thickness (DFT), Material Safety Data Sheet (MSDS), and certified test reports showing results to equal performance criteria of products specified herein.

.4 Applicator Qualifications:

.1 Pre-Qualification: Each bidder for this project shall be pre-qualified and approved in writing by the material manufacturer.

.2 Applicators: Use experienced applicators having a record of successful in-service resinous flooring system applications similar in material and extent to those specified in this Section and as follows:

.1 Applicators must have completed flooring manufacturer's training program for Products specified.

.2 Applicators must be licensed, certified or approved in writing by the flooring manufacturer for the Products specified.

.3 Applicator Experience: Minimum 5 years' experience in the application of the type of system specified. Applicator shall submit a list of five (5) projects of similar size, scope and complexity.

.5 Mock-Up:

.1 Construct one 10 sq.m. (100 sq.ft.) mock-up of each type and colour of resinous flooring in location acceptable to Consultant to demonstrate quality of finished system, complying with manufacturer's installation instructions and requirements of this Section in accordance with Section 01450 Quality Control.

.2 Arrange for Consultant's review and acceptance, obtain written acceptance before proceeding with Work.

.3 Upon acceptance, mock-up shall serve as a minimum standard of quality for the balance of the Work of this Section. Mock-up shall be left in place for the duration of the Work.

.4 During job mock-up and initial period of installation, manufacturer of coating system will provide a trained employee to insure proper use and installation of product. Periodic site visits will also be made during installation to verify continued proper installation.

.6 Pre-installation meetings: comply with Section 01 12 00 - Coordination and Sequence of Construction. Conduct pre-installation meeting two weeks prior to commencing work of this Section and on-site installations to:

.1 Notify attendees 3 weeks prior to meeting and ensure meeting attendees include as minimum:

.1 Owner;

.2 Engineer;

.3 Applicator

.4 All Affected Subcontractors;

.5 Manufacturer’s Technical Representative.

.2 Coordinate with related specification listed in section 1.3 - Related Specification Sections

.3 Verify project requirements, including mock-up requirements.

.4 Verify substrate conditions, preparation and priming.

.5 Co-ordinate products, installation methods and techniques.

.6 Sequence work of related sections.

.7 Co-ordinate with other building sub-trades to ensure proper installation and site preparation.

.8 Review manufacturer's installation instructions, including application, curing and protection procedures.

.9 Review warranty requirements.

1.6 SUBMITTALS

.1 Make Submittals in accordance with Section 01 33 00 Submittals.

.2 Product Data:

.1 Submit product data for each type of product specified including manufacturer’s technical product data, installation instructions, colors available and recommendations for each type of resinous flooring product required for the following items;

.2 MSDS: Submit Manufacturer’s Safety Data Sheet for each Product being used.

.3 Product Samples:

.1 Upon Engineers request, submit manufacturer's colour charts showing the full range of colours available for each type of finish coat material indicated for Consultant’s initial selection.

.4 Applicator Certificate:

.1 Submit certificate issued to system applicator or written letter indicating applicator is recognized and approved to install specified system by coating material manufacturer.

.5 Samples for Verification:

.1 Submit samples of each colour and material being applied, with texture to simulate actual conditions, on representative samples of the actual substrate and as follows for Consultant's verification:

.2 Use representative colours when preparing samples for review; resubmit until required sheen, colour, and texture are achieved.

.3 List of material and application for each coat of each sample; label each sample for location and application.

.4 Submit samples on the following substrates for Consultant's review of colour and texture:

.1 Hardboard: Provide 300 mm x 300 mm square samples for each colour and finish.

.5 Obtain written acceptance of Samples in writing from the Consultant before commencing Work of this Section. Accepted Samples shall be the final standard of acceptance of the finish.

.6 Warranty:

.1 Submit an unexecuted, unsigned warranty for review, clearly stating that the traffic coating name, the terms of the specified warranty and duration, prior to any installation.

1.7 CLOSEOUT SUBMITTALS

.1 Make Closeout Submittals in accordance with Section 01 78 00 Closeout Submittals.

.2 Operations and Maintenance Data: Submit manufacturer's printed maintenance instructions for repair, cleaning and maintenance procedures; include name of original installer and contact information.

1.8 DELIVERY, STORAGE AND HANDLING

.1 Refer to Specification Section 01 61 00 - General Equip. Stipulations.

.2 Delivery:

.1 Applicator will check material for completeness and shipping damage prior to job start.

.2 All materials must be factory pre-weighed and pre-packaged in single, easy to manage batches to eliminate on-site mixing errors. No on-site weighing or volumetric measurements allowed.

.3 Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying product name, manufacturer, batch or lot number and date of manufacture.

.3 Storage:

.1 Store materials in accordance with manufacturer's written instructions.

.2 Keep containers sealed until ready for use. Material should be stored in a dry, enclosed, protected area from the elements.

.3 Do not subject material to excessive heat or freezing.

.4 Shelf life: Established based on manufacturer's written recommendation for each material being used.

.4 Handling:

.1 Protect materials during handling and application to prevent damage or contamination.

.2 Condition materials for use accordingly to manufacturer's written instructions prior to application.

.3 Record material lot numbers and quantities delivered to jobsite/storage.

1.9 ENVIRONMENTAL AND SITE CONDITIONS

.1 Do not install the Work of this Section outside of the following environmental ranges without Manufacturers' written acceptance:

.1 Material Temperature: Precondition material for at least 24 hours between 18°C and 30°C (65°F and 86°F).

.2 Ambient and Substrate Temperature: Minimum/Maximum 10˚/30˚C (50˚/86˚F).

.3 Substrate temperature must be at least 3˚C (5˚F) above measured Dew Point.

.4 Mixing and Application attempted at Material, Ambient and/or Substrate Temperature conditions less than 18˚C (65˚F) will result in a decrease in Product workability and slower cure rates.

.5 Relative Ambient Humidity: maximum ambient humidity 85% (during application and curing).

.6 Measure and confirm acceptable test results for Ambient Relative Humidity, Ambient and Surface Temperature and Dew Point.

.2 Substrate Moisture:

.1 Moisture content of concrete substrate must be ≤ 4% by mass as measured with a Tramex® CME/CMExpert type concrete moisture meter.

.2 Additionally, internal concrete relative humidity tests may be conducted as per ASTM F2170 and values must be ≤ 85%.

.3 If moisture content of concrete substrate is higher than 4% by mass and / or if relative humidity test results exceed readings of 85% RH, Consultant

will instruct on addition of moisture mitigation systems or moisture tolerant primers.

.3 Supply temporary utilities, including power, water, temporary ventilation and lighting for use by applicator.

.4 Maintain constant ambient room temperature for 48 hours before, during and after installation or until cured. Minimum temperature of 10°C (50°F) and maximum temperature of 30°C (85°F). Do not apply Product while ambient and substrate temperatures are rising.

.5 Erect suitable barriers and post legible signs at points of entry to prevent traffic and trades from entering the work area during application and curing period of the floor.

.6 Ensure adequate ventilation and air flow.

1.10 WARRANTY

.1 Submit Warranty information in accordance with Section 01 77 0 – Closeout Procedures.

.2 Submit Applicator's written warranty, signed and issued in the name of Owner warranting the Work of this Section against defects in materials and workmanship for a period of one (1) year from the date of Substantial Performance of the Work.

.3 Resinous flooring manufacturer must submit a written warranty, signed and issued in the name of the Owner, certifying resinous flooring will remain in place in accordance with General Condition article CG-12.3, except the warranty period shall be 5 years from the date of substantial completion. The warranty must remain a full warranty for the duration of the period specified. The scope of this warranty must not be limited by other system components manufactured or distributed by the resinous flooring manufacturer. No letter amending the manufacturer's standard warranty will be accepted and the warranty certificate must reflect these requirements.

.4 Contractor must submit a written warranty, signed and issued in the name of the Owner, certifying resinous flooring will remain in place for a period of 5 years from the date of substantial completion. This warranty will cover the removal and replacement of defective resinous flooring products, including labour. The warranty must remain a full warranty for the duration of the period specified. The scope of this warranty must not be limited by other system components manufactured or distributed by the resinous flooring manufacturer. No letter amending the manufacturer's standard warranty will be accepted and the warranty certificate must reflect these requirements.

.1 Materials: 5 years.

.1 All resinous flooring system materials are to be supplied by the resinous flooring manufacturer.

PART 2 PRODUCTS

2.1 APPROVED MANUFACTURERS

.1 Sika Canada Inc. 601 Delmar Avenue, Pointe-Claire, Quebec, H9R 4A9 Phone (514) 697-2610, Fax (514) 697-3087 http://www.sika.ca.

.2 Substitutions: Consultant may consider additional manufacturers having similar Products to Basis-of-Design Manufacturer listed above during the construction period, provided they meet the performance and aesthetic requirements established by the named Products. Submit requests for substitution in accordance with Section 01200 Alternatives before starting any Work of this Section:

2.2 MATERIALS

.1 SYSTEM 2 - Self-Leveling/Broadcast Surfacing of 6 mm

.1 Resinous Flooring System: solid colour, high gloss, resin-rich, trowel applied, epoxy floor screed system and as follows:

Physical Property	Minimum Test Results
Compressive Strength:	91 MPa (13,198 psi) at 28 days in accordance with ASTM C579.
Tensile Strength:	6 MPa (870 psi) at 28 days in accordance with ASTM C307
Flexural Strength:	28 MPa (4,061 psi) at 28 days in accordance with ASTM C580.
Thermal Compatibility:	Passes in accordance with ASTM C884.
Indentation:	0.35% in accordance with MIL-PRF-24613.
Impact Resistance:	2.8 joules in accordance with ASTM D2794.
Abrasion Resistance:	0.17g in accordance with ASTM D4060. (CS17/1000cycles/1000g).
Coefficient of Thermal Expansion:	0.39 x 10-4 mm/mm/°C (0.21 x 10-4 in/in/°F) in accordance with ASTM D696.
Water Absorption:	0.3% in accordance with ASTM C413
Pull-off Strength:	> 2 MPa (>290 psi) with substrate failure in accordance with ASTM D4541.
Flammability:	3 mm in accordance with ASTM D635.
Resistance to Fungi Growth:	Rated 1 in accordance with ASTM G21.
Resistance to Mold Growth:	Rated 10 in accordance with ASTM D3273.
VOC Content:	≤ 50 g/L in accordance with ASTM D2369.

.1 System Thickness: minimum 6 mm (1/4 in).

.2 Acceptable products:

.1 Sikafloor® Morritex Trowel Heavy-Duty System as manufactured by Sika Canada Inc.

.2 Components

.1 Primer, Screed Mortar Binder:

.2 Applied Thickness:

.1 Prime Coat: 254 µm (10 mils) w.f.t.

.1 Screed Mortar: 6mm (1/4 in)

Physical Property	Minimum Test Results
Compressive Strength:	41 MPa (5,946 psi) in accordance with ASTM D695.
Tensile Strength:	36 MPa (5,221 psi) in accordance with ASTM D638.
Pull-off Strength:	>1.7 MPa (246 psi) in accordance with ASTM D4541.
Hardness:	83 Shore D in accordance with ASTM D2240.
VOC Content:	≤ 25 g/L in accordance with ASTM D2369.

.2 Acceptable products:

.1 Sikafloor® 156 as manufactured by Sika Canada Inc.

.3 High Strength Trowel Screed Mortar Aggregate: in clear epoxy resin matrix

.1 Acceptable products:

.1 Aggregate PT as manufactured by Sika®

.4 Grout Coat and Top Coat: two component, solid colour, high solids, low odour, low VOC, high gloss epoxy finish:

.1 Applied Thickness:

.1 Grout Coat: w.f.t.

.2 Top Coat: w.f.t.

Physical Property	Minimum Test Results
Compressive Strength:	56 MPa (8,122 psi) in accordance with ASTM D695.
Tensile Strength:	7.4 MPa (1,073 psi) in accordance with ASTM D638.
Pull-off Strength:	>2 MPa (290 psi) in accordance with ASTM D4541.
Hardness:	76 Shore D in accordance with ASTM D2240.
VOC Content:	≤ 50 g/L in accordance with ASTM D2369.
Impact Resistance:	5.88 joules in accordance with ASTM D2794.
Abrasion Resistance:	0.11g loss in accordance with ASTM D4060 (CS17/1000cycles/1000g).

.2 Acceptable products:

.1 Sikafloor® 261 as manufactured by Sika Canada Inc.

.5 Chemical-Resistant Top Coat: two-component, clear, ultra violet light-resistant, non-yellowing, smooth aliphatic urethane top coat:

Physical Property	Minimum Test Results
VOC Content:	≤ 240 g/L in accordance with ASTM D2369.
Abrasion Resistance:	0.082g loss in accordance with ASTM D4060 (CS17/1000cycles/1000g).
Pull-off Strength:	>5.8 MPa (>840 p.s.i) in accordance with ASTM D4541.
Flame Spread Rating:	5 in accordance with CAN/ULC S102.
Smoke Developed Rating:	94 in accordance with CAN/ULC S102.

.1 Acceptable products:

.1 Sikafloor® Duochem 942 as manufactured by Sika Canada Inc.,

2.3 ACCESSORIES

.1 Provide all cleaning agents, cleaning cloths, sanding materials, and clean-up materials required per manufacturer's specifications.

PART 3 EXECUTION

3.1 EXAMINATION

.1 Examine surfaces to receive flooring system. Submit Notice in Writing to Consultant, Contractor, and Owner if surfaces are not acceptable. Do not begin surface preparation or application until unacceptable conditions have been corrected. Do not apply flooring system to substrate treatments for moisture, repair, or levelling not of the same manufacturer.

.2 Surface must be clean, sound and dry. Remove dust, laitance, grease, curing compounds bond inhibiting impregnations, waxes and any other contaminants. All projections, rough spots, etc. should be dressed off to achieve a level surface prior to the application.

.3 Pre-Installation Testing:

.1 Substrate moisture:

.1 Measure and confirm acceptable conditions for Substrate Moisture Content, Ambient Relative Humidity, Ambient and Surface Temperature and Dew Point.

.2 Confirm and record above values at least once every 3 hours during installation or more frequently whenever conditions change

(e.g. Ambient Temperature rise/fall, Relative Humidity increase/decrease, etc.).

.2 Concrete substrate to have a minimum compressive strength of 25 MPa (3,625 psi) at 28 days and a minimum of 1.5 MPa (218 psi) in tension at time of application.

.4 Ensure concrete substrate conforms to the minimum requirements of the flooring manufacturer.

.5 Do not apply flooring system to sand-cement setting beds. Remove sand-cement beds to structural concrete substrate. Re-level/slope as required to achieve grade and/or drainage in accordance with manufacturer's minimum requirements.

.6 Do not apply flooring system to asphaltic or bitumen membranes, soft wood, aluminum, copper or fiberglass reinforced polyester/vinyl ester composites.

.7 Apply to glazed or vitrified brick and tile, structural wood, and steel only with manufacturer's written recommendation for proper surface preparation.

3.2 PREPARATION

.1 Prepare surface to receive flooring systems in accordance with manufacturer's written instructions.

.2 Remove dirt, oil, grease, wax, laitance, curing compounds, water-soluble concrete hardeners, and other surface contaminants. Remove sealers, finishes, and paints.

.3 All projections, rough spots, etc. should be removed and patched to achieve a level surface prior to the application.

.4 Remove unsound concrete by appropriate mechanical means.

.5 Concrete: Clean and prepare to achieve laitance-free and contaminant-free, open textured surface by shot blasting or equivalent mechanical means. Provide CSP level in accordance with ICRI Guideline No. 310-2R and manufacturer's written recommendation.

.6 Chemical Surface Preparation: Chemical surface preparation (acid etching) is unacceptable and will void manufacturer's warranty.

.7 Control Joints and Cracks: Repair and treat control joints and surface cracks utilizing manufacturer's standard materials and installation details.

3.3 APPLICATION

.1 Manufacturer's representative must be on the job site at start of installation and provide the Engineer with a written report verifying acceptable installation procedures are followed.

.2 Mix and apply material in accordance with manufacturer's written installation instructions and procedures. Apply to manufacturer's recommended coverage rates unless thicker coverage is specified in this Section.

.3 Follow manufacturer's written recommendations on terminations and connections to walls, drains, doorways, columns and floor-to-floor transitions.

.4 Do not apply while ambient and substrate temperatures are rising.

.5 Apply resinous flooring with care to ensure that no laps, voids, or other marks or irregularities are visible. Apply to achieve appearance of uniform colour, sheen and texture; all within limitations of materials and areas concerned.

.6 Broadcast Silica Broadcast Aggregates into the wet Broadcast Coat resin.

.7 Match colours and textures of Consultant accepted samples.

.8 Install cove base 150 mm (6") high with 38 mm (1.5") radius in accordance with manufacturer's written instructions. Install cove base with a minimum 3 mm (1/8") thickness

.9 Install L type white alloy or zinc base bead top strips at specified heights straight and level.

3.4 CLEANING

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

.2 Disposal of this product, solution and any by-products should at all times comply with the requirements of environmental protection and waste disposal legislation and any regional local authority requirements

.3 Progress Cleaning: Perform cleanup as work progresses

.4 Leave work area clean at end of each day. Final cleaning: Upon completion, remove surplus materials, rubbish, tools, and equipment. Waste Management: Collect recyclable waste and dispose of or recycle field generated construction waste created during construction or final cleaning related to work of this Section. Remove recycling containers and bins from site and dispose of materials at appropriate facility

3.5 PROTECTION

.1 The General Contractor is responsible for protection, including all required repairs and restoration as a result of improperly protected product installation, and final cleaning of surface after final coats.

.2 Protect freshly applied Products from dampness, condensation and water for at least seventy-two (72) hours.

.3 Monitor air flow and changes in air flow. Protect against introduction of dust, debris, and particles, etc. that may result in surface imperfections and other defects.

.4 Follow manufacturer's written recommendations with respect to cure, wait time and return to service.

END OF SECTION

EPOXY COATING (HEAVY)

1 GENERAL

1.1 General

1.1.1 The Contractor shall supply labour, materials and equipment for the complete installation of epoxy flooring on all interior concrete floors. Epoxy coating shall form a 200 mm curb along all walls and cover all maintenance pads in all rooms. Epoxy coating in the chemical containment area coated 600 mm from finished floor along walls and curbs.

1.2 Related Specification Sections

1.2.1 In addition to the general project requirements in Division 1, the following sections are referenced in this section:

.1 Section 03102 Surface Preparation and Repairs.

.2 Section 03300 Cast-in-Place Concrete.

.3 Section 03905 Concrete Repairs

.4 Section 03906 Local Concrete Repairs

.5 Section 09670 Epoxy Dampprofing

1.3 Code and Regulatory Requirements

1.3.1 All products shall conform to the following standards and regulations:

.1 American Society for Testing and Materials (ASTM)

.1 ASTM C307-03 (2012) Standard Test Method for Tensile Strength of Chemical-Resistant Mortar, Grouts, and Monolithic Surfacing's.

.2 ASTM C413-01(2012), Standard Test Method for Absorption of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes.

.3 ASTM C579-01 (2012), Standard Test Methods for Compressive Strength of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing, and Polymer Concretes.

.4 ASTM C580-02 (2012), Standard Test Method for Flexural Strength and Modulus of Elasticity of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing's, and Polymer Concretes.

.5 ASTM C884/C884M-98(2010) Standard Test Method for Thermal Compatibility Between Concrete and an Epoxy-Resin Overlay.

.6 ASTM D635-10, Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position.

.7 ASTM D638-10, Standard Test Method for Tensile Properties of Plastics.

.8 ASTM D695-10 Standard Test Method for Compressive Properties of Rigid Plastics.

.9 ASTM D696-08e1 Standard Test Method for Coefficient of Linear Thermal Expansion of Plastics Between −30°C and 30°C with a Vitreous Silica Dilatometer.

.10 ASTM D2240- 05 (2010), Standard Test Method for Rubber Property-Durometer Hardness.

.11 ASTM D2369-10e1, Standard Test Method for Volatile Content of Coatings.

.12 ASTM D2794-93(2010) Standard Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact).

.13 ASTM D3273 Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber.

.14 ASTM D4060-10, Standard Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser.

.15 ASTM D4541-09e1, Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers.

.16 ASTM F2170-11 Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes.

.17 ASTM F2659-10, Standard Guide for Preliminary Evaluation of Comparative Moisture Condition of Concrete, Gypsum Cement and Other Floor Slabs and Screeds Using a Non-Destructive Electronic Moisture Meter.

.18 ASTM G21-13, Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.

.2 Canadian Standards Association (CSA)

.1 CSA A23.1-14/A23.2-14 Concrete Materials and Methods of Concrete Construction / Test Methods and Standard Practices for Concrete.

.3 International Concrete Repair Institute (IRCI)

.1 ICRI Guideline No. 310.2R-2013, Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings and Polymer Overlays.

.4 United States Department Defence

.1 MIL-PRF-24613A (SH) 11-2007, Performance Specification: Deck Covering Materials, Interior, Cosmetic Polymeric

1.4 Quality Assurance

1.4.1 In addition to the requirements of 01450 – Quality Control, the following measures are required:

.1 Perform work in accordance with the printed requirements of the resinous flooring manufacturer and this specification. Advise Engineer of any discrepancies prior to commencement of the work.

.2 Maintain one (1) copy of the specification and manufacturer's literature on site throughout the execution of the work.

.3 At the beginning of the work and, at all times during the execution of the work, allow access to the site by the resinous flooring manufacturer's representative.

1.4.2 Single Source Responsibility: Obtain primary epoxy flooring materials including primers, resins, hardening agents, finish or sealing coats from a single manufacturer with not less than ten years of successful experience in manufacturing and installing principle materials described in this section. Contractor must have completed at least five (5) projects of similar size and complexity, provide secondary materials only of type and from source recommended by manufacturer of primary materials. All materials, including primers, resins, curing agents, finish coats, aggregates and sealants are manufactured and tested under an ISO 9002 registered quality system.

1.4.3 Manufacturer Qualifications:

.1 No request for substitution shall be considered that would change the generic type of system specified. Equivalent materials of other manufacturers may be substituted only on approval of the Engineer. Requests for substitution will be considered only if submitted 10 days prior to bid date. Requests shall include the respective manufacturer's technical literature for each product giving the name, generic type, descriptive information, recommended dry film thickness (DFT), Material Safety Data Sheet (MSDS), and certified test reports showing results to equal performance criteria of products specified herein.

1.4.4 Applicator Qualifications:

.1 Pre-Qualification: Each bidder for this project shall be pre-qualified and approved in writing by the material manufacturer.

.2 Applicators: Use experienced applicators having a record of successful in-service resinous flooring system applications similar in material and extent to those specified in this Section and as follows:

.1 Applicators must have completed flooring manufacturer's training program for Products specified.

.2 Applicators must be licensed, certified or approved in writing by the flooring manufacturer for the Products specified.

.3 Applicator Experience: Minimum 5 years' experience in the application of the type of system specified. Applicator shall submit a list of five (5) projects of similar size, scope and complexity.

1.4.5 Mock-Up:

.1 Construct one 10 sq.m. (100 sq.ft.) mock-up of each type and colour of resinous flooring in location acceptable to Consultant to demonstrate quality of finished system,

complying with manufacturer's installation instructions and requirements of this Section in accordance with Section 01450 Quality Control.

.2 Arrange for Consultant's review and acceptance, obtain written acceptance before proceeding with Work.

.3 Upon acceptance, mock-up shall serve as a minimum standard of quality for the balance of the Work of this Section. Mock-up shall be left in place for the duration of the Work.

.4 During job mock-up and initial period of installation, manufacturer of coating system will provide a trained employee to insure proper use and installation of product. Periodic site visits will also be made during installation to verify continued proper installation.

1.4.6 Pre-installation meetings: comply with Section 01120 - Coordination and Sequence of Construction. Conduct pre-installation meeting two weeks prior to commencing work of this Section and on-site installations to:

.1 Notify attendees 3 weeks prior to meeting and ensure meeting attendees include as minimum:

.1 Owner;

.2 Engineer;

.3 Applicator

.4 All Affected Subcontractors;

.5 Manufacturer's Technical Representative.

.2 Coordinate with related specification listed in section 1.3 - Related Specification Sections

.3 Verify project requirements, including mock-up requirements.

.4 Verify substrate conditions, preparation and priming.

.5 Co-ordinate products, installation methods and techniques.

.6 Sequence work of related sections.

.7 Co-ordinate with other building sub-trades to ensure proper installation and site preparation.

.8 Review manufacturer's installation instructions, including application, curing and protection procedures.

.9 Review warranty requirements.

1.5 Submittals

1.5.1 Make Submittals in accordance with Section 01330 Submittals.

1.5.2 Product Data:

.1 Submit product data for each type of product specified including manufacturer's technical product data, installation instructions, colors available and recommendations for each type of resinous flooring product required for the following items;

.2 MSDS: Submit Manufacturer's Safety Data Sheet for each Product being used.

1.5.3 Product Samples:

.1 Contractor to submit manufacturer's colour charts showing the full range of colours available for each type of finish coat material indicated for Consultant's initial selection.

1.5.4 Applicator Certificate:

.1 Submit certificate issued to system applicator or written letter indicating applicator is recognized and approved to install specified system by coating material manufacturer.

1.5.5 Samples for Verification:

.1 Submit samples of each colour and material being applied, with texture to simulate actual conditions, on representative samples of the actual substrate and as follows for Consultant's verification:

.2 Use representative colours when preparing samples for review; resubmit until required sheen, colour, and texture are achieved.

.3 List of material and application for each coat of each sample; label each sample for location and application.

.4 Submit samples on the following substrates for Consultant's review of colour and texture:

.1 Hardboard: Provide 300 mm x 300 mm square samples for each colour and finish.

.5 Obtain written acceptance of Samples in writing from the Consultant before commencing Work of this Section. Accepted Samples shall be the final standard of acceptance of the finish.

1.5.1 Warranty:

.1 Submit an unexecuted, unsigned warranty for review, clearly stating that the traffic coating name, the terms of the specified warranty and duration, prior to any installation.

1.6 Closeout Submittals

1.6.1 Make Closeout Submittals in accordance with Section 01780 Closeout Submittals.

1.6.2 Operations and Maintenance Data: Submit manufacturer's printed maintenance instructions for repair, cleaning and maintenance procedures; include name of original installer and contact information.

1.7 Delivery, Storage and Handling

1.7.1 Refer to Specification Section 01610 - General Equip. Stipulations.

1.7.2 Delivery:

.1 Applicator will check material for completeness and shipping damage prior to job start.

.2 All materials must be factory pre-weighed and pre-packaged in single, easy to manage batches to eliminate on-site mixing errors. No on-site weighing or volumetric measurements allowed.

.3 Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying product name, manufacturer, batch or lot number and date of manufacture.

1.7.3 Storage:

.1 Store materials in accordance with manufacturer’s written instructions.

.2 Keep containers sealed until ready for use. Material should be stored in a dry, enclosed, protected area from the elements.

.3 Do not subject material to excessive heat or freezing.

.4 Shelf life: Established based on manufacturer’s written recommendation for each material being used.

1.7.4 Handling:

.1 Protect materials during handling and application to prevent damage or contamination.

.2 Condition materials for use accordingly to manufacturer’s written instructions prior to application.

.3 Record material lot numbers and quantities delivered to jobsite/storage.

1.8 Environmental and Site Conditions

1.8.1 Do not install the Work of this Section outside of the following environmental ranges without Manufacturers’ written acceptance:

.1 Moisture: Ensure substrate is within moisture limits prescribed by epoxy manufacturer.

.2 Material Temperature: Precondition material for at least 24 hours between 18°C and 30°C (65°F and 86°F).

.3 Ambient and Substrate Temperature: Minimum/Maximum 10˚/30˚C (50˚/86˚F).

.4 Substrate temperature must be at least 3˚C (5˚F) above measured Dew Point.

.5 Mixing and Application attempted at Material, Ambient and/or Substrate Temperature conditions less than 18˚C (65˚F) will result in a decrease in Product workability and slower cure rates.

.6 Relative Ambient Humidity: maximum ambient humidity 85% (during application and curing).

.7 Measure and confirm acceptable test results for Ambient Relative Humidity, Ambient and Surface Temperature and Dew Point.

1.8.2 Substrate Moisture:

.1 Moisture content of concrete substrate must be ≤ 4% by mass as measured with a Tramex® CME/CMExpert type concrete moisture meter.

.2 Additionally, internal concrete relative humidity tests may be conducted as per ASTM F2170 and values must be ≤ 85%.

.3 If moisture content of concrete substrate is higher than 4% by mass and / or if relative humidity test results exceed readings of 85% RH, Consultant will instruct on addition of moisture mitigation systems or moisture tolerant primers.

1.8.3 Supply temporary utilities, including power, water, temporary ventilation and lighting for use by applicator.

1.8.4 Maintain constant ambient room temperature for 48 hours before, during and after installation or until cured. Minimum temperature of 10°C (50°F) and maximum temperature of 30°C (85°F). Do not apply Product while ambient and substrate temperatures are rising.

1.8.5 Erect suitable barriers and post legible signs at points of entry to prevent traffic and trades from entering the work area during application and curing period of the floor.

1.8.6 Ensure adequate ventilation and air flow.

1.9 Warranty

1.9.1 Submit Warranty information in accordance with Section 01770 – Closeout Procedures.

1.9.2 Submit Applicator's written warranty, signed and issued in the name of Owner warranting the Work of this Section against defects in materials and workmanship for a period of one (1) year from the date of Substantial Performance of the Work.

1.9.3 Resinous flooring manufacturer must submit a written warranty, signed and issued in the name of the Owner, certifying resinous flooring will remain in place in accordance with General Condition article CG-12.3, except the warranty period shall be 20 years from the date of substantial completion. The warranty must remain a full warranty for the duration of the period specified. The scope of this warranty must not be limited by other system components manufactured or distributed by the resinous flooring manufacturer. No letter amending the manufacturer's standard warranty will be accepted and the warranty certificate must reflect these requirements.

1.9.4 Contractor must submit a written warranty, signed and issued in the name of the Owner, certifying resinous flooring will remain in place for a period of 20 years from the date of

substantial completion. This warranty will cover the removal and replacement of defective resinous flooring products, including labour. The warranty must remain a full warranty for the duration of the period specified. The scope of this warranty must not be limited by other system components manufactured or distributed by the resinous flooring manufacturer. No letter amending the manufacturer's standard warranty will be accepted and the warranty certificate must reflect these requirements.

.1 Materials: 20 years.

.1 All resinous flooring system materials are to be supplied by the resinous flooring manufacturer.

2 PRODUCTS

2.1 Approved Manufacturers

2.1.1 Basis-of-Design Manufacturer: Sika Canada Inc. 601 Delmar Avenue, Pointe-Claire, Quebec, H9R 4A9 Phone (514) 697-2610, Fax (514) 697-3087 http://www.sika.ca.

2.1.2 Substitutions: Consultant may consider additional manufacturers having similar Products to Basis-of-Design Manufacturer listed above during the construction period, provided they meet the performance [and aesthetic] requirements established by the named Products. Submit requests for substitution in accordance with Section 01200 Alternatives before starting any Work of this Section:

2.2 Materials

2.2.1 System 1: Epoxy floor coating in all rooms shall be 100 percent solids

.1 Approved Manufacturers

.1 STONKOTE GS 4, non slip (A137 sand No. 2 slip resistance), as manufactured by STONHARD, telephone 905 430-3333.

.2 Sikafloor 261, as manufacture by Sika Canada Inc. 601 Delmar Avenue, Pointe-Claire, Quebec, H9R 4A9 Phone (514) 697-2610, Fax (514) 697-3087 http://www.sika.ca.

2.2.2 System 2: Diesel Fuel Secondary Containment

.1 Approved Manufacturers

.1 STONHARD STONCHEM 577, a 3 mm (125 mils) 100 percent solids high performance lining system consisting of mortar, engineering fabric, mortarcoat and topcoat as manufactured by STONHARD, telephone 905 430-3333.

.2 Sikafloor Fastflor CR broadcast, as manufacture by Sika Canada Inc. 601 Delmar Avenue, Pointe-Claire, Quebec, H9R 4A9 Phone (514) 697-2610, Fax (514) 697-3087 http://www.sika.ca.

2.3 Colour

2.3.1 Epoxy floor coating, concrete curbs and pads refer to contract drawings for color selection.

2.3.2 Lining system colour to be grey to match finish colour.

3 EXECUTION

3.1 Examination

3.1.1 Examine surfaces to receive flooring system. Submit Notice in Writing to Consultant, Contractor, and Owner if surfaces are not acceptable. Do not begin surface preparation or application until unacceptable conditions have been corrected. Do not apply flooring system to substrate treatments for moisture, repair, or levelling not of the same manufacturer.

3.1.2 Surface must be clean, sound and dry. Remove dust, laitance, grease, curing compounds bond inhibiting impregnations, waxes and any other contaminants. All projections, rough spots, etc. should be dressed off to achieve a level surface prior to the application.

3.1.3 Pre-Installation Testing:

.1 Substrate moisture:

.1 Measure and confirm acceptable conditions for Substrate Moisture Content, Ambient Relative Humidity, Ambient and Surface Temperature and Dew Point.

.2 Confirm and record above values at least once every 3 hours during installation or more frequently whenever conditions change (e.g. Ambient Temperature rise/fall, Relative Humidity increase/decrease, etc.).

.2 Concrete substrate to have a minimum compressive strength of 25 MPa (3,625 psi) at 28 days and a minimum of 1.5 MPa (218 psi) in tension at time of application..

.3 The Contractor shall provide a calcium chloride test confirming acceptable moisture content prior to full acceptance by the Owner.

3.1.4 Ensure concrete substrate conforms to the minimum requirements of the flooring manufacturer.

3.1.5 Do not apply flooring system to sand-cement setting beds. Remove sand-cement beds to structural concrete substrate. Re-level/slope as required to achieve grade and/or drainage in accordance with manufacturer’s minimum requirements.

3.1.6 Do not apply flooring system to asphaltic or bitumen membranes, soft wood, aluminum, copper or fiberglass reinforced polyester/vinyl ester composites.

3.1.7 Apply to glazed or vitrified brick and tile, structural wood, and steel only with manufacturer’s written recommendation for proper surface preparation.

3.1.8 Safety: Comply with requirement of Workplace Hazardous Material Information Systems (WHMIS) regarding the use, handling, storage and disposal of hazardous materials.

3.1.9 Job area to be free of other trades during and, for a period of 24 hours, after floor installation.

3.2 Preparation

3.2.1 Manufacturer's representative must be on the job site at start of installation and provide the Engineer with a written report verifying acceptable installation procedures are followed.

3.2.2 Prepare surface to receive flooring systems in accordance with manufacturer's written instructions.

3.2.3 Remove dirt, oil, grease, wax, laitance, curing compounds, water-soluble concrete hardeners, and other surface contaminants. Remove sealers, finishes, and paints.

3.2.4 All projections, rough spots, etc. should be removed and patched to achieve a level surface prior to the application.

3.2.5 Remove unsound concrete by appropriate mechanical means.

3.2.6 Concrete: Clean and prepare to achieve laitance-free and contaminant-free, open textured surface by shot blasting or equivalent mechanical means. Provide CSP level in accordance with ICRI Guideline No. 310-2R and manufacturer's written recommendation.

3.2.7 Chemical Surface Preparation: Chemical surface preparation (acid etching) is unacceptable and will void manufacturer's warranty.

3.2.8 Control Joints and Cracks: Repair and treat control joints and surface cracks utilizing manufacturer's standard materials and installation details.

3.3 Application

3.3.1 Coating: Mix coating according to manufacturer's recommended procedures. Squeegee apply and backroll first coat. When surface is tack free, apply second coat to achieve 12-15 mil net dry film thickness (300 – 375 microns).

3.3.2 Joint Sealant: Install manufacturer's epoxy or urethane sealant compatible with floor finish.

3.3.3 Allow epoxy coating to cure at least five (5) hours to establish tack-free surface.

3.4 Application for Diesel Fuel Secondary Containment

3.4.1 Primer: Mix and apply primer over properly prepared substrate with strict adherence to manufacturer's installation procedures and coverage rates. Coordinate timing of primer application with application of troweled mortar to ensure optimum adhesion between resinous lining materials and substrate

3.4.2 Mortar: Mix mortar material according to manufacturer's recommended procedures. Uniformly spread mortar over substrate using manufacturer's specially designed hand trowel. Hand trowel apply mixed material over freshly primed substrate

3.4.3 Engineering Fabric: Embed fabric into mortar material with strict adherence to manufacturer's installation procedures

3.4.4 Saturant: Uniformly roll the saturant into the fiberglass fabric as recommended in manufacturer's application procedures

3.4.5 Topcoat: Remove any surface irregularities. Mix and apply mineral composite topcoat with strict adherence to manufacturer's installation procedures.

3.5 Curing

3.5.1 Cure epoxy flooring materials in compliance with manufacturer’s directions, taking care to prevent contamination during stages of application and prior to completion of curing process. Close area of application for a minimum of 24 hours.

3.6 Cleaning

3.6.1 Clean in accordance with Section 01740- Cleaning.

3.6.2 Disposal of this product, solution and any by-products should at all times comply with the requirements of environmental protection and waste disposal legislation and any regional local authority requirements.

3.7 Protection

3.7.1 The General Contractor is responsible for protection, including all required repairs and restoration as a result of improperly protected product installation, and final cleaning of surface after final coats.

3.7.2 Protect freshly applied Products from dampness, condensation and water for at least seventy-two (72) hours.

3.7.3 Monitor air flow and changes in air flow. Protect against introduction of dust, debris, and particles, etc. that may result in surface imperfections and other defects.

3.7.4 Follow manufacturer’s written recommendations with respect to cure, wait time and return to service.

END OF SECTION

PART 1 GENERAL

1.1 INTENT

.1 This section describes the materials and procedures for painting and coatings.

1.2 SCOPE OF WORK

.1 Work under this section includes providing paint or coatings but not limited to:

.1 Surface preparation of substrate

.2 Provision of materials, labour, and equipment required to complete painting or coatings works.

.3 Waste management and disposal of materials.

1.3 RELATED SECTIONS

.1 Section 04 22 00 – Concrete Masonry Unit

.2 Section 05 50 00 – Metal Fabrications

.3 Section 08 11 00 – Metal Doors and Frames

.4 Section 09 25 90 – Gypsum Board

.5 DIVISION 11 – EQUIPMENT

.6 DIVISION 15 – MECHANICAL

.7 DIVISION 16 – ELECTRICAL

1.4 REFERENCES

.1 The Master Painters Institute (MPI):

.1 MPI Architectural Painting Specification Manual 2005

.2 MPI Approved Products List, 2012

.2 American Society for Testing and Materials (ASTM):

.1 ASTM D3960-05 (201) - Standard Practice for Determining Volatile Organic Compound (VOC) Content of Paints and Related Coatings

.2 ASTM D523-14 (2018) - Standard Test Method for Specular Gloss

.3 Underwriters Laboratories of Canada (ULC):

.1 UL 2760 - Surface Coatings: Recycled Water-borne

.2 UL 2768 - Standard for Sustainability for Architectural Surface Coatings

.4 Environmental Protection Agency (EPA):

.1 EPA SW-846 - Test Methods for Evaluating Solid Waste, Physical/Chemical Methods

.5 Society of Protective Coatings

.1 SSPC-SP 1 - Solvent Cleaning
.2 SSPC-SP 2 - Hand Tool Cleaning
.3 SSPC-SP 3 - Power Tool Cleaning
.4 SSPC-SP 6/NACE No. 3 - Commercial Blast Cleaning
.5 SSPC-SP 7/NACE No. 4 - Brush-off Blast Cleaning

.6 National Fire Code of Canada 2015

1.5 SUBMITTALS

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

.2 All paint systems to be submitted at same time for coordination and colour selection.

.3 Provide on cover letter, listing all submitted products with MPI products numbers and categorized by MPI formula systems as outlined in this specification.

.4 Submit full records of all products used. List each product in relation to finish formula and include the following:

.1 Finish formula designation
.2 Product type and use
.3 Manufacturer's product number
.4 Colour number
.5 Manufacturer's Material Safety Data Sheets (MSDS)
.6 Maximum VOC classification
.7 Eco-Logo certification.
.8 Submit manufacturer's application instructions for each product specified.

.5 Product Data:

.1 Subcontractor to receive well written confirmation of specific surface preparation procedures and primers used for fabricated steel items from fabricator/supplier to ensure appropriate and manufacturer compatible finish coat materials prior to commencement of painting.
.2 Subcontractor to receive written Product Data regarding chemical composition of coatings or treatments applied by others (pressure preservatives, admixtures and sealers, etc.) and their paintability.
.3 Submit Product Data for concrete and concrete block primers.

.6 Samples

.1 Submit physical samples of the standard colour range showing full range of available colours where colour availability is restricted.

.2 Submit samples 30 days before materials are required. Submit the following samples in sizes indicated:

.1 Three (3) copies of brushouts minimum 200mm x 250mm of each finish including colour, sheen and texture required 30 days prior to commencement of application. Identify each sample with job, finish, colour name, number, sheen and gloss values, substrate to be applied to, date and name of Subcontractor.

.7 Surface Preparation

.1 Submit manufacturer's representative's written approval of surface preparation methods and any specific recommendations for alternative methods.

.8 Scheduling

.1 Submit work schedule for various stages of painting to Engineer for approval. Submit schedule minimum of two (2) working days in advance of proposed operations.

.2 Obtain written authorization from Engineer for any changes in work schedule.

.9 Progress Reports

.1 Arrange to have paint manufacturer's representative inspect work of this Section on a regular basis and prepare weekly reports. Submit a copy of the reports to the Engineer.

.10 Closeout Submittals

.1 Submit three (3) copies of list of materials used, together with MSDS for each Product for incorporation into the Operations and Maintenance Manuals. Include maintenance information such as cleaning and full pigment information for future touch up.

.11 Extra Materials

.1 Submit one (1) unopened four-litre can of each type and colour of finish coating. Identify colour and paint type in relation to established colour schedule and finish formula.Deliver to Engineer and store where directed.

.12 Alternatives

.1 Submit requests for alternatives in accordance with Section 01 20 00 – Alternatives.

.2 Submit letter from manufacturer that alternative product meet or exceed performance characteristics as outlined in MPI formula requirements and will be covered under all warranties outlined in contract documents.

.3 Provide comparison chart between specified product and proposed alternative demonstrating alternative meets or exceeds all testing codes.

1.6 QUALITY ASSURANCE

.1 Execute work of this Section by a firm which has adequate plant, equipment and skilled workers to perform work expeditiously and which is known to have been responsible, during immediate past 5 years, for installations similar to the scope of work contained herein. Ensure firm is fully conversant with applicable laws, bylaws, codes, fire, health and safety regulations and other regulations which govern.

.2 Provide work of this Section executed by competent applicators with membership in good standing in OPCA and/or PDCA and have a minimum of 5 years experience in application of Products, systems, coatings and assemblies specified and with approval and training of Product manufacturers.

.3 Retain purchase orders, invoices and other documents to prove that all materials utilized in this contract meet requirements of the specifications. Produce documents when requested by engineer.

.4 Retain the bat or lot number for each product.

.5 Pre-installation meetings: Prior to the commencement of painting operations meet at the Site with the material supplier's representative and with the Engineer to review this Section, the painting Work to be done and the following related items:

.1 Equipment use and servicing
.2 Material storage and application techniques
.3 Surface preparation and ambient temperature
.4 Inspection requirements
.5 Inspection reports
.6 Hold points or check points
.7 Safety requirements during application
.8 Mock ups or samples of coatings in highly corrosive environments

.6 Standard of Acceptance:

.1 Walls: No defects visible from a distance of 1000 mm at 90 degrees to surface.
.2 Ceilings: No defects visible from floor at 45 degrees to surface when viewed using final lighting source.
.3 Final coat to exhibit uniformity of colour and uniformity of sheen across full surface area.

1.7 DELIVERY, STORAGE AND HANDLING

.1 Deliver and store materials in original containers, sealed, with labels intact.

.2 Indicate on containers or wrappings:

.1 Manufacturer's name and address.

.2 Type of paint.

.3 Compliance with applicable standard.

.4 Colour number in accordance with established colour schedule.

.3 Remove damaged, opened and rejected materials from site.

.4 Provide and maintain dry, temperature controlled, secure storage. Store materials and supplies away from heat generating devices.

.5 Store materials and equipment in a well-ventilated area with temperature range to meet the manufacturer's specifications.

.6 Provide minimum one (1) 9 kg dry chemical fire extinguisher adjacent to storage area.

.7 Remove only in quantities required for same day use.

.8 Fire Safety Requirements:

.1 Store oily rags, waste products, empty containers and materials subject to spontaneous combustion in ULC approved, sealed containers and remove from site on a daily basis.

.2 Handle, store, use and dispose of flammable combustible materials in accordance with the National Fire Code of Canada.

1.8 ENVIRONMENTAL REQUIREMENTS

.1 Safety: comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage and disposal of hazardous materials.

.2 Ventilation:

.1 Contractor to provide continuous ventilation during and after application of paint. Run ventilation system 24 hours per day during installation and for seven (7) days after completion of application of paint.

.3 Substrate and ambient temperature must be within limits prescribed by manufacturer to approval of Engineer.

.4 Maintain minimum substrate and ambient air temperature of 10ºC. Maximum relative humidity 85 percent. Maintain supplemental heating until paint has cured sufficiently. Provide temporary heating where permanent facilities are not available to maintain minimum recommended temperatures.

.5 Apply paint finish only in areas where dust is no longer being generated by related construction operations, such that airborne particles will not affect the quality of the finished surface.

.6 Apply paint only when surface to be painted is dry, properly cured and adequately prepared.

1.9 WARRANTY

.1 Warrant work of this Section for a period of 2 years against defects and/or deficiencies in accordance with General Conditions of the Contract. Promptly correct any defects or deficiencies which became apparent within warranty period, to satisfaction of the Engineer and at no expense to the Owner. Defects include but are not limited to material and workmanship defects such as:

.1 Improper cleaning and preparation of surfaces.

.2 Entrapped dust and dirt.

.3 Material shrinkage, cracking, splitting and defective workmanship.

PART 2 PRODUCTS

2.1 MATERIALS

.1 Paint materials for each coating formula to be products of a single manufacturer.

.2 Regulatory Requirements:

.1 Conform to latest edition of Industrial Health and Safety Regulations issued by applicable authorities having jurisdiction in regard to site safe.

.2 Comply with more stringent of applicable laws, bylaws, codes, fire regulations, health and safety regulations of authorities having jurisdiction or requirements. Ensure standards used for work of this Section are considered a minimum.

.3 Where required, ensure paints and coatings meet flame spread and smoke developed ratings designated by local code requirements and/or authorities having jurisdiction.

.4 Conform to requirements of local authorities having jurisdiction in regard to storage mixing application and disposal of paint and related waste materials.

.3 Low odour products: whenever possible, select products exhibiting low odour characteristics. If two (2) products are otherwise equivalent, select the product with the lowest odour.

.4 Water based paints and coatings must maintain a minimum surface and ambient air temperature of between 18°C and 32°C during application and drying of paint and maintain until building occupancy occurs.

.5 Solvent based paints and contains must maintain a minimum interior surface and ambient air temperature of between 7°C and 35°C during application and drying of paint and maintain until building occupancy occurs.

.6 Where required, use only materials having minimum MPI "Environmental Friendly" E3 rating based on VIC (10 CFR 59)

.7 Where indoor air quality (odour) is an issue, use only MPI listed materials having a minimum E3 rating.

.8 Water-borne surface coatings must:

.1 Meet or exceed all applicable governmental and/or industrial safety and performance standards.

.2 Manufactured and transported in such a manner that all steps of the process, including the disposal of waste products arising therefrom, will meet the requirements of all applicable governmental acts, bylaws and regulations including, for facilities located in Canada, the Fisheries Act and the Canadian Environmental Protection Act (CEPA).

.9 Water-borne surface coatings must not be formulated or manufactured with: aromatic solvents, formaldehyde, halogenated solvents, mercury, lead, cadmium, hexavalent chromium or their compounds.

.10 Water-borne surface coatings and recycled water-borne surface coatings must have a flash point of 61ºC or greater.

.11 Water-borne surface coatings and recycled water-borne surface coatings must contain information describing proper disposal methods within their packaging.

.12 Recycled water-borne surface coatings must not contain:

.1 Lead in excess of 600.0 ppm weight/weight total solids.

.2 Mercury in excess of 50.0 ppm weight/weight total product.

.3 Cadmium in excess of 1.0 ppm weight/weight total product.

.4 Hexavalent chromium in excess of 3.0 ppm weight/weight total product.

.5 Organochlorines or polychlorinated biphenyls (PCBS) in excess of 1.0 ppm weight/weight total product.

.13 Substitution Limitations:

.1 Comparable Products from other manufacturer not listed herein will be accepted provided they meet requirements of MPI Approved paints and this Specification after full review by the Engineer.

2.2 COLOURS

.1 Contractor to provide available colour sample demonstrating full range from selected manufacturer after Contract award.

.2 Engineer will provide colour schedule based upon the submitted colour sample.

.3 Selection of colours will be from manufacturer's full range of colours.

.4 Where specific products are available in a restricted range of colours, selection will be based on the limited range.

.5 Perform all colour tinting operations prior to delivery of paint to site. On-site tinting of painting materials allowed only with Engineer's written permission.

.6 Second coat in a three-coat system to be tinted slightly lighter colour than top coat to show visible difference between coats.

2.3 INTERIOR PAINT FINISHES / COATINGS

.1 Vertical / Ceiling Concrete Surfaces:

.1 INT 3.1A Latex MPI Gloss Level 3 – Egg Shell finish over alkali-resistant primer – premium grade; by the following manufacturers:

.1 Benjamin Moore

.2 PPG Architectural

.3 Sherwin-Williams

.2 INT 3.1B Latex MPI Gloss Level 3 – Egg Shell finish over flat latex aggregate – premium grade; by the following manufacturers:

.1 Benjamin Moore

.2 PPG Architectural

.3 Sherwin-Williams

.3 INT 3.1E Latex MPI Gloss Level 3 – Egg Shell finish – premium grade; by the following manufacturers

.1 Benjamin Moore

.2 PPG Architectural

.3 Sherwin-Williams

.4 INT 3.1L W.B. Light Industrial Coating MPI Gloss Level 3 – Egg Shell - premium grade; by the following manufacturers:

.1 Benjamin Moore

.2 PPG Architectural

.3 Sherwin-Williams

.5 INT 3.1P Epoxy high build, low gloss finish – premium grade; by the following manufacturers:

.1 Benjamin Moore

.2 PPG Architectural

.3 Sherwin-Williams

.2 Concrete Masonry Units (CMU's):

.1 INT 4.2A Latex MPI Gloss Level 3 – Egg Shell finish over latex block filler – premium grade; by the following manufacturers:

.1 Benjamin Moore

.2 PPG Architectural

.3 Sherwin-Williams

.2 INT 4.2C: Alkyd [MPI Gloss Level 3 – Egg Shell] finish over latex block filler

.1 Benjamin Moore

.2 PPG Architectural

.3 Sherwin-Williams

.3 INT 4.2F Epoxy tile-like finish (for dry environments) over latex block filler – premium grade; by the following manufacturers:

.1 Cloverdale Paint

.2 PPG Architectural

.3 Sherwin-Williams

.4 INT 4.2G Epoxy tile-like finish (for wet environments) over epoxy block filler – premium grade; by the following manufacturers:

.1 Cloverdale Paint

.2 PPG Architectural

.3 Sherwin-Williams

.5 INT 4.2K W.B. Light Industrial Coating MPI Gloss Level 3 – Egg Shell - premium grade; by the following manufacturers:

.1 Benjamin Moore

.2 PPG Architectural

.3 Sherwin-Williams

.6 INT 4.2R Epoxy high build, low gloss finish over epoxy block filler – premium grade; by the following manufacturers:

.1 Cloverdale Paint

.2 PPG Architectural

.3 Sherwin-Williams

.3 Structural Steel and Metal Fabrications:

.1 INT 5.1L Epoxy finish over epoxy primer – premium grade; by the following manufacturers:

.1 Cloverdale Paint

.2 PPG Architectural

.3 Sherwin-Williams

.2 INT 5.1P High build epoxy over epoxy zinc rich primer – premium grade; by the following manufacturers:

.1 Cloverdale Paint

.2 PPG Architectural

.3 Sherwin-Williams

.3 INT 5.1Y Epoxy high build, low gloss finish over anti-corrosive epoxy primer – premium grade; by the following manufacturers:

.1 Cloverdale Paint

.2 PPG Architectural
.3 Sherwin-Williams

.4 Steel – High Heat:

.1 INT 5.2B Heat resistant enamel, aluminum – maximum 800°F (427°C); by the following manufacturers:
.1 Benjamin Moore
.2 PPG Architectural
.3 Sherwin-Williams

.5 Galvanized Metals:

.1 INT 5.3C Alkyd MPI Gloss Level 3 – Egg Shell finish over cementitious primer
.2 INT 5.3D Epoxy finish over epoxy primer
.1 Cloverdale Paint
.2 PPG Architectural
.3 Sherwin-Williams
.3 INT 5.3E Epoxy finish over vinyl wash primer and epoxy primer
.1 Cloverdale Paint
.2 PPG Architectural
.3 Sherwin-Williams

.6 Plaster and Gypsum Board:

.1 INT 9.2A Latex MPI Gloss Level 3 – Egg Shell finish over latex sealer:
.1 Benjamin Moore
.2 PPG Architectural
.3 Sherwin-Williams
.2 INT 9.2C: Alkyd MPI Gloss Level 3 – Egg Shell finish over latex sealer, by the following manufacturers
.1 Benjamin Moore
.2 PPG Architectural
.3 Sherwin-Williams
.3 INT 9.2L W.B. Light Industrial Coating MPI Gloss Level 3 – Egg Shell - premium grade; by the following manufacturers
.1 Benjamin Moore
.2 PPG Architectural
.3 Sherwin-Williams

2.4 EXTERIOR PAINT FINISHES / COATINGS

.1 Concrete Masonry Units (CMU's):

.1 EXT 4.2A Latex MPI Gloss Level 3/4 – Low Sheen finish over latex block filler – premium grade; by the following manufacturers:

.1 Benjamin Moore

.2 PPG Architectural

.3 Sherwin-Williams

.2 EXT 4.2B Latex MPI Gloss Level 3/4 – Low Sheen flat aggregate finish; by the following manufacturers:

.1 Benjamin Moore

.2 PPG Architectural

.3 Sherwin-Williams

.3 EXT 4.2E Epoxy finish over epoxy block filler – premium grade; by the following manufacturers:

.1 Cloverdale Paint

.2 PPG Architectural

.3 Sherwin-Williams

.2 Structural Steel and Metal Fabrications:

.1 EXT 5.1D Alkyd MPI Gloss Level 5 – Semi-Gloss finish over alkyd primer

.2 EXT 5.1F Epoxy finish over high build epoxy – premium grade; by the following manufacturers:

.1 Cloverdale Paint

.2 PPG Architectural

.3 Sherwin-Williams

.3 Steel – High Heat:

.1 EXT 5.2B Heat resistant enamel, aluminum – max. 800°F (427°C); by the following manufacturers:

.1 Benjamin Moore

.2 PPG Architectural

.3 Sherwin-Williams

.2 EXT 5.3C: Epoxy finish – premium grade; by the following manufacturers:

.1 Cloverdale Paint

.2 PPG Architectural

.3 Sherwin-Williams

.3 Polyurethane, pigmented finish; by the following manufacturers:

.1 PPG Architectural

.2 Sherwin-Williams

PART 3 EXECUTION

3.1 GENERAL

.1 Perform all painting operations in accordance with MPI Architectural Painting Specification Manual, except where specified otherwise.

.2 Apply all paint materials in accordance with paint manufacturer's written application instructions.

.3 Commencement of work does not imply acceptance of surfaces except as qualified herein. Surfaces such as concrete, masonry, structural steel and miscellaneous metal, wood, gypsum board and plaster, is not responsibility of this Subcontractor. Commencement of work implies acceptance of previously completed work.

3.2 PREPARATION

.1 Provide scaffolding, staging, platforms and ladders, as required for execution of work. Erect scaffolding to avoid interference with work of other trades. Comply with the Occupational Health and Safety Act.

.2 Remove electrical cover plates, light fixtures, surface hardware on doors, door stops, bath accessories and all other surface mounted fittings and fastenings prior to undertaking any painting operations. Store for re-installation after painting is completed.

.3 Move and cover furniture and portable equipment as necessary to carry out painting operations. Replace as painting operations progress.

.4 Prohibit traffic, where possible, from areas where painting is being carried out and until paint is cured.

.5 As painting operations progress, place "WET PAINT" signs in occupied areas to approval of Engineer.

3.3 PROTECTION

.1 Protect existing building surfaces not to be painted from paint splatters, markings and other damage. If damaged, clean and restore such surfaces as directed by Engineer.

.2 Cover or mask floors, windows and other ornamental hardware adjacent to areas being painted to prevent damage and to protect from paint drops and splatters. Use non-staining coverings.

.3 Protect items that are permanently attached such as Fire Labels on doors and frames.

.4 Protect factory-finished products and equipment.

3.4 EXISTING CONDITIONS

.1 Investigate existing substrates for problems related to proper and complete preparation of surfaces to be painted. Report to Engineer all damage, defects, unsatisfactory or unfavourable conditions before proceeding with work.

.2 Investigate moisture content of surface to be painted, and report findings to Engineer. Do not proceed with work until conditions fall within acceptable range as recommended by manufacturer.

.3 If substrate is steel, do not apply coatings over or when surface temperature is within 3°C of the dew point.

.4 If the substrate is wood, do not stain or paint if moisture reading is higher than 15%. Inspect work to assure surfaces are smooth, free from machine marks and nail heads have been countersunk.

.5 If substrate is new plaster or masonry, allow to cure for 30 to 90 days. Ensure moisture content is between 12% to 14% and test for alkalinity and neutralize (pH 6.5 – 7.5) before proceeding with priming.

.6 If substrate is gypsum board, inspect to ensure joints are completely filled and sanded smooth. Inspect surfaces for “nail popping”, screw heads not recessed and taped, breaks in surface or other imperfections.

.7 Where Room Finish Schedule indicates existing and/or new wall finishes to be painted, existing surfaces such as existing door and frames, mechanical supply and return air grilles (walls and ceilings), access doors and electrical panels which have been previously painted to be painted for a complete finish room. If Room Finish Schedule indicates “-“ it denotes entire room need not be painted, paint only patched areas.

3.5 CLEANING

.1 Clean all surfaces to be painted as follows.

.1 Remove all dust, dirt and other surface debris by vacuuming and wiping with dry, clean cloths.

.2 Wash surfaces with solution of T.S.P. bleach and clean, warm water using a stiff bristle brush to remove dirt, oil and other surface contaminants.

.3 Rinse scrubbed surfaces with clean water until foreign matter is flushed from surface.

.4 Allow surfaces to drain completely and allow to dry thoroughly.

.5 To prepare surfaces for water-based painting, water-based cleaners should be used in place of organic solvents.

.6 Use trigger-operated spray nozzles for water hoses.

.7 Many water-based paints cannot be removed with water once dried. However, minimize the use of kerosene or any such organic solvents to clean-up water-based paints.

.2 Prevent contamination of cleaned surfaces by salts, acids, alkalis, other corrosive chemicals, grease, oil and solvents before prime coat is applied and between applications of remaining coats. Apply primer, paint or pre-treatment as soon as possible after cleaning and before deterioration occurs.

.3 Sand existing surfaces with intact, smooth, high gloss coatings to provide adequate adhesion for new finishes.

3.6 SURFACE PREPARATION

.1 Prepare substrate in accordance with the MPI Architectural Painting Specification Manual

.2 Remove doors before painting to paint bottom and top edges and re-hang once dry. Do not paint stainless steel or bronze door butts. Paint or finish top and bottom edges of doors. Touch-up or refinish tops and edges after fitting.

.3 Previously Finished Surfaces:

.1 Clean existing interior surfaces to be repainted or varnished to provide bond. Remove rust, scale, oil, grease, mildew, chemicals and other foreign matter. Remove loose paint and fill flush with suitable patching material. Clean off bubbled, cracked, peeling or otherwise defective paint by stripping with suitable environmental strippers or by burning. Do not burn off paints suspected of having lead content. Treat residue from stripping as Hazardous Waste. Flatten gloss paint and varnish with sandpaper and wipe off dust. If previous coatings have failed so as to affect proper performance or appearance of coatings to be applied, remove previous coatings completely and prepare substrates properly and refinish as specified for new work. Leave entire surface suitable to receive designated finishes and in accordance with manufacturer's instructions.

.4 Gypsum Board:

.1 Examine and ensure gypsum board surfaces are without defects or deficiencies and suitable to receive painting applications. Commencement implies acceptance of gypsum board work. Examine surfaces after for imperfections showing through and fill small nicks or holes with patching compound and sand smooth. Examine surfaces after priming for imperfections showing through.

.2 Clean surfaces dry, free of dust, dirt, powdery residue, grease, oil, was or any other contaminants. Sand and dust as necessary prior to painting and between coats to provide an anchor for next coat and to remove defects visible from a distance up to 1m.

.5 Fire Resistant Coatings:

.1 Coordinate with coating manufacturer for surface preparation requirements to ensure proper adhesion of finish.

3.7 SURFACE PREPARATION – METAL

.1 Prepare aluminum and galvanized steel by acid etching using MPI Product #25. Rinse with clean water and thoroughly dry.

.2 Clean new metal surfaces to be painted by: removing rust, loose mill scale, welding slag, dirt, oil, grease and other foreign substances in accordance with the following, as described in each of the painting systems in the MPI Architectural Painting Specification Manual:

.1 Solvent cleaning: SSPC-SP-1.

.2 Hand tool cleaning: SSPC-SP-2.

.3 Power tool cleaning: SSPC-SP-3.

.4 Commercial blast cleaning: SSPC-SP-6.

.5 Brush-off blast cleaning: SSPC-SP-7.

.3 Clean existing metal surfaces to be repainted by removing loose, cracked, brittle or non-adherent paint, rust, loose mill scale, welding slag, dirt, oil, grease and other foreign substances in accordance with following, as described in each of the painting systems in the MPI Architectural Painting Specification Manual:

.1 Scrape edges of old paint back to sound material. Where remaining paint is thick and sound, feather exposed edges.

.2 Commercial blast clean rusted and bare metal surfaces where existing paint system has failed.

.3 Solvent cleaning: SSPC-SP-1.

.4 Hand tool cleaning: SSPC-SP-2.

.5 Power tool cleaning: SSPC-SP-3.

.6 Commercial blast cleaning: SSPC-SP-6.

.7 Brush-off blast cleaning: SSPC-SP-7.

.4 Remove traces of blast products from surfaces, pockets and corners to be painted by brushing with clean brushes and vacuum cleaning.

.5 Do not apply paint until prepared surfaces have been accepted by Engineer.

3.8 MIXING PAINT

.1 Unless otherwise specified herein or pre-approved, paint to be ready and factory tinted.

.2 Mix ingredients in container before and during use and ensure breaking-up of lumps, complete dispersion of settled pigment and uniform composition.

.3 Thin paint for spraying according to manufacturer's instructions. If directions are not on container, obtain instructions in writing from manufacturer and provide copy of instructions to Engineer.

.4 Do not use kerosene or any such organic solvents to thin water-based paints.

3.9 APPLICATION

.1 Method of application to be as approved by Engineer. Apply paint by brush, roller, air sprayer or airless sprayer. Conform to manufacturer's application instructions unless specified otherwise.

.2 Safety Precautions:

.1 When handling solvent coating materials, wear approved vapour/particulate respirator as protection from vapours. Dust respirators do no provide protection from vapours.

.3 Brush application:

.1 Work paint into cracks, crevices and corners. Paint surfaces not accessible to brushes by spray, daubers or sheepskins.

.2 Brush out runs and sags.

.3 Remove runs, sags and brush marks from finished work and repaint.

.4 Spray application:

.1 Provide and maintain equipment that is suitable for intended purpose, capable of properly atomizing paint to be applied and equipped with suitable pressure regulators and gauges.

.2 Keep paint ingredients properly mixed in containers during paint application either by continuous mechanical agitation or by intermittent agitation as frequently as necessary.

.3 Apply paint in a uniform layer, with overlapping at edges of spray pattern.

.4 Brush out immediately all runs and sags.

.5 Use brushes to work paint into cracks, crevices and places that are not adequately painted by spray.

.5 Use dipping, sheepskins or daubers only when no other method is practical in places of difficult access and only when specifically authorized by Engineer.

.6 Apply each coat of paint as a continuous film of uniform thickness. Repaint thin spots or bare areas before next coat of paint is applied.

.7 Allow surfaces to dry and properly cure, after cleaning and between subsequent coats, for minimum time period, as recommended by manufacturer.

.8 Sand and dust between each coat to remove visible defects.

.9 Finish tops of cupboards, cabinets and projecting ledges, both above and below sight lines as specified for surrounding surfaces.

.10 Finish inside of cupboards and cabinets as specified for outside surfaces.

.11 Finish closets and alcoves as specified for adjoining rooms.

.12 Finish top, bottom, edges and cutouts of doors after fitting as specified for door surfaces.

.13 Finish behind wall-mounted items.

.14 Finish listed surfaces indicated on the Room Finish Schedule and/or noted on Drawings and as specified. Refer to Room Finish Schedule for type, location and extent of finishes required and include touch-ups and field painting necessary to complete work shown, scheduled or specified.

.15 Finishes and number of coats specified in Room Finish Schedule are intended as minimum requirements guide only. Refer to manufacturer's recommendations for exact instructions for thickness of coating to obtain optimal coverage and appearance.

.16 Do not paint baked paint surface, chrome plated, stainless steel, aluminum or other surfaces finished with final finish in factory. Finish paint primed surfaces.

.17 Apply additional paint coats, beyond number of coats specified for any surface, to completely cover and hide substrate and to produce a solid, uniform appearance.

.18 Apply primer coat soon after surface preparation is completed to prevent contamination of substrate

.19 Provide paint coating thicknesses indicated, measured as minimum DFT.

3.10 MECHANICAL ELECTRICAL EQUIPMENT

.1 In finished areas paint exposed conduits, piping, hangers, ductwork and other mechanical and electrical equipment. Colour and texture to match adjacent surfaces, except as noted otherwise.

.2 In boiler room, mechanical and electrical rooms paint exposed conduits, piping, hangers, ductwork and other mechanical and electrical equipment.

.3 In other unfinished areas leave exposed conduits, piping, hangers, ductwork and other mechanical and electrical equipment in original finish and touch-up scratches and marks.

.4 Touch-up scratches and marks on factory-painted finishes and equipment with paint as supplied by manufacturer of equipment.

.5 Do not paint over nameplates.

.6 Keep sprinkler heads free of paint.

.7 Paint disconnect switches for fire alarm system and exit light systems in Red enamel.

.8 Paint all fire protection piping Red.

.9 Paint all natural gas piping Yellow.

.10 Paint both sides and edges of backboards for telephone and electrical equipment before installation. Leave equipment in original finish, except for touch-up, as required and paint conduits, mounting accessories and other unfinished items.

3.11 FIELD QUALITY CONTROL

.1 Field inspection of painting operations to be carried out by independent inspection firm as designated by Engineer.

.2 As work progresses and upon completion of work, submit written reports and manufacturers' confirmation that materials and application methods conform to manufacturers' requirements.

.3 Advise Engineer when each applied coating is ready for inspection. Do not proceed with subsequent coats until previous coat has been approved.

.4 Cooperate with inspection firm and provide access to all areas of the work.

.5 Non-Conforming Work:

.1 Replace damaged work which cannot be satisfactorily repaired, restored or cleaned, to satisfaction to Consultant at no cost to the Owner. Touch-up small affected areas, repaint large affected areas or areas without sufficient DFT of paint. Remove runs, sags, of damaged paint by scraper or by sanding prior to application of paint.

.2 Lack of uniformity – the following are considered non-conforming qualities:

.1 Brush/roller marks, streaks, laps, runs, sags, drips, heavy stippling, hiding or shadowing by inefficient application methods, skipped or missed areas and foreign materials in paint coatings.

.2 Evidence of poor coverage at rivet heads, plated edges, lap joints, crevices, pockets, corners and re-entrant angles.

.3 Damage due to touching before paint is sufficiently dry or any other contributory cause.

.4 Damage due to application on moist surfaces or caused by inadequate protection from weather.

.5 Damage and/or contamination of paint due to blown contaminants (dust, spray paint, etc.)

3.12 RESTORATION

.1 Clean and re-install all hardware items that were removed before undertaking painting operations.

.2 Remove protective coverings and warning signs as soon as practical after operations cease.

.3 Remove paint splashings on exposed surfaces that were not painted. Remove smears and splatter immediately as operations progress, using compatible solvent.

.4 Protect freshly completed surfaces from paint droppings and dust to approval of Engineer. Avoid scuffing newly applied paint.

.5 Restore areas used for storage, cleaning, mixing and handling of paint to clean condition as approved by Engineer.

3.13 WASTE MANAGEMENT

.1 Disposal of paint waste:

.1 Be responsible for removal and disposal of material and waste generated.

.2 Paint, stain and wood preservative finishes and related materials (thinners, solvents, etc.) are hazardous Products and are subject to regulations for disposal. Obtain information on these controls from applicable authorities having jurisdiction.

.3 Separate and recycle waste materials. Where paint recycling is available, collect waste paint by type and provide for delivery to recycling or collection facility. Treat materials that cannot be reused as hazardous waste and dispose of in an appropriate manner.

.4 Place materials defined as hazardous or toxic waste, including used sealant and adhesive tubes and containers, in containers or areas designated for hazardous waste.

.5 To reduce amount of contaminants entering waterways, sanitary/storm drain systems or into ground adhere to the following procedures:

.1 Retain cleaning water for water-based materials to allow sediments to be filtered out. In no case clean equipment using free draining water.

.2 Retain cleaners, thinners, solvents and excess paint and place in designated containers and ensure proper disposal.

.3 Return solvent and oil soaked rags used during painting operations for contaminant recovery, proper disposal, or appropriate cleaning and laundering.

.4 Dispose of contaminants in an approved legal manner in accordance with hazardous waste regulations.

.5 Dry empty paint cans prior to disposal or recycling (where available).

.6 Close and seal tightly partly used cans of materials including sealants and adhesive containers and store protected in well ventilated fire-safe area at moderate temperature.

.7 Set aside and protect surplus and uncontaminated finish materials not required by Owner and deliver or arrange collection for verifiable re-use or re-manufacturing.

.8 Cleaning

.9 Clean all surfaces to be painted as follows.

.10 Remove all dust, dirt and other surface debris by vacuuming and wiping with dry, clean cloths.

.11 Wash surfaces with solution of T.S.P. bleach and clean, warm water using a stiff bristle brush to remove dirt, oil and other surface contaminants.

.12 Rinse scrubbed surfaces with clean water until foreign matter is flushed from surface.

.13 Allow surfaces to drain completely and allow to dry thoroughly.

.14 To prepare surfaces for water-based painting, water-based cleaners should be used in place of organic solvents.

.15 Use trigger-operated spray nozzles for water hoses.

.16 Many water-based paints cannot be removed with water once dried. However, minimize the use of kerosene or any such organic solvents to clean-up water based paints.

.17 Prevent contamination of cleaned surfaces by salts, acids, alkalis, other corrosive chemicals, grease, oil and solvents before prime coat is applied and between applications of remaining coats. Apply primer, paint or pre-treatment as soon as possible after cleaning and before deterioration occurs.

.18 Sand existing surfaces with intact, smooth, high gloss coatings to provide adequate adhesion for new finishes.

END OF SECTION

DIVISION 12 INDEX

PHENOLIC RESIN LABORATORY CASEWORK

PART 1 GENERAL

1.1 SECTION INCLUDES

.1 Modular Phenolic Resin Casework

.2 Mobile Modular Phenolic Resin Casework

.3 Countertops

.4 Shelving

1.2 RELATED SECTIONS

.1 Division 06 Section 10 00, “Rough Carpentry and Wall Blocking”

.2 Division 09 Section 65 13, “Resilient Base and Accessories”

.3 Division 11 Section 53 00, “Laboratory Equipment”

.4 Division 12 Section 36 00, “Countertops”

.5 Division 22 Section 40 00, “Plumbing Fixtures”

.6 Related Work to Be Performed By Others:

.1 Final Installation of all plumbing, service and electrical fixtures attached to casework or countertop (excluding piping and wiring within fume hoods).

.2 Final Connection to service lines of all plumbing, service and electrical fixtures attached to laboratory casework or furniture.

1.3 REFERENCES

.1 AWI: Quality Standards, Second Edition

.2 ISO 9001:2015 – Quality Management International Standards Organization (ISO)

.3 FSC: Forest Stewardship Council

.4 ADA, ATBCB, ADAAG: Americans with Disabilities Act Accessibility Guidelines Americans with Disabilities Act

.5 AWI QCP

1.4 SUBMITTALS

.1 Product Data:

.1 Drawings shall include data and details for construction of the laboratory casework as well as information regarding the name, quantity, type and construction of materials (such as hardware, etc.), that will be used to complete the project.

.2 Shop Drawings:

.1 The laboratory casework manufacturer shall furnish shop drawings illustrating the layout and placement of all laboratory casework and fume hoods as well as any products included in this section.

.2 Indicate the type and location of all service fittings and associated supply connections.

.3 Preparation instructions and recommendations.

.4 Storage and handling requirements and recommendations.

.5 Installation methods.

.3 Selection Samples**,** Submit the following:

.1 Samples for Selection: Manufacturer's standard sample collection.

.2 One unit of each type of exposed hardware.

.3 One (1) 24” wide, full-height base cabinet: Construction to consist of one (1) drawer, one (1) door, with adjustable full depth shelf and related hardware (pulls, hinges, drawer slides, etc.).

.4 One 36” wide x 36” high wall cabinet: Construction to consist of two adjustable shelves as well as related hardware and doors.

.4 Quality Assurance / Control

.1 Design Data: Manufacturer shall submit design criteria which are in compliance with the project specifications.

.2 Manufacturers’ Instructions: Provide manufacturer’s instructions for installation and maintenance of all products provided and installed within this section.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Packaging, Shipping, Handling and Unloading:

.1 Packaging: Products shall have packaging adequate enough to protect finished surfaces from soiling or damage during shipping, delivery and installation.

.2 Shipping: Casework delivery shall only take place after painting, utility rough-ins and related activities are completed that could otherwise damage, soil or deteriorate casework in installation areas.

.3 Handling and Unloading: Care, such as the use of proper moving equipment, experienced movers, etc., shall be used at all times to avoid damaging the casework. Until installation takes place, any wrapping, insulation or other method of protection applied to products from the factory will be left in place to avoid accidental damage.

.2 Acceptance at Site:

.1 Casework will not be delivered or installed until the conditions specified under Part 3.2 of this document have been met. Products delivered to sites that are not enclosed and/or improperly conditioned will not be warrantied against warping or damage due to unsatisfactory conditions.

.3 Storage:

.1 Casework shall be stored in the area of installation. If, prior to installation, it is necessary for casework to be temporarily stored in an area other than the installation area, the environmental conditions shall meet the environmental requirements specified under the Project Site Conditions article of this Specification. An operational HVAC system that maintains temperature and humidity at occupancy levels must be in place.

.4 Waste Management and Disposal:

.1 The supplier of the laboratory casework is responsible for removing any waste or refuse resulting from the installation of, or work pertaining to laboratory casework; thereby leaving the project site clean and free of debris. Trash container(s) are to be provided by others.

1.6 QUALITY ASSURANCE

.1 Manufacturer Qualifications:

.2 The following list of information will be provided to the Architect at least ten (10) days prior to the bid opening:

.1 List of manufacturing facilities

.2 A list of ten (10) installations of comparable stature completed by their workforce within the past 5 years

.3 Construction details depicting the materials, sizes and methods of construction

.4 Independent laboratory test reports that include information, fume hoods and tabletop finish and performance

.5 SEFA member in good standing

.3 Mock-Ups

.1 Area mock-ups shall be as indicated on the shop drawings. Post bid mock-up areas must be priced for disassembly and reassembly and used within the project.

.2 Do not proceed with remaining work until installation is approved by Architect.

.1 Base cabinets installed with specified hardware.

.2 Wall cabinets installed with specified hardware.

.3 Workstation(s) installed.

.4 Fume hood(s) installed.

1.7 WARRANTY

.1 Furnish a written warranty that work performed under this Section shall remain free from defects as to materials and workmanship for a period of one (1) year from date of shipment. Defects in materials and workmanship that may develop within this time are to be replaced without cost or expense to the Owner. Damage caused by vandalism or improper storage of products as mentioned in Section 3.2 shall not be included within warranty.

.2 Defects include, but are not limited to:

.1 Cracked, or delamination

.2 Slippage, shift, or failure of attachment to wall, floor, or ceiling

.3 Structural failure

.4 Warping or unloaded deflection of components

.5 Failure of hardware

.3 The warranty with respect to products of another manufacturer sold by Mott Manufacturing is limited to the warranty provided by Mott Manufacturing. Products from another manufacturer that have longer warranty's than offered by Mott Manufacturing can be redeemed through the other manufacturer directly.

PART 2 PRODUCTS

2.1 APPROVED MANUFACTURERS

.1 Acceptable Manufacturer:

.1 Mott Manufacturing, 562 Industrial Park Rd. Maxwelton, WV, USA 24957
Tel: (519) 752-7825 Email: inquire@mott.ca www.mott.ca

.2 Fisher scientific Canada. https://www.fishersci.ca/ca/en/home.html

.3 Hemco
https://www.hemcocorp.com/labfurn.html?utm_source=chatgpt.com

.2 Substitutions:

.1 Must meet the previously stated manufacturer qualifications and have prior approval.

.3 [**OPTIONAL**]

.1 Requests for substitutions:

.2 All requests will be considered in accordance with provisions of Section 01 60 00.

2.2 MATERIALS

.1 Phenolic:

.1 Panels produced by a variety of material manufacturers can be selected to be used as the basis of construction material.

2.3 SPECIAL MATERIALS

.1 Glass:

.1 Glass for framed doors shall be 1/8" float glass (6mm thick on all floor cases and base cabinets) [or Selected Glass].

.2 Glass for unframed sliding glass doors shall be 6mm float glass **[or Selected Glass].**

[Glass Options]
- 6mm thick clear laminated safety
- 1/8" thick tempered
- 6mm thick tempered

2.4 CABINET CONSTRUCTION

.1 Door and Drawer Fronts: Fronts shall be made of 1/2" thick phenolic resin panels. All perimeter edges shall be machine polished and have the edges eased to remove sharpness.

.2 Face Style [OL1]: Full flush overlay door and drawer faces with 1/8" reveal vertically and horizontally between door and/or drawer faces. Door and drawer faces shall leave 1/16" reveals between door and/or drawer faces and the end panel of a cabinet.

[OR]

Face Style [OL2]: Revealed overlay door and drawer faces with 1/8" reveal vertically and horizontally between door and/or drawer faces. Door and drawer faces shall leave 1/4" reveals between door and/or drawer faces and the end of a cabinet.

.3 Shelves: Shelves shall be manufactured from 3/4" thick phenolic resin and 1" thick phenolic resin on >30" wide shelves. Shelves shall have the exposed front edge banded with a PVC edge banding. Full depth shelves are standard and shall come to within 3/4" of the face of the cabinet in open units and within 3/4" to the inside face of cabinet doors **[or Selected Shelf Depth Option]**.

[Selected Shelf Depth Options]
- half depth
- split depth

.4 Drawer Bodies: Drawer sides and back are to be constructed from 1/2" thick phenolic resin. Drawer sides shall be attached via dovetail joints at all four corners. Drawer bottom shall be 1/4" phenolic and shall be captured in all four sides of the drawer body and glued completely around the entire bottom.

.5 Cabinet Ends: Cores shall be made of 1/2" thick phenolic resin. All exposed perimeter edges shall be machine polished and have the edges eased to remove sharpness.

.6 Base Cabinet Support Rails: Top rail (front), and intermediate rails between drawers shall be phenolic resin being 3-1/2" by 3/4" thick; captured in slotted cabinet end and fastened to cabinet end panels from the top or through painted steel angles. Front edges shall be machine polished and eased to remove sharpness. Back rails (top & bottom) shall be phenolic resin 3/4" thick by 6-1/2". Rails shall be fastened to cabinet side panels using painted steel angles and into the floor panel.

.7 Cabinet Backs: Backs shall be made of 1/4" phenolic resin. Base cabinet backs shall be removable without using mechanical fasteners. Floor case and wall cabinet backs shall be fixed in place by means of the whole perimeter being inset into adjacent cabinet components.

.1 Optional on drawer cabinets per architect

.2 Mandatory on cabinets with doors

.3 Sink cabinets to have a partial back to allow for plumbing, etc.

.8 Framed Glass Hinged or Framed Glass Sliding Doors: 1/2" phenolic resin shaped to accept 1/8" float glass [or Selected Glass] on wall cabinets. All fronts shall be slightly eased at all edges. Glass to be 6 mm float glass [or Selected Glass] on floor cabinets. Hold glass in place with a removable plastic panel retainer to facilitate change of damaged glass. Provide sliding doors that slide in top channels with a nylon wheel operating on an inset aluminum track.

[Selected Glass] - 1/8" thick tempered

.9 Unframed Sliding Glass Doors: Unframed sliding doors to be 6 mm float glass [or Selected Glass] with all edges ground, pull handles shall be ground into glass. Glass set in an extruded aluminum shoe with nylon wheel assemblies and top and bottom extruded aluminum track. Provide silencer guides fitting on top of glass panel for smooth and noiseless operation.

[Selected Glass] - 6 mm laminated safety
- 6 mm tempered safety

.10 Tops and Bottoms of Floor and Wall Cases: Cabinets shall be enclosed with 3/4" thick phenolic resin panels with machine polished front edges. Tops and bottoms are captured by grooves in the end panels as well as fastened through painted steel angles to end panels.

.11 Security Panels: Shall be between all locking doors or drawers and vertically adjacent drawers when locks are specified as keyed differently.

.12 Vertical Dividers: Full height dividers and half height dividers shall be 1/2" thick phenolic resin matching cabinet body, secured to the bottom of the cabinet and

top rails with painted steel angles. Exposed edges shall be machine polished to match casework.

.13 Cabinet Bottom Base: Integral base shall support the structure above and provide a toe space that is 3" deep by 4" high. Toe space front shall be made of phenolic resin matching the rest of the cabinet.

2.5 HARDWARE

.1 Pulls:

.1 Door and drawer pulls shall be rectangular in shape with a brushed aluminum finish [or Selected Handle] mounted vertically on doors and horizontally on drawers. Two pulls shall be required on all drawers over 24" wide.

.2 **[Selected Handle]** - clear anodized aluminum, full width of door or drawer
- brushed stainless steel, 5/16" diameter wire on 4" centers
- clear anodized aluminum, 5/16" diameter wire on 4" centers

.2 Hinges:

.1 Hinges shall be European style with self-closing feature [or Selected Hinge type] able to open doors to 165°. Two hinges for doors less than 48" in height and three hinges on doors 48" or above in height.

[Selected Hinge Type] - stainless overlay five (5) knuckle with hospital tips
- self-closing 3-knuckle barrel style

.3 DELETE THE FOLLOWING PARAGRAPH IF EUROPEAN CONCEALED HINGES OR 3-KNUCKLE BARREL HINGES ARE SELECTED]

.4 Door Catches:

.1 Roller Catches: Shall be used on all hinged doors. Catches shall have a spring-loaded polyethylene roller and are provided with a steel strike plate [Or Selected Door Catch]. Double doors without locks shall have a catch on each door. Tall cases shall have latching devices located on upper and lower part of each door.

[Selected Door Catch Options] - Magnetic

.2 Elbow Catches: Catches and strike plates shall be used on left hand doors of double door cases where locks are used, and shall be steel, cadmium plated.

.5 Locks: **[OPTIONAL]**

.6 Locks shall be provided on casework drawers and hinged doors when indicated by the specified product number, shown on the drawings or called for in the casework schedule. Exposed surface of locks shall be chrome plated. All locks, for the purpose of coordinating keying systems, shall be removable-core disc tumbler type [or Selected Lock]. Locks are keyed individually unless otherwise specified to be furnished with master keys, grand master keying is not provided unless specified prior to bidding time.

.1 **[Selected Lock]** - removable-core disc tumbler, keyed in groups per room with master key

.2 - removable-core pin tumbler with 3-Levels, keyed individually with master keys, and grand master key

.3 - removable-core pin tumbler with 3-levels, keyed alike in groups with master keys, and grand master key

.7 Sliding Framed Glass Doors: Locks shall be plunger style sliding showcase locks which are to be of the same type as those selected above.

.8 Sliding Glass Doors: Locks shall be ratchet type sliding showcase locks which are to be of the same type as those selected above.

.9 Drawer Slides:

.1 Drawer slides for standard drawers shall be grade ‘1’ 100 lbs ball bearing full extension type [or Selected Slide], and 200lbs ball bearing full extension type on all file drawers [or Selected Slide].

.10 **[Selected Slides]**

.1 - 200 lbs - full extension type – zinc plated

.2 - 100 lbs - full extension type with soft/self-close feature – zinc plated

.3 - 200 lbs - full extension type with soft/self-close feature – zinc plated

.11 Shelf Support Clips:

.1 Shelf support clips shall be twin pin plastic seismic shelf supports [or Selected Shelf Clip], for mounting on interior of cabinets. Clips shall be corrosion resistant and shall retain shelves from accidental removal. Shelves are adjustable on 1-1/4” centers.

.2 [Selected Shelf Clip Options]

.1 - single steel pin

.2 - semi-recessed pilaster with shelf clips

.12 Mobile Cabinets:

.1 Mobile cabinets shall be provided with four caster wheels and brakes in lieu of the 4” toe kick. Caster mounting plates shall be 3-1/2” high from the ground and able to carry 165 lbs per wheel [or Selected Caster Wheels]. Counterweights shall be installed to prevent drawers holding 50 lbs from tipping the cabinet. Banks of drawers used on mobile cabinets

shall incorporate an interlocking feature allowing only one drawer to open at a time.

.2 **[Selected Caster Wheel Option]** - Caster mounting plates shall be 4" high from the ground and able to carry 250 lbs per wheel.

PART 3 EXECUTION

3.1 INSTALLERS

.1 Installer Qualifications:

.1 Installer shall have a minimum of 5 years continued experience in installation or application of systems similar to those required for this project.

.2 Installer shall be authorized by either the distributor or manufacturer. Warranty will be void if unauthorized installer executes the installation.

3.2 EXAMINATION

.1 Site Verification of Conditions:

.2 Casework will not be delivered or installed until the following conditions have been met:

.1 Building must be enclosed (windows and doors sealed and weather-tight);

.2 An operational HVAC system that maintains temperature and humidity at occupancy levels must be in place;

.3 Ceiling, overhead ductwork and lighting must be installed;

.4 Site must be free of further construction such as "wet work";

.5 Required backing and reinforcements must be installed accurately and the project must be ready for casework installation.

.3 Note:

.1 In the event that any of the specified requirements for installation are not present at the time of requested delivery, the general contractor or owner must provide the casework manufacturer with a letter of deviation that releases the manufacturer from any responsibility or liability from any damage to the products resulting from the unfavorable building conditions.

3.3 INSTALLATION

.1 Casework Installation:

.1 Casework shall be set with components plumb, straight and square, securely anchored to building structure with no distortion. Concealed shims shall be used as required.

.2 Cabinets in continuous runs shall be fastened together with joints flush, uniform and tight with misalignment of adjacent units not to exceed 1/16 of an inch.

.3 Wall casework shall be secured to walls that are structural enough to withstand load capacity required by cabinets.

.4 Top edge surfaces shall be abutted in one true plane. Joints are to be flush and gap shall not exceed 1/8 of an inch between tops units.

.5 Casework and hardware shall be adjusted and aligned to allow for accurate connection of contact points and efficient operation of doors and drawers without any warping or binding.

.2 Countertop Installation:

.1 Countertops are to have been fabricated in lengths according to drawings, with ends abutting tightly and sealed with corrosion resistant sealant.

.2 Tops will be anchored to base casework in a single true plane with ends abutting at hairline joints with no raised edges at joints.

.3 Joints shall be factory prepared having no need for in-field processing of top and edge surfaces.

.4 Joints shall be dressed smoothly, surface scratches removed and entire surface cleaned thoroughly.

3.4 CLEANING

.1 Ensure all products are unsoiled and match factory finish. Remove or repair damaged or defective units.

.2 Clean all finished surfaces, including drawers and cabinet shelves, and touch up as necessary.

.3 Countertops shall be cleaned and free of grease or streaks.

3.5 PROTECTION

.1 Counter tops and ledges shall be protected with ¼" ribbed cardboard for the remainder of the construction process.

.2 Examine casework for damaged or soiled areas; replace, repair, and touch-up as required.

.3 Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

COUNTERTOPS

PART 1 GENERAL

1.1 INTENT

.1 Conform to the sections of Division 1 as applicable.

.2 The subsequent specifications are designed to describe to the provider of the countertops the standards and expectations that the owner and architect allow for a quality and functional installation of the countertops.

1.2 SCOPE OF WORK

.1 Work supplied under this section includes the following:

.1 Modular Casework
.2 Mobile Modular Casework
.3 Mobile Workstations
.4 Stainless Steel Casework
.5 Overhead Service Carriers
.6 Shelving
.7 Electrical Fixtures

1.3 RELATED SPECIFICATION SECTIONS

.1 In addition to the general project requirements in Division 1, the following sections are referenced in this section:

.1 Division 15 - Mechanical
.2 Related Work to Be Performed by Others:
.3 Final installation of all plumbing, service and electrical fixtures attached to casework or countertop (excluding piping and wiring within fume hoods).
.4 Final connection to service lines of all plumbing, service and electrical fixtures attached to laboratory casework or furniture.

1.4 CODE AND REGULATORY REQUIREMENTS

.1 All products shall conform to the following standards and regulations:

.1 SEFA 8: Laboratory Furniture – Casework, Shelving and Tables Guidelines

.2 Science Equipment and Furniture Association (SEFA):

.1 ISO 9001:2000 – Quality Management

.3 International Standards Organization (ISO):

.1 ADA (ATBCB ADAAG) Americans with Disabilities Act Accessibility Guidelines

.4 Americans with Disabilities Act (ADA).

1.5 QUALITY ASSURANCE

.1 Manufacturer Qualifications:

.1 Must be ISO certified.

.2 SEFA

.3 A list of ten (10) installations of comparable stature completed within the past 5 years.

.4 10 years experience manufacturing metal laboratory casework.

.5 Construction details depicting the materials, sizes and methods of construction.

.6 Independent laboratory test reports that include information on cabinet, fume hood and table top finish and performance that have been conducted within the last two years.

1.6 QUALITY ASSURANCE

.1 In addition to the requirements of 01450 – Quality Control, the following measures are required.

1.7 SUBMITTALS

.1 Complete submittals in accordance with Specification Section 01 33 00.

PART 2 PRODUCTS

2.1 DESIGN CRITERIA

.1 Panels shall be of material specifically designed for laboratory work surfaces. Fabricated work surfaces shall comply with all current codes and regulations. Tops and shelves shall have uniform thickness (+0.03) and flatness (maximum difference of 0.03") for 10 foot span.

.2 Panels to be UL registered and labeled for quality consistency.

.3 Chemical Resistance: Evaluation of chemical resistance is based on SEFA's (Scientific Equipment and Fixture Association) standard list of 49 chemicals/concentrations, their required methods of testing and their minimum acceptable results as a means of establishing a minimum acceptable level of performance for all exposed and semi-exposed surface.

.4 Panels to have screw pull-out strength minimums per following chart (lbs):

Screw	#6	#8	#10	#12	¼"	5/16"	3/8"	7/16"	½"
Dept: 1/2"	250	308	340	350	450	570	685	790	900

Panels: 5/8"	310	370	435	492	560	710	855	990	1,100
Panels: ¾"			518	590	680	850	1,000	1,200	1,400

.5 Uniform load to cause no more than ¼" deflection at center of the span:

Thickness	12"x24"	12"x36"	12"x48"	24"x36"
½" panels:	370	110	45	220
5/8" panels:	690	210	85	410
¾" panels:	1,400	401	172	800
1" panels:	2,605	785	335	1,500

.6 Chemical Resistance Test Results:

Level 0 = No detectable change,
Level 1 = Slight change in colour or gloss,
Level 2 = Slight surface etching or severe staining,
Level 3 = Pitting, cratering, swelling, erosion of coating. Obvious & significant deterioration.

Chemical Reagent	Black	Chemical Reagent	Black
1. Amyl Acetate	0	26. Tincture of Iodine	0
2. Ethyl Acetate	0	27. Methyl Ethyl Ketone	1
3. Acetic Acid, 98%	0	28. Methylene Chloride	0
4. Acetone	0	29. Monochlorobenzene	0
5. Acid Dichromate, 5%	0	30. Napthaline	0
6. Butyl Alcohol	0	31. Nitric Acid 20%	0
7. Ethyl Alcohol	0	32. Nitric Acid, 30%	0
8. Methyl alcohol	0	33. Nitric Acid, 70%	1
9. Ammonium Hydroxide, 28%.	0	34. Phenol, 90%	0
10. Benzene	0	35. Phosphoric Acid, 85%	0
11. Carbon Tetrachloride	0	36. Silver Nitrate	0
12. Chloroform	0	37. Sodium Hydroxide, 10%	3
13. Chromic Acid, 60%	2	38. Sodium Hydroxide, 20%	3
14. Cresol	0	39. Sodium Hydroxide, 40%	3
15. Dichloroacetic Acid	0	40. Sodium Hydroxide Flakes	0
16. Dimethylformamide	0	41. Sodium Sulfide,Saturated Solut	0
17. Dioxane	0	42. Sulfuric Acid, 33%	0
18. Ethyl Ether	0	43. Sulfuric Acid, 77%	0
19. Formaldehyde	0	44. Sulfuric Acid, 96%	0
20. Formic Acid	0	45. 50% Sulfuric Acid (77%) +50% Nitric Aid (70%)	2
21. Furfural	0	46. Toulene	0
22. Gasoline	0	47. Trichloroethylene	0
23. Hydrochloric Acid,	0	48. Xylene	0

37%			
24. Hydroflouric Acid, 48%	1	49. Saturated Zinc Chloride	0
25. Hydrogen Peroxide	0		

2.2 APPROVED MANUFACTURERS

.1 Mott Manufacturing, 562 Industrial Park Rd. Maxwelton, WV, USA 24957 Tel: (519) 752-7825 Email: inquire@mott.ca www.mott.ca

.2 JHC Lab-Resin, 595 Berriman Street, Brooklyn, New York, USA, 11208, Phone:(718) 649-1661, e-mail: info@jhclabresin.com, URL: www.jhclabresin.com.

.3 Hamilton Scientific and Laboratory Design and Supply Inc., 825 East Albert Drive, Manitowoc, Wisconsin, 54220 tel: 920.657.1970

.4 Equivalent products may be submitted for Engineer's approval providing the product submitted meets or exceeds the performance criteria of the products specified.

2.3 MATERIALS

.1 Phenolic Resin Work Surface Lab grade:

.1 Thickness: 1"

.2 Color: Black Non-Glare Matt (NGM) Low gloss smooth finish - NGM M-808

2.4 FABRICATION

.1 Drip grooves shall be provided on the underside at all exposed edges.

.2 All exposed edges to be sanded to a smooth finish and, except as indicated below shall be rounded to a ¼" radius at front top edge and at vertical corners.

.3 Fix work surface panels. Use #10, type A sheet metal screws sized to stop at least 1/8" short of the finished face. Pre-drill panel with an 11/64" diameter high speed drills bit aligned with 7/32" clearance holes in the supporting structure.

.4 Curbs shall be bonded to the top of the work surface to form a square joint.

.5 Cutouts for under-mounted sinks shall be routed and sanded to form smooth edged openings with the top edge radiused to approximately 1/8". The bottom edge of the sink opening shall be finished smooth with the edge broken to prevent sharpness. Corners of sink cutouts shall be radiused not less than ¾". Under-mounted sinks shall be supported by brackets blind-fixed to the underside of the work surface.

.6 Exposed edges must have a finished black core.

.7 TECHNICAL DATA SHEET.

Performance Properties as per NEMA Standards

Coefficient of liner	Test	Results
Expansion	ASTM D696	1.65 x 105 in/degC
Comprehensive Strength	ASTM D695	43,000 PSI
Fire Resistance	ASTM D635	Self Extinguising

Performance Properties as per NEMA Standards (continued)

Coefficient of liner	Test	Results
Flexural Strength	ASTM D790	
Ultimate		23,000 PSI
Modulus		15,000 PSI
Impact Strength	ASTM D256	.68 Ft-lbs inch
Tensile Strength	ASTM D638	
Ultimate		22,000 PSI
Modulus		17,000 PSI
Rockwell Hardness	ASTM D785	120
Water Absorbtion	ASTM D570	0.30%
Direct Flame Resistance	Bunsen Burner	3 minute

PART 3 EXECUTION

3.1 INSTALLERS

.1 Installer Qualifications:

.1 Installer shall have a minimum of 5 years continued experience in installation or application of systems similar to those required for this project.

.2 Installer shall be authorized by either the distributor or manufacturer. Warranty will be void if unauthorized installer executes the installation.

3.2 EXAMINATION

.1 Site Verification of Conditions:

.1 Countertop will not be installed until the following conditions have been met:

.2 Building must be enclosed (windows and doors sealed and weather-tight);

.3 An operational HVAC system that maintains temperature and humidity at occupancy levels must be in place;

.4 Ceiling, overhead ductwork and lighting must be installed;

.5 Site must be free of any further construction such as “wet work.”

3.3 INSTALLATION

.1 Countertop Installation:

.1 Countertops are to have been fabricated in lengths according to drawings, with ends abutting tightly and sealed with corrosion resistant sealant.

.2 Tops will be anchored to base casework in a single true plane with ends abutting at hairline joints with no raised edges at joints.

.3 Joints shall be factory prepared having no need for in-field processing of top and edge surfaces.

.4 Joints shall be dressed smoothly, surface scratches removed and entire surface cleaned thoroughly.

3.4 CLEANING

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

.2 Progress Cleaning: Perform cleanup as work progresses

.1 Leave work area clean at end of each day.

.3 Final cleaning: Upon completion, remove surplus materials, rubbish, tools, and equipment

.4 Waste Management:

.1 Collect recyclable waste and dispose of or recycle field generated construction waste created during construction or final cleaning related to work of this Section.

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

3.5 PROTECTION:

.1 Counter tops and ledges shall be protected with 1/4 inch ribbed cardboard for the remainder of the construction process.

.2 Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

DIVISION 13 INDEX

CHEMICAL RESISTANCE COATING

PART 1 GENERAL

1.1 GENERAL

.1 The Contractor shall supply labour, materials and equipment for the complete installation of the chemically resistant coating on all interior concrete surfaces as listed on the drawings. General floor coating shall form a covered 150 mm curb along all walls and cover all maintenance pads in all rooms. Protective coating in the chemical containment areas shall be finished from finished floor to top of all containment walls and curbs height as shown on drawings.

1.2 SUBMITTALS

.1 Production Data: Submit manufacturer's technical data, installation instructions and general recommendations for each resin system required.

.2 Samples: Submit, for verification purposes, 300 mm x 300 mm square samples of each type of resin system required, applied to rigid backing, in colour and finish indicated.

1.3 QUALITY ASSURANCE

.1 Single Source Responsibility: Obtain primary protective resins including primers, resins, hardening agents, finish or sealing coats from a single manufacturer with not less than 10 years of successful experience in manufacturing the principle materials described in this section. Contractor must have completed at least five (5) projects of similar size and complexity. Provide secondary materials only of type and from source recommended by manufacturer of primary materials.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver material to job site. Contractor will check material for completeness and shipping damage prior to job start.

.2 Store material in a dry, enclosed area protected from exposure to moisture. Temperature of storage area shall be maintained between 16º and 32ºC (60º and 90ºF).

1.5 REFERENCES

.1 American Society for Testing and Materials (ASTM):

.1 ASTM D16-14 - Standard Terminology Relating to Paint, Related Coatings, Materials and Applications

.2 ASTM D4259-88 (2012) - Standard Practice for Abrading Concrete

.3 ASTM D4263-83 (2012) - Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method

.4 ASTM F1869-11 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride

.2 International Concrete Repair Institute (ICRI)

.1 Guideline No. 310.R-2013: Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, and Polymer Overlays

.3 Society for Protective Coatings (SSPC)

.1 SSPC-TR 5/ICRI Technical Guideline 03741/NACE 02203 - Design, Installation, and Maintenance of Protective Polymer Flooring Systems for Concrete

.2 SSPC-Guide 20 - Procedures for Applying Thick Film Coatings and Surfacings Over Concrete Floors

.3 SSPC-TU 2/NACE 6G197 - Design, Installation, and Maintenance of Coating Systems for Concrete Used in Secondary Containment

.4 SSPC SP13/NACE No. 6 - Surface Preparation of Concrete

.5 References herein are as detailed in Systems and Specifications SSPC Painting

.6 Manual, Volume 2, published by the Society for Protective Coatings (formerly the Steel Structures Painting Council), 40 24th Street 6th Floor, Pittsburgh, PA, 15222-4656 (www.sspc.org).

.4 NACE International (NACE)

.1 NACE SP0892-2007 - Coatings and Linings over Concrete for Chemical Immersion and Containment Service

.2 References herein are as published by NACE International (the National Association of Corrosion Engineers), Technical Practices Committee, 1440 South Creek Drive, Houston, Texas, 77084-4906 (www.nace.org).

1.6 DEFINITIONS

.1 Dry Film Thickness (DFT): Thickness of a coat of paint in fully cured state measured in mils (1/1000 inch)

PART 2 PRODUCTS

2.1 MANUFACTURER

.1 Carboline, 95 Sunray Street, Whitby, ON, Canada L1N 9C9, (647)-226-5275, email: pescudero@carboline.com, URL: www.carboline.com

.2 PPG, 8200 Keele Street, Concord, ON, Canada L4K 2A5, (416)-522-4196, email: kevin.boichuk@ppg.com, URL: www,ppg.com

.3 Tnemec Company, Missouri, USA, (905)-339-8386, email: dwalker@tnemec.com, URL: www.tnemec.com.

.4 Sika Canada Inc., 6915 Davand Drive, Mississauga, ON, Canada, (416)-573-7223, email: dolenc.greg@ca.sika.com, URL: www.sika.ca

2.2 MATERIALS

.1 Type 1 – Chemically resistant coating for interior floors, to protect against splash and spill:

.1 Coating Systems for:

.1 Alum 45-55%

.2 Acceptable Systems:

.1 Stoncor: Stonclad HT + HT4

.2 PPG: Amercoat 240

.3 Tnemec: Series 237SC/280

.4 Sika: Sikafloor 82 EpoCem with Sikagard CRV10

.2 Colour

.1 Floor and wall coatings, concrete curbs and pads shall be colour Stonhard GS4-6003 Silver Grey or Tnemec 31GR Silver Gray or Sika Agate Gray RAL 7038 or approved equal.

.2 Lining system colour to be manufacturer's standard gray

PART 3 EXECUTION

3.1 EXECUTION

.1 Concrete substrate must be properly cured for a minimum of 30 days. A calcium chloride test in accordance ASTM F1869 is required to determine acceptable moisture content of any horizontal concrete surfaces. All vertical concrete surfaces shall be tested in accordance with ASTM D4263.

.2 Temperature: Utilities, including electric, water, heat (air temperature between 16º and 32ºC) and finished lightning to be supplied by General Contractor. Maintain ambient temperature of not less than 18ºC and a floor temperature of not less than 16ºC from seven (7) days before installation to at least 48 hours after completion of work and maintain relative humidity not higher than 40 percent during same period.

.3 Moisture: Ensure substrate is within moisture limits prescribed by the coating or lining manufacturer.

.4 Safety: Comply with requirement of Workplace Hazardous Material Information Systems (WHMIS) regarding the use, handling, storage and disposal of hazardous materials.

.5 Job area to be free of other trades during and, for a period of 24 hours, after coating and lining installation.

.6 Protection of finished surfaces from damage by subsequent trades is the responsibility of the General Contractor.

.7 Manufacturer's representative must be on the job site at start of installation.

3.2 PREPARATION

.1 Substrate: Concrete surfaces shall be prepared to CSP 4 to 6. by mechanical means such as a shot blast (blastrac) machine or sand blasting for removal of bond inhibiting materials such as curing components and laitance. Work to be completed in accordance with SSPC SP13/NACE No. 6 and ICRI Guideline 310.2R-201303732. In no case shall acid etching be utilized as the surface preparation method.

.2 All coating surfaces shall be dried, brushed and vacuumed before primer is applied.

.3 A manufacturer's representative shall visit the site, arranged by the Contractor, and review the substrate preparation before any product is applied. The representative shall confirm in writing that the area is suitably prepared. This written confirmation is required to be submitted to the engineer before product is applied.

3.3 TYPE 1: LINING APPLICATION

.1 Control Joint and Crack Treatment: All shrinkage cracks and control joints to be treated with a flexible reinforced system such as Stonhard Stonproof CT5 or Tnemec Series 206 or Sika Sikaflex 2C NS or SL in accordance with SSPC TU 2/NACE 6G197 Technology Update Report Figure 7. Bidder shall estimate 10 percent of surface area for such treatment and provide a linear foot price for additions and deletions.

.2 Key In: Create key in terminations at all lining terminations as shown in Figure 8 of the SSPC TU2/NACE 6G197 Technology Update Report.

.3 Primer: Mix and apply primer over properly prepared substrate with strict adherence to manufacturer's installation procedures and coverage rates. Coordinate timing of primer application with application of troweled mortar to ensure optimum adhesion between resinous lining materials and substrate

.4 Mortar: Mix mortar material according to manufacturer's recommended procedures. Uniformly spread mortar over substrate. Hand trowel apply mixed material over freshly primed substrate

.5 Engineering Fabric: Embed fabric into mortar material with strict adherence to manufacturer's installation procedures

.6 Saturant: Uniformly roll the saturant into the fiberglass fabric as recommended in manufacturer's application procedures

.7 Topcoat: Remove any surface irregularities. Mix and apply resin finish topcoat with strict adherence to manufacturer's installation procedures.

3.4 CURING, PROTECTION AND CLEANING

.1 Cure flooring and lining materials in compliance with manufacturer’s directions, taking care to prevent contamination during stages of application and prior to completion of curing process. Close area of application for a minimum of 24 hours.

.2 Protect resinous systems from damage and wear during construction operation. Where temporary covering is required for this purpose, comply with manufacturer’s recommendations for protective materials and method of application. General Contractor is responsible for protection and cleaning of surface after final coats.

END OF SECTION

DIVISION 14 INDEX

TRAVELLING BRIDGE CRANE

PART 1 GENERAL

1.1 SCOPE

.1 This section covers one (1) travelling bridge crane, complete with trolley and hoist, which shall be installed in the filter room of the Tertiary/UV Building.

.2 The crane shall have an electrically operated bridge, an electrically operated trolley and an electrically operated hoist.

.3 Crane rails shall conform to latest governing standards and as specified herein.

.4 The travelling bridge crane shall be furnished and installed in the location and arrangement as indicated on the drawings, complete with all hoisting equipment, electrical wiring including collectors, conductors and conductor supports, controllers, pendant control station, power feed disconnect switch and all other accessories necessary for a complete and properly operating installation.

1.2 GENERAL

.1 Equipment and accessories furnished and installed under this section shall be fabricated, assembled, erected and placed in proper operating condition in full conformity with drawings, specifications, engineering data, instructions and recommendations of the equipment manufacturer, unless exceptions are noted by the Engineer.

.2 The bridge crane assembly shall consist of structural members fabricated by the crane supplier and components (end trucks, wheels, bridge drive mechanism, trolley and hoist).

.3 The bridge crane assembly shall be pre-assembled and run in the shop, then match marked and disassembled for shipment conforming to manufacturer's quality control procedures.

.4 General Equipment Stipulations: The general equipment stipulations shall apply to the equipment furnished under this section.

.5 Reference Standards:

.1 ASME HST-4 - 2021 Performance Standard for Overhead Electric Wire Rope Hoists

.2 ANSI MH 27.1-2016 - Specifications for Under-Hung Cranes and Monorail Systems

.3 CSA B167-16 (R2021) – Overhead cranes, gantry cranes, monorails, hoists, and jib cranesCSA C22.2 No. 33-2023 - Electrical safety requirements for cranes and hoists

.4 CSA C22.1-21 - Canadian Electric Code

.5 CSA G40.20-13/G40.21-13 (R2023) General requirements for rolled or welded structural quality steel/Structural quality steel

.6 CSA S16-19 – Design of Steel Structures

.7 CSA W47.1-19 - Certification of Companies for Fusion Welding of Steel Structures

.8 CSA W59-18 – Welded Steel Construction

.9 Ontario Hydro Electrical Safety Code

.10 Ontario Occupational Health and Safety Act and Regulations

.11 CMAA (Crane Manufacturers Association of America) Specification No. 70 – 2020, Multiple Girder Cranes

.12 CMAA (Crane Manufacturers Association of America) Specification No. 74 – 2020, Single Girder Cranes

.6 Power Supply: Power supply to the equipment will be 600 volts, 60 Hz, 3 phase.

.7 Labels: Each bridge, trolley and hoist shall each have a conspicuous, easy-to-read label showing manufacturer's name, crane serial number and rated capacity. The rated capacity of each hoist shall also be shown on the load block.

.8 Painting: Shop painting as per manufacturer’s recommendation.

1.3 SUBMITTALS

.1 Make submittals in accordance with Section 01 33 00 – Submittals.

.2 Provide sufficient detail to show the general construction pertinent to the proper review of the equipment. Description of the materials of construction of the major components, including:

.1 General assembly drawings of bridge, trolleys, hoists and other major components.

.2 Details of crane rails, suspension fittings, safety stops, bumpers and all required connections.

.3 Details of electrical conductors and collectors.

.4 Hoist hook travel range and lifting range.

.5 Indicate design forces/reactions forces induced by the operation of the crane system.

.6 Drawings and product specification to be signed and sealed by a Professional Engineer registered in the Province of Ontario.

.3 A precise list of all electrical requirements for the equipment, including all controls, monitoring equipment and instruments shall be given, including all power characteristics and materials of construction.

.4 The Supplier shall indicate a list of spare parts that they recommend be purchased and individual prices for each item.

.5 All ancillary equipment to be provided by the Supplier shall be listed.

.6 Special accessories or tools for the adjustment or removal of parts required for any piece of equipment shall be listed and furnished as part of the supply.

.7 Submit installation manuals before shipping equipment.

.8 Submit load testing plans and certified load test results of the bridge crane assembly.

.9 Submit Operating and maintenance manual.

1.4 QUALIFICATIONS

.1 Supplier shall have a minimum of five (5) years of recent manufacturing experience in the hoist, crane and monorail business.

1.5 MAINTENANCE DATA

.1 Refer to Section 01 77 00 – Closeout Procedures.

1.6 MEASUREMENT AND PAYMENT

.1 Work outlined in this section is included in the lump sum tender price.

1.7 STORAGE

.1 The equipment and accessories shall be stored indoors in a dry area in accordance with the manufacturer's recommendations.

PART 2 PRODUCTS

2.1 PERFORMANCE AND DESIGN REQUIREMENTS

.1 The travelling bridge crane shall be a shop-assembled unit with top-running bridge. The bridge crane assembly shall be designed for the following conditions:

Crane Classification	CMAA Class A - Indoor
Hoisting capacity	6.3 metric tonnes
Distance centre-to-centre of crane rails	12,150 mm
Approximate overall length of crane rails	15 m
Maximum available distance from center line of crane rails to face of wall/columns, each side	200 mm
Top of concrete corbel	El . 84.000 m
Operating floor elevation	El. 79.322 m

Distance of pendant control station above operating floor	900 mm
Crane speeds at rated capacity:	
Bridge	40 m/min
Trolley	20 m/min
Hook	8 / 1.0 m/min
Required Hook travel:	
Hook at highest position EL	El. 83.275 m
Hook at lowest position EL	El. 75.668 m
Importance Category	Post-Disaster

.2 Operating Conditions

.1 The following site operating and water quality conditions must be assumed for all design calculations:

.1 40ºC maximum/5ºC minimum ambient air temperature.

.2 95 percent maximum relative humidity (non-condensing).

.3 Fully enclosed facility.

2.2 ACCEPTABLE MANUFACTURERS

.1 Equipment must be supplied from one of the following acceptable manufacturers:

.1 Liftsafe Engineering and Service Group Inc.

.2 Zelus Material Handling

.3 Kone Cranes

.4 Columbus McKinnon Corporation

.5 RWS Hoist and Cranes Inc.

2.3 BRIDGE

.1 The bridge shall be supported on continuous concrete corbels at each end, rigidly supported by end trucks and shall be designed to run on the top of the crane rails. The bridge shall be constructed to accommodate a bottom running hoist trolley. The flange wearing surface of bridge and trolley interface shall be either specially fabricated flanges or standard flanges ground smooth.

.2 Steel design and fabrication shall comply with applicable portions of the specifications of the American Institute of Steel Construction and CSA S16. Loadings, impact allowances, fatigue and allowable stresses shall be in accordance with the governing standards. Deflection of the main girder for a single girder bridge or either girder for a double girder bridge shall not exceed 1/800th of the span, with the maximum hoist load

.3 End Trucks: End trucks, each fabricated from structural steel members, shall be designed to distribute the loading equally to each wheel, shall be securely

attached to the beam by welding or with fitted bolts in reamed holes and shall be provided with heavy gusset plates to ensure adequate rigidity and squareness. Each truck shall have heavy end plates to engage the stops on the crane rails. End truck shall have a wheelbase of approximately 1/7th the bridge span.

.4 The end trucks and wheels shall be designed to operate on the crane rails and shall clear the standard ASCE crane rail fittings, anchors and splices.

.5 Wheels: Bridge crane wheels shall be of the double flange type, made of rolled, forged or cast steel, with machined universal crowned or tapered hardened treads, designed to operate on the specified runway. One (1) wheel in each truck shall have integrally cut spur gear teeth or machine-cut gears pressed on hubs to serve as drive wheels. The other wheels shall be idlers. Axles may be either rotating or fixed type. Wheel bearings shall be permanently shielded, lifetime-lubricated, antifriction type, adequate for radial and end thrust loading.

.6 Bridge Drive Mechanism: The bridge drive shall consist of a two-speed electric motor, enclosed reduction gearing and a cross shaft to drive one (1) wheel of each end truck. The shaft shall be designed to withstand torsional strain and shall be supported with self-aligning, lifetime-lubricated bearings at intervals sufficient to prevent distortion of the shaft.

.7 The drive motor shall contain a built-in adjustable mechanical brake. The bridge brake shall be solenoid operated, adjustable shoe or disc type, acting directly on the bridge drive motor shaft.

.8 Gearing shall be helical, spur or herringbone type, made from rolled or cast steel and shall have machine-cut teeth. All shafts shall be made from alloy steel and shall be heat treated.

.9 The bridge travel shall have the ability to automatically reduce its speed near the ends of the runway.

2.4 CRANE RAIL AND ASSEMBLY

.1 The crane rail shall be ASCE 40.

.2 Rail assembly to be complete with epoxy grout layer, neoprene bearing pads, intermittent soleplates, adjustable (weldable/bolted) rail clips and drill and resin anchor bolts. Securing crane rail shall be as recommended by Gantrex or equivalent.

.3 Design loads shall be as per the requirements of the selected bridge crane.

.4 The rail assembly shall all be hot-dipped galvanized following ASTM A123.

2.5 TROLLEY AND HOIST

.1 The trolley and hoist shall be bottom running. The hoist shall be of the electric wire rope type.

.2 Trolley: The trolley frame shall be rigid, shall support the hoist and shall be electrically driven type.

.3 The trolley drive shall be a sealed worm or spur gear unit, permanently lubricated with an oil bath.

.4 Wheels shall be single flange type, made from rolled, forged or cast iron. Trolley drive wheels shall have integrally cut spur gear teeth or machine-cut gears pressed on hubs. Wheel bearings shall be permanently shielded, re-greaseable, tapered roller type, adequate for radial and end thrust loading.

.5 Hoisting Assembly and Wire Rope: Electric hoists shall consist of a two-speed electric motor, a grooved winding drum and gearing. Antifriction bearings shall be used throughout. The winding drum shall have machined grooves designed to receive the full run of hoisting cable without over-wrapping. True Vertical Lift shall be provided as stated in the performance and design requirements. The ratio between the diameter of the drum and the diameter of the hoisting cable shall be at least 20 to 1. At least two (2) laps of cable shall remain on the drum when the lifting hook is in the lowest position. Rope shall be Carbon steel hoist wire rope.

.6 Hoist gearing shall be spur or helical type and shall be fully enclosed in an oil-tight housing. All bearings shall be antifriction type with oil lubrication or lifetime grease packing.

.7 The hoist shall be provided with mechanical and electrical load brakes arranged so that the load may be raised or lowered by electric power and automatically sustained at any position of the hook when the power is cut off. The mechanical load brake shall prevent acceleration of the load when lowering and shall completely sustain the load when brought to rest, independent of the electric brake. The electric brake shall be released whenever current is flowing to the hoist motor and shall be automatically activated when the current is shut off or interrupted. The mechanical load brake shall operate in oil in a sealed enclosure.

.8 The hoist shall be provided with adjustable limit switches to stop the hoisting mechanism at the upper and lower limits of hook travel.

.9 The lifting tackle shall consist of a lower block and hook, necessary sheaves and wire rope, made especially for hoisting service. Wire rope shall be as recommended by the rope manufacturer for use on the specified drum. The lower block shall be of the safety type with guarded sheaves. The sheaves shall have antifriction or sleeve type bearings.

.10 Hooks: Each load hook shall be slow opening, non-fracturing, forged steel and shall be provided with a safety latch. The hooks shall be mounted on antifriction bearings to permit easy turning.

.11 Self-Locking Worm Gears: Each hoist shall be equipped with self-locking worm gears.

2.6 BUMPERS AND STOPS

.1 Bumpers and stops in compliance with the governing standards shall be installed on the bridge, trolley and crane rails. The bumpers and stops shall be located so that no part of the bridge or trolley encroaches on the clearances specified or indicated on the drawings.

.2 Mechanical Bumpers or force stops to be located at all bridge and crane rail ends in case of brake failure in any direction of travel.

.3 Mechanical hoist to be equipped with safety catch rated to withstand impact from the maximum allowable load dropped from highest point of loading.

2.7 ELECTRICAL

.1 Motors: Motors shall be high-starting torque, squirrel-cage, totally enclosed type, designed especially for crane and hoist service and suitable for operation on the power supply specified. Motor size and speed shall be adequate to start the fully rated load capacity. Refer to Division 26 for motor specifications. Motors shall be rated to operate at 600V, 3 phase.

.2 Controllers: Control of hoist, trolley and bridge motions shall all be from a single pendant push-button station. Controllers shall be of the reversing, magnetic contactor type, with thermal overload protection and shall be installed at the motor and operated from the pendant station. Bridge and trolley controllers shall be provided with ballast resistance for cushioned starting. Controller for bridge crane shall be powered internally via a control transformer provided with the bridge crane package.

.3 The pendant shall contain a separate push button for each of the following motions:

.1 On
.2 Off
.3 Hoist up
.4 Hoist down
.5 Trolley forward
.6 Trolley reverse
.7 Bridge forward
.8 Bridge reverse

.4 The pendant shall be suspended stationary from the bridge approximately 1.8 m from the centre line of the west runway. Push buttons shall be clearly identified as to the function and control and shall be of the mechanically or electrically interlocking type to prevent possibility of damage to equipment should two (2) or more buttons be depressed simultaneously. Push buttons shall be provided with a spring return to neutral and shall automatically return to the off position when pressure on the button is released. A control power transformer with one (1) secondary lead fused and the other ground shall be provided to reduce voltage at the push-button station to a maximum of 120 volts. The pendant control cable shall be heavy-duty type with extra-flexible stranding and neoprene jacket. Support for the pendant station shall be provided by a steel wire rope or chain equipped with a suitable strain-relief clamp for the conductor cable.

.5 Power Feed System: A complete electric power feed system for the crane assembly and runway shall be provided. The system shall be designed to operate at 600V and shall consist of insulated conductors and insulated collector assemblies. The conductors shall be the completely enclosed type. The current and voltage rating of the conductors and collectors shall be based on crane supplier's recommendations. Electrical power system shall include low voltage transformer for control power. Conductor bar support shall be rolled galvanized steel

.6 Stationary conductors shall be installed adjacent to the west runway with supports and brackets as required. Cross conductors shall be supported by angles across the top of the bridge. Collectors for hoist operation shall be installed on the hoist trolley and wired to the hoist. Conductors and collectors shall be installed in conformity with the recommendations and instructions of the system manufacturer.

.7 One (1) 600V, 3 phase will be provided for the crane system. The 600V feed shall terminate at the disconnect switch. Wiring to the crane system beyond the disconnect switch shall be by the supplier.

.8 A feeder circuit for the crane assembly shall be furnished and installed under this section. A suitable surface-mounted junction box with all hanger brackets, a power feed disconnect switch and other accessories required for a complete installation, shall be furnished and installed under this section at the location indicated on the drawings and the feeder circuit wired in.

.9 Wiring: All wiring of the bridge crane shall be installed in accordance with the Ontario Electrical Safety Code and requirements in Division 26. All insulated wire shall be heat resisting and shall be insulated for 600 volts. The power feeder circuit for the bridge crane assembly will be furnished and installed under the electrical section to the location indicated on the drawings and will be wired to the bridge crane assembly junction box via the power feeder disconnect switch.

.10 Power Feeder Disconnect Switch: A heavy-duty, NEMA 4X, stainless steel disconnect switch shall be provided and installed at the power termination point as indicated on the drawings. The disconnect switch shall have front cover-

mounted nameplates that contain a permanent record on switch type, manufacturer's name and catalogue number and horsepower rating. An additional nameplate shall be provided to identify the equipment and shall be engraved, laminated black-over-white plastic, with 12.7 mm letters that reads "BRIDGE CRANE DISCONNECT SWITCH". Nameplate shall be securely fastened to the enclosure with stainless steel fasteners.

PART 3 EXECUTION

3.1 ERECTION

.1 The erection of the crane rail and support beams shall be witnessed by the manufacturer of the bridge crane. The crane, hoist and trolley shall be erected by workers who are regularly engaged in crane erecting and who are acceptable to the crane manufacturer. The orientation of installation of the hoist and trolley on the crane bridge shall be as directed by the Engineer.

3.2 WIRING

.1 All wiring shall be installed in intermediate metal conduit in accordance with the Ontario Electrical Safety Code and requirements in Division 26.

3.3 INSPECTION AND TESTING

.1 After complete assembly and installation, the crane shall be tested. A manufacturer's representative shall be present during installation, testing and commissioning. The inspection and testing shall verify that the crane has been assembled properly and that all required adjustments have been made.

.2 Acceptance Testing: The crane shall be subject to operational and rated load testing.

.3 The crane shall raise, lower, hold in any position and transport a test load equal to 125 percent of the rated capacity of the crane, with no detrimental effects on the crane. All motions shall be executed satisfactorily. The Contractor shall provide the test weights.

.4 The following functions shall be tested:

.1 Hoisting and lowering.

.2 Trolley travel.

.3 Bridge travel.

.4 Limit switches, locking and safety devices.

.5 The trip setting of hoist limit switches shall be determined by tests with an empty hook travelling in increasing speeds up to the maximum speed. The actuating mechanism of the limit switch shall be located to trip the switch, under all

conditions, in sufficient time to prevent contact of the hook or hook block with any part of the trolley.

.6 Hoisting and lowering tests will be conducted with 0, 50, 100 and 125 percent of the nominal or rated load.

.7 The rated load test shall consist of the following operations:

.1 The test load shall be lifted a sufficient distance to ensure that the load is supported by the crane and held by the hoist brakes.

.2 The test load shall be transported by means of the trolley for the full length of the bridge.

.3 The test load shall be transported by means of the bridge for the full length of the runway in one (1) direction with the trolley as close to the extreme right-hand end of the crane as practical and in the other direction with the trolley as close to the extreme left-hand end of the crane as practical.

.4 The test load shall be lowered, stopped and held with the brakes.

.5 Wiring shall be given an insulation resistance test using a 500-volt megger.

.8 Following completion of the tests, the crane shall be inspected by the Contractor and the manufacturer's representative in the presence of the Engineer for misalignment, breakage, and undue wear. All deficiencies shall be corrected by the Contractor in a manner acceptable to the Engineer.

.9 Test Reports: Field inspection and testing of the crane shall be documented by the crane manufacturer's representative through the Contractor, noting the deficiencies and corrections and certifying that the crane is acceptable for operation. Certification of the inspection shall be submitted to the Engineer.

END OF SECTION

PORTABLE GANTRY CRANE

PART 1 GENERAL

1.1 INTENT

.1 This section covers supply, delivery, supervision of installation and commissioning of portable and adjustable gantry cranes, chain hoists and related accessories.

1.2 RELATED SECTIONS

.1 DIVISION 1 – GENERAL REQUIREMENTS

.2 DIVISION 11 – EQUIPMENT

1.3 OPERATING CONDITIONS

.1 The following site operating and water quality conditions must be assumed for all design calculations:

.1 35°C maximum/-40°C minimum ambient air temperature.

.2 95% maximum relative humidity (non-condensing).

.2 Refer to the Contract Drawings for further details.

1.4 REFERENCES

.1 ASME HST-4-2021 - Performance Standard for Overhead Electric Wire Rope Hoists

.2 ASME B30.2-2022 - Overhead and Gantry Cranes.

.3 CSA W47.2-11 (R2020) - Certification of Companies for Fusion Welding of Aluminum

.4 Ontario Occupational Health and Safety Act and Regulations.

1.5 SUBMITTALS

.1 Submit the Shop Drawings for review in accordance with Section 01 33 00 – Submittals.

.2 The shop drawing submission shall include, but not be limited to, the following:

.1 Provide sufficient detail to show the general construction pertinent to the proper review of the equipment and of the description of the materials of construction, including;

.1 Details of vertical, diagonal, and horizontal members, chains suspension fittings, safety stops and bumpers.

.2 Manual hoist technical details from the manufacturer.

.3 General assembly drawings of the components.

.4 The Supplier shall indicate a list of spare parts which they would recommend be purchased and individual prices for each item.

.5 All ancillary equipment to be provided by the Supplier shall be listed.

.6 Special accessories or tools for the adjustment or removal of parts required for any piece of equipment shall be listed and furnished as part of the supply.

.7 Shop drawings shall be stamped and signed by an engineer registered to practice in Ontario.

.3 Submit load testing plans and certified test results.

1.6 QUALIFICATIONS

.1 The Supplier shall have a minimum of five (5) years of recent experience in the manufacturing of portable hoists.

1.7 MAINTENANCE DATA

.1 Maintenance manual shall be supplied and shall be submitted in accordance with the submittals section. Refer to section 01 77 00 – Closeout Procedures. Equipment designations used shall correspond to those indicated on the drawings.

.2 Maintenance manuals shall include the following:

.1 Equipment function, and limiting conditions.

.2 Assembly, installation, alignment, adjustment, and checking instructions.

.3 Parts lists and predicted life of parts subject to wear

.4 **The maintenance manuals shall be in addition to any instructions or parts lists packed with or attached to the equipment when delivered**.

PART 2 PRODUCTS

2.1 GENERAL

.1 All lifting systems shall be capable of overcoming the initial dislodging force, overcoming friction including pump and lifting chain weight (the sum of all of these weights is referred to as the minimum weight) with a minimum factor of safety of 4.0 minimum.

.2 Portable systems shall be manufactured from materials that are compatible and shall not corrode, and will operate safety, in all weather conditions.

2.2 PORTABLE GANTRY CRANE

.1 Provide two (2) portable and adjustable gantry cranes to the following specifications:

- .1 Lightweight, corrosion-resistant, all aluminum alloy construction, with anodized powder coated finish.
- .2 Minimum 1100 kg lifting capacity.
- .3 Minimum 2.0 m clear span between supporting legs, adjustable to 6.0 m, clear span with a maximum lifting height of 3.10 m from the ground.
- .4 Adjustable beam span and support leg height.
- .5 Extruded hollow aluminum alloy box beam.
- .6 Fittings
  - .1 Provide all fittings; include all structural aluminum hangers, braces and all connection hardware.
  - .2 Provide adequately sized fabricated fittings for the indicated loads and factor of safety.
  - .3 Provide proper bracing to prevent movement of rail beam during operation.
- .7 Safety Stops and Bumpers
  - .1 Fit open ends of the crane beam with safety stops or bumpers to prevent trolley from running off the ends.
- .8 Bolts, Nuts and Clamps
  - .1 Provide screwed-on, painted and weatherproof nameplates indication crane capacity, as approved by the Engineer.
- .9 Gantry base with four caster wheels with 360 swivel and locking casters.
- .10 The gantry crane shall be supplied complete with a beam trolley, as supplied by EME Model 2200LW or approved equivalent.
- .11 The gantry crane shall be supplied with one (1) manual chain hoist for each crane (Total of 2 hoists). Hoist capacity shall be equal to the lifting capacity of the portable crane specified and be supplied with 10 m of galvanized chain.

2.3 WARRANTY

.1 The manufacturer shall provide a two (2) year warranty on all components against defects in workmanship and materials from the data of startup. All components shall be fully tested prior to shipping.

2.4 ACCEPTABLE MANUFACTURERS

.1 Equipment must be supplied from the following acceptable Manufacturer:

- .1 EME – Easily Moved Equipment.
- .2 LiftSafe Service Group
- .3 O’Brien Lifting Solutions Inc.

.2 Devices whose Manufacturer does not have substantiated test data from recognized and independent testing facilities for exact design being provided, shall not be allowed.

PART 3 EXECUTION

3.1 INSTALLATION AND INSPECTION

.1 The hoist system shall be installed as indicated on the Contract Drawings, in accordance with the Manufacturer's recommendations and as approved by the Engineer.

.2 Provide the services of a factory trained representative to inspect, operate, test, adjust, and troubleshoot the installation.

.3 Provide and install all lubricants and liquids necessary for initial operation of the equipment.

.4 Inspection to include checking for:

.1 Cracks and other damaged or defective parts. Each system, as well as accessories, must be undamaged, without cracks and free of defective parts.

.2 Completeness of installation as specified and as recommended by the Manufacturer.

.3 Correctness of setting, alignment and relative arrangement of various parts of the system.

.5 Provide for additional supervision of installation by Equipment Supplier as required. Arrange with the Engineer a mutually agreeable date when the representative should be on site.

.6 Submit a report, signed by the Manufacturer's representative, describing in detail the inspection, tests, and adjustments made, quantitative results and suggestions for precautions to be taken to ensure proper maintenance. The report must verify that the equipment conforms to all specifications.

3.2 MECHANICAL TESTING AND CERTIFICATION

.1 After startup and prior to final acceptance, the Contractor shall conduct Engineer witnessed performance tests on the equipment.

.2 The field service representative will cause the hoist system mechanism to perform all mechanical functions that the mechanism is designed to perform. Tests will be scheduled with the Engineer at least two (2) weeks prior to the planned test date.

.3 The field service representative shall submit to the Engineer a written report stating that the equipment has been checked and is suitable for operation.

3.3 SUPERVISION OF INSTALLATION AND COMMISSIONING

.1 Test and commission the equipment in accordance with Section 01810 – Testing and Commissioning.

.2 At the completion of satisfactory installation, each unit shall be started by the General Contractor under the supervision of the Supplier and in conjunction with plant operating conditions. All controls and alarms shall be checked and tested to ensure proper control and equipment protection.

.3 Equipment shall only be accepted after receipt of a satisfactory report submitted by the Manufacturer's representatives.

.4 Modify or replace equipment or materials failing required tests.

.5 Perform additional testing required due to changes of materials, and/or failure of materials or construction to meet specifications at no extra cost to the Owner.

3.4 TESTING

.1 Test all equipment after installation in the presence of the Engineer to verify that it meets the stated specifications, local codes and Ministry of Labour requirements.

.2 After installation has been completed and before being placed into service, the portable lifting systems shall be operated manually and tests carried out to provide the following:

.1 All clearances and alignments are in order.

.2 All protective devices operate satisfactorily.

.3 After the above has been completed, the portable lifting systems will be tested with the hook carrying:

.1 Rated load: During these tests, the equipment shall show itself capable of dealing with the overload without difficulty. Load test to 125% of the rated load.

.2 All test weights and slings shall be provided.

.3 Where the equipment does not meet the specifications, it is to be revised, replaced or readjusted to the satisfaction of the Engineer until it does meet the specifications.

.4 A written test report shall be sent to the Engineer and be included in the maintenance manual.

3.5 TRAINING

.1 Operator instruction and training on equipment shall be provided. The training will give a complete overview of all equipment, testing, adjusting, and maintenance procedures.

3.6 STORAGE

.1 The equipment and accessories shall be stored indoors in a dry area, in accordance with the Manufacturer's recommendations.

3.7 MAINTENANCE

.1 Provide maintenance on Supplier's material as required by the Supplier from the date of delivery to the initial startup.

END OF SECTION

DIVISION 20 INDEX

PART 1 GENERAL

1.1 REFERENCES

.1 American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE)

.1 ANSI/ASHRAE 90.1-2019 (I-P), Energy Standard for Buildings Except Low-Rise Residential Buildings.

.2 Ontario Regulation

.1 ONTARIO OBC-2012, 2012 Ontario Building Code Compendium.

.3 National Fire Protection Association (NFPA)

.1 NFPA (Fire) 13, Installation of Sprinkler Systems, 2013 edition.

1.2 GENERAL

.1 This section covers items common to all sections of Divisions 20, 21, 22, 23, & 25.

.2 Coordinate location & installation of all equipment with all trades to ensure the equipment is serviceable.

.3 Prime mechanical contractor shall be responsible to ensure that all requirements of Division 20, 21, 22, 23, & 25 are met and comply with all other divisions and contract documents.

.4 The word "provide" shall mean "supply and install".

.5 Conform to the requirements of Division 00, Division 01 and Instructions to Tenderers.

.6 It is a requirement of this Contract that there be a single prime mechanical sub-contractor who shall retain sub-sub-contractors for all the other mechanical work as defined by the contract documentation. There shall not be more than one prime mechanical trade sub-contractor directly retained by the general contractor. Sub-sub-mechanical contractor shall include, but not limited to, insulation, plumbing, HVAC, controls, refrigeration, service, welding, seismic, acoustic, and specialities, etc.

.1 If the general contractor fails to obtain a single mechanical contractor, the general contractor shall act as the prime mechanical contractor and shall be responsible for all coordination between the various mechanical trades. The general contractor shall be responsible for all additional costs associated with scope gap and coordination between the various mechanical contractors. This additional work shall not constitute an

additional cost to the client and all the extra work required for a working mechanical system shall be born by the general contractor.

1.3 EQUIPMENT

.1 General:

.1 Mechanical equipment that is not regulated by the Green Energy Act, shall carry a permanent label installed by the manufacturers stating the equipment complies with the requirement of ASHRAE 90.1.

.2 The minimum equipment efficiency, standard rating and operating conditions shall be as per ASHRAE 90.1, superceded by Ontario Building Code (OBC) Supplementary Standard SB -10, unless indicated otherwise on contract documents. The higher of the energy efficiencies of the listed equipment shall prevail.

.3 Provide new materials and equipment of proven design, quality and of current models with published ratings for which replacement parts are readily available.

.4 Uniformity: Use product of one manufacturer unless otherwise specified, for equipment or material of the same type of classification.

.2 Installation:

.1 Unions, flanges and/or couplings: provide for ease of maintenance and disassembly.

.2 Space for servicing, disassembly and removal of equipment and components: provide as recommended by manufacturer, Code or as indicated; whichever is the more stringent.

.3 Equipment drains: pipe to floor drains in a manner which is non-obstructing.

.4 Install equipment, rectangular cleanouts and similar items parallel to or perpendicular to building lines.

.5 Unless otherwise specified, follow manufacturer's recommendations for safety, adequate access for inspection, maintenance and repairs.

.6 Permit equipment maintenance and disassembly with minimum disturbance to connecting piping and duct systems without interference with building structure or other equipment.

.7 Lubrication: Provide accessible lubricating means for bearings, including permanent lubrication "Lifetime" bearings. Extended grease nipples to be supplied.

1.4 ANCHOR BOLTS TEMPLATES

.1 Supply anchor bolts and templates for installation by other divisions.

1.5 TRIAL USAGE

.1 Engineer may use equipment and systems for test purposes or for continuity of operation prior to acceptance. Supply labour, material, and instruments required for testing & operation.

.2 For continuous use, refer to Section 15054 - Use of Mechanical Systems During Construction.

1.6 PROTECTION OF OPENINGS

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

1.7 ELECTRICAL

.1 Electrical work to conform to Division 26 including the following:

.1 Control wiring and conduit is specified in Division 26 except for conduit, wiring and connections below 50 V which are related to control systems. Refer to Division 26 for quality of materials and workmanship.

.2 Any costs associated with deviation of mechanical equipment rating affecting electrical Division 26 shall be carried by the mechanical contractor.

.3 All control wiring & conduit associated with Building Automation System & HVAC controls shall be provided by Division 25 including power wiring to all control panels & other field mounted control devices. Emergency power circuits are provided by Division 26 in the vicinity of the power source.

1.8 PAINTING

.1 Apply at least one coat of corrosion resistant primer paint to ferrous supports and site fabricated work.

.2 Prime and touch up marred finished paintwork to match original. Use primer or enamel to match original. Do not paint over nameplates.

.3 Restore to new condition, finishes which have been damaged too extensively to be merely primed and touched up.

.4 Hangers, supports and equipment fabricated from ferrous metals shall be given at least one coat of corrosion resistant primer paint before shipment to job site.

.5 Touch-up damaged surfaces of all mechanical equipment and materials, to the satisfaction of Engineer. Use primer or enamel to match original. Do not paint over nameplates.

1.9 SPARE PARTS

.1 Furnish spare parts, indicated in various section, and as follows:

.1 One casing joint gasket for each size pump.

.2 One head gasket set for each heat exchanger.

.3 One glass for each gauge glass.

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

.5 Six fusible links for each type of fire damper.

1.10 SPECIAL TOOLS

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

1.11 WASTE MANAGEMENT AND DISPOSAL

.1 Waste Reduction Workplan (WRW):

.1 Perform work in accordance with project's WRW. If one does not exist, provide the following:

.1 Identify opportunities for reduction, re-use and/or recycling of materials.

.2 Post workplan or summary where workers on site are able to review its content.

.2 Materials Source Separation Program (MSSP):

.1 Perform all work in accordance with project's MSSP. If one does not exist, provide the following:

.1 Provide containers for collection of re-usable and/or recyclable materials.

.2 Transport off-site salvaged materials to authorized recycling facility or to users of material for re-use.

.3 Disposal of Waste:

.1 Disposal of waste, volatile materials, mineral spirits, oil, paint thinner, etc. into waterways, storm or sanitary sewers is prohibited.

.4 Storage, Handling and Protection:

.1 Store materials for re-use in a secure area as directed by project manager, where they will not be damaged. Provide protection of materials as necessary.

.2 Unless otherwise specified, removed materials become the Contractor's property. Contractor shall be responsible for transport & delivery of non-salvageable items to a licensed disposal facility.

1.12 DEMONSTRATION, OPERATING, AND MAINTENANCE INSTRUCTIONS

.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 Where specified elsewhere in Division 20, 21, 22, 23, & 25 manufacturers to provide demonstrations and instructions.

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

.4 Instruction duration time requirements as specified in appropriate sections.

.5 Where deemed necessary, Owner may record these demonstrations on video tape for future reference.

.6 Furnish trained instructors to instruct Owner's operating staff in the operation, maintenance and adjustment of all mechanical equipment; and instruct personnel on any changes to or modifications of any equipment made under terms of the guarantee.

.7 The instructions shall take place during regular working hours before systems are accepted and turned over to Owner's staff.

.8 Ensure that the Owner's operating personnel have received and been given opportunity to review the Operating and Maintenance Manuals prior to commencing instruction. Allow two full days on site for review of these manuals with Owner's personnel and for their instruction in operation and maintenance of all mechanical equipment.

1.13 CLOSEOUT SUBMITTALS

.1 Submit operation and maintenance data for incorporation into manual.

.2 Operation and maintenance manual (O&M) to be approved by, and final copies deposited with, Engineer before final inspection.

.3 For all equipment listed in O&M manuals provide a schedule detailing the supplied component, name, address & phone no. of equipment vendor, parts supplier and warranty agent.

.4 Operation data to include:

.1 Control schematics for each system including environmental controls.

.2 Description of each system and its controls.

.3 Description of operation of each system at various loads together with reset schedules and seasonal variances.

.4 Operation instruction for each system and each component.

.5 Description of actions to be taken in event of equipment failure.

.6 Valves schedule and flow diagram.

.5 Maintenance data shall 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.

.6 Performance data to include:

.1 Equipment manufacturer's performance data sheets with point of operation as left after commissioning is complete.

.2 Equipment performance verification test results.

.3 Special performance data as specified elsewhere.

.4 Testing, adjusting and balancing reports as specified in Section 23 05 93 - Testing, Adjusting and Balancing.

.7 Approvals:

.1 Submit electronic format (pdf) copy of draft Operation and Maintenance Manual to Engineer for approval. Submission of individual data will not be accepted unless so directed by Engineer.

.2 Make changes as required and re-submit as directed by Engineer.

.3 Upon acceptance by Engineer submit one (1) electronic format (pdf) and three (3) hardcopies of O&M manuals to Owner.

.8 Additional data:

.1 Prepare and insert additional data into operation and maintenance manual when the need becomes apparent during demonstrations and instructions specified above.

1.14 ACCEPTABLE PRODUCTS

.1 Design is based on first manufacturer's name under acceptable products. Subsequent manufacturer's names indicate that those named are acceptable providing they meet specifications and space limitations and are subject to acceptance by Shop Drawing Review.

1.15 SHOP DRAWINGS AND PRODUCT DATA

.1 Submit single electronic (pdf) copy of shop drawings and product data along with transmittal, in accordance with Div. 01 - General Requirements. Hard copy shop drawings shall not be accepted.

.2 Shop drawings and product data shall show:

.1 Mounting arrangements.

.2 Operating and maintenance clearances. eg. access door swing spaces.

.3 Shop drawings and product data shall be accompanied by:

.1 Detailed drawings of bases, supports, and anchor bolts.

.2 Acoustical sound power data, where applicable.

.3 Points of operation on full equipment performance curves.

.4 Manufacturer to certify as to current model production.

.5 Certification of compliance to applicable codes.

.4 The information to be indicated on manufacturers' shop drawings submitted for review shall include the following:

.1 General arrangement drawings showing component parts. Where the equipment proposed, or a component part thereof, includes modifications to a manufacturers' standard to meet the requirements of a specification, a complete assembly drawing must be submitted.

.2 Overall dimensions, roughing-in dimensions and clearance dimensions of all major components.

.3 Mounting details and dimensions.

.4 Complete certified performance data for the specified application with particular reference to rate of flow, operating pressure and temperatures, entering and leaving conditions of air or fluid, operating weights, operating limitation, electrical characteristics and BHP requirements.

.5 Gauge of fabricated material and finish specification.

.6 Vibration isolators and resilient hangers stating locations and weight distribution.

.7 Electrical wiring diagrams, control panel boards, motor test data, motor starters and controls for electrically-operated equipment furnished by mechanical trades.

.5 Review of shop drawings or detail drawings will not relieve the obligation of ensuring that the equipment, materials, or layouts meet the functional requirements of the specifications, and that all necessary mounting space and clearance requirements are met. Thus, the Engineer's review is for assistance only.

.6 No equipment will be accepted on the job site without shop drawings having been reviewed by the Engineer.

1.16 CLEANING

.1 Prior to turnover to client, clean interior and exterior of all new systems. Replace all air & hydronic filters on new & modified systems. Vacuum interior of new and modified ductwork and air handling units.

1.17 AS-BUILT DRAWINGS

.1 Site records:

.1 Mechanical sub-contractor shall mark all changes as work progresses and as changes occur.

.2 On a weekly basis, transfer information to record set of documents, revising to show all work as actually installed.

.3 Use different colour waterproof ink for each service.

.4 Make available for reference purposes and inspection at all times.

.2 As-built drawings:

.1 Prior to start of Testing, Adjusting and Balancing (TAB), 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 Engineer to submit AutoCAD 2010 disk of mechanical drawings to contractor. Contractor shall modify CAD Drawings disks in accordance with Engineer CAD standards to reflect mechanical systems as installed.

.4 Submit electronic CAD files & hard copy to Engineer for approval and make corrections as directed.

.5 TAB to be performed using as-built drawings.

.6 Following approval, submit completed hard copy as-built drawings and CD with Operating and Maintenance Manuals.

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

1.18 CONFLICT/CO-ORDINATION DRAWINGS

.1 For congested areas, prior to installation the contractor shall prepare interference drawings indicating proposed location of all systems & equipment including ductwork, piping, fans, diffusers, VAV boxes, conduits, lighting fixtures, etc. Prior to installation the contractor shall submit the drawings to the Engineer for review.

.2 Architectural, structural and electrical outlines may be shown to assist in coordination of work; confirm final arrangements before layout of mechanical work.

.3 Do not scale.

.4 Except where dimensioned, drawings indicate general mechanical layouts only.

.5 Provide field drawings to show relative positions of various services. Obtain approval before beginning work. As a minimum provide layout/coordination drawings for mechanical rooms & corridor ceilings. Drawings must show coordination between all equipment and systems within the given space. All sub-trades to coordinate their work in conjunction with others.

.6 Within six (6) weeks of Letter of Intent, mechanical & electrical trades to verify that proposed rooms, shafts, chases, reflected ceiling elevations, etc. provide adequate space for the installation of mechanical & electrical systems. This is to

identify if there are any spatial shortcomings and to give adequate time for construction manager, consultants and trades to make any dimensional changes and to make clear to all trades where items are to be installed. Installation and layout will not be on a first come first layout basis.

.7 If this procedure is not followed the contractor shall be responsible for all modifications required to integrate the systems & equipment.

.8 When requested by the City, contractor shall provide a single line isometric drawing of the proposed plumbing vent system.

1.19 FEES AND PERMITS

.1 Pay all fees and obtain all permits, taxes relating to the mechanical scope of work.

1.20 WARRANTY

.1 Unless indicated otherwise provide one (1) year warranty starting at substantial completion for all new systems including materials, equipment & labour.

1.21 LOCATION OF MECHANICAL EQUIPMENT

.1 Allow for 1500 mm of adjustment for exact location of air handling units, pumps, ducts, piping, etc. at no extra cost or credit.

1.22 ELECTRONIC DRAWINGS

.1 CIMA+ will agree to supply the mechanical drawings in the form of electronic documents for the project to the User for the convenience of the User in carrying out its work. The User shall sign a License Agreement before drawings will be released.

1.23 CUTTING, PATCHING & CORING

.1 Provide cutting, patching and coring of all walls, ceiling & concrete slabs and other surfaces as required for mechanical work. Check with Owner or Building Management prior to core drilling and cutting of structure regarding building requirements and policies. Provide notification, clearance & protection.

.2 The following procedure shall be followed for cutting & core drilling:

.1 Contractor to coordinate and summarize all new cores and openings in building structure. Contractor to investigate on site and locate any existing available hole which may be re-used for new systems.

.2 Contractor to prepare a layout sketch showing all existing openings & holes and required new openings & holes, with size and locations to the closest grid line in both directions, and submit for review and approval by the architect & structural engineer.

.3 Structural engineer to provide written report outlining acceptance of the openings, as well as specific requirements for reinforcing at each location.

.4 Contractor to proceed with reinforcing tracing as per report and scanning for electrical conduit. Scanning to be completed using ground penetrating Radar (GPR) technology.

.5 Contractor shall identify at each location prior to coring and cutting the location, direction and layer of each reinforcing bar and conduit.

.6 Any core or opening where reinforcing steel was cut during the cutting & coring process must be retained on site, and the Contractor must inform the engineer with the following information: size of the reinforcing bar, reinforcing layer location (top steel or bottom slab steel) and direction of the bar (east - west or north - south).

.3 Patch and make good surfaces cut, damaged or disturbed, to Engineer's approval. Match existing material, colour, finish and texture or as indicated otherwise.

.4 Provide dust tight screens or partitions to localize dust generating activities and for protection of finished areas of work, workers and public.

1.24 MECHANICAL COST BREAKDOWN

.1 Upon award of contract, provide billing template for engineer's review and comment.

.2 Costs such as site trailers, mobilization, shop drawings, engineering, etc. to be included as part of material and labour for each piece of equipment.

.3 Controls programming and commissioning to be billed upon completion of commissioning.

.4 Fire protection engineering costs to be included as part of material and labour costs.

.5 **Closeout documents including O&M manuals, as-built drawings, approved air & hydronic TAB reports, seismic letters, NFPA letters, etc. shall constitute 5% of the total mechanical construction cost and shall be approved as a single lump sum line item after submission to and final acceptance by Engineer. Contractor to indicate cost as a separate line item in Progress Billing.**

.6 Proposed billings to be submitted a minimum of fourteen (14) calendar days prior to submission of first billing, for review and approval by Engineer.

.7 Equipment costs are to be broken down into specific equipment groupings and submitted with proposed billing submittal.

1.25 FINAL INSPECTION

.1 Do not request final inspection until:

.1 Deficiencies are less than 25 items.

.2 All systems have been tested and are ready for operation.

.3 All air & water balancing has been completed as applicable.

.4 The Owner's operating personnel have been instructed in the operation of all systems and equipment.

.5 The complete operation and maintenance data books have been delivered to the Engineer.

.6 All inspection certificates have been furnished including but not limited to seismic certification, NFPA (Fire) 13 certification, City's final plumbing inspection.

.7 All record drawings have been completed and approved.

.8 All fire extinguishers have been installed.

.9 All spare parts and replacement parts have been provided and receipt of same acknowledged.

.10 The cleaning up is finished in all respects.

.11 Upon completion of above, contractor to request in writing for final site review with a minimal 72 hour notification.

.2 Final installation shall be subject to the approval of the Engineer.

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION (NOT APPLICABLE)

END OF SECTION

SEISMIC RESTRAINT SYSTEM

PART 1 GENERAL

1.1 RELATED SECTIONS

.1 This section shall be read in conjunction with:

.1 Specification Section 20 05 01 - Mechanical General Requirements;

.2 All mechanical sections in Divisions 20, 21, 22, 23, and 25.

1.2 REFERENCES

.1 Ontario Regulation

.1 ONTARIO OBC-2012, 2012 Ontario Building Code Compendium.

.2 National Fire Protection Association (NFPA)

.1 NFPA (Fire) 13, Standard for the Installation of Sprinkler Systems.

.2 NFPA (Fire) 14, Standard for the Installation of Standpipe and Hose Systems.

.3 NFPA (Fire) 20, Standard for the Installation of Stationary Pumps for Fire Protection.

1.3 DEFINITIONS

.1 SRS: acronym for Seismic Restraint System.

1.4 QUALIFICATIONS

.1 Prime mechanical contractor shall engage a Seismic Engineer who shall be responsible for all mechanical sections to ensure all mechanical sections listed in Item 1.1.1 are covered. Prime mechanical contractor shall ensure the Seismic Engineer is a Professional Engineer holding a Certificate of Authorization in the Province of Ontario with a minimum of 5 years experience in seismic design, and is covered with a minimum of $2 million Professional Liability Insurance.

.2 The Manufacturer shall be a member of VISCMA (Vibration Isolation and Seismic Control Manufacturers Association). They shall have a letter issued to their Supplier confirming that they have reviewed and accepted the engineering practices used by the Seismic Engineer. The letter shall also state that the manufacturer accepts the Supplier to act as their representative for the product.

.3 Acceptable Suppliers: HTS Engineering, Master Group, Walmar, E.H. Price. Alternate to be approved by Addendum (only).

1.5 GENERAL DESCRIPTION

.1 This section covers design, supply and installation of complete SRS for all systems, equipment specified for installation on this project. This includes fire protection piping & mechanical equipment and systems, both vibration isolated and statically supported.

.2 SRS to be fully integrated into & compatible with:

.1 Noise and vibration controls specified elsewhere in this project specification.

.2 Structural, mechanical, electrical design of project.

.3 During a seismic event, SRS to prevent systems and equipment from causing personal injury and from moving from normal position unless noted otherwise. specified critical systems as noted below must remain operational during and after a seismic event:

.1 All systems for buildings as listed in OBC Table 4.1.8.18 - non-structural components.

.2 Life safety systems.

.3 Natural gas systems.

1.6 SUBMITTALS

.1 Submit shop drawings and product data in accordance with Section 20 05 01 - Mechanical General Requirements.

.2 Seismic Engineer shall be a Professional Engineer specializing in design of SRS and registered in Province of Ontario. The following submittals shall bear the SRS Design Engineer's seal and signature:

.1 A complete list of documents reviewed & list of exclusion.

.2 Full details of design criteria, calculations for all equipment & associated systems.

.3 A spreadsheet identifying all equipment requiring or not requiring seismic restraints and include all calculations.

.4 Copy of shop drawings and product data sent to Structural Engineer for review of connection points to building structure.

1.7 FINAL CERTIFICATE SUBMITTAL

.1 Seismic Engineer shall be a Professional Engineer specializing in design of SRS and registered in Province of Ontario. The following shall bear the SRS Design Engineer's seal and signature:

.1 SRS installation inspections.

.2 SRS final certification letter for the project.

.2 The Fire Protection Contractors shall be responsible for their respective discipline as it relates to Seismic restraints system. The contractor shall adhere to this

section and/or more stringent code (i.e. NFPA (Fire) 13, 14 & 20). Prime mechanical contractor to compile all of the above, review and submit for the record.

.3 The final certification letter shall be formatted to identify the following within the body of the letter:

.1 The date of the final inspection.

.2 A statement that lists ALL contract documents which were reviewed including but not limited to the mechanical drawings, project change orders, site instructions, etc.

.3 A statement which clearly identifies any exclusions of scope of service.

.4 A statement that certifies the complete mechanical seismic installation meets the latest version of OBC & applicable codes & standards.

1.8 MAINTENANCE DATA

.1 Provide maintenance data including monitoring requirements for incorporation into manuals specified in Section 20 05 01 - Mechanical General Requirements.

PART 2 PRODUCTS

2.1 GENERAL

.1 Definitions

.1 Seismic System: isolation and seismic restraint products supplied by one supplier.

.2 Manufacturer: manufacturer of the isolation and seismic restraint system.

.3 Supplier: manufacturers' and seismic engineer's representative

.2 Each contractor shall use one Supplier to provide seismic design, isolation, and seismic restraint.

.3 Seismic restraints are to be provided for all operational and functional components of building services in accordance with the current Ontario Building Code and NFPA (Fire) 13, 14 & 20.

.4 The contractor shall utilize a Supplier familiar with the design of seismic systems to provide a comprehensive package of isolation and seismic restraint for the project. Provide detailed shop drawings showing the proposed restraint system for all required equipment, piping, and ductwork on the project. The shop drawings submittals shall include all items listed in Item 1.6.

.1 Acceptable Manufacturers: Kinetics / Vibron, Tecoustics, Mason, Gripple Seismic.

.2 Alternates to be approved by Addendum only.

.5 Cable restraint systems, rod stiffener clamps and seismic isolator capacities to be verified by an independent test laboratory. Connection materials and site specific designs to be by the Seismic Engineer. The Seismic Engineer may specify material and anchors provided by the contractor where this is appropriate. It is the contractors' responsibility to ensure that the Seismic Engineers' requirements and specification have been met.

.6 At the completion of the project, the Supplier and the Seismic Engineer shall review the installations on site, and shall prepare a written report, with a sealed letter from the Seismic Engineer, certifying that the installations have been completed in accordance with their design and shop drawings. Refer to item 1.1.

2.2 SEISMIC FORCE

.1 The Importance Factor for this project is:

.1 I = 2.0

Note: As per OBC.

.2 The site classification for seismic site response and shear wave velocity parameters shall be as indicated on structural documents and as recorded in the geotechnical report.

PART 3 EXECUTION

3.1 INSTALLATION

.1 Install Seismic Restraint Systems in accordance with Seismic Engineer's and manufacturer's recommendations.

.2 Install SRS at least 25 mm from all other equipment, systems, services.

.3 Co-ordinate connections with all disciplines.

3.2 INSPECTION AND CERTIFICATION

.1 SRS to be inspected and certified by Manufacturer upon completion of installation.

.2 Seismic Design Engineer shall provide written report to Engineer certifying that SRS has been installed in accordance with the SRS drawings. The report shall bear the seal and signature of the SRS Design Engineer.

3.3 COMMISSIONING DOCUMENTATION

.1 Upon completion and acceptance of certification, hand over to Engineer complete set of construction documents, revised to show "as-built" conditions.

END OF SECTION

ACCESS DOORS FOR MECHANICAL

PART 1 GENERAL

1.1 RELATED SECTIONS

.1 This section shall be read in conjunction with:

.1 Specification Section 20 05 01 - Mechanical General Requirements;

.2 All mechanical sections in Divisions 20, 21, 22, 23, and 25.

PART 2 PRODUCTS

2.1 ACCESS DOORS

.1 Supply and install as necessary to gain access to all concealed mechanical equipment for operating, inspecting, adjusting, servicing.

.2 Sizes: Except as indicated otherwise, to be minimum sizes as follows:

.1 For body entry: 600 x 600 mm (24" x 24").

.2 For hand entry: 300 x 300 mm (12" x 12").

.3 Construction: Rounded safety corners, concealed hinges, screwdriver latch, anchor straps, able to open 180°.

.4 Materials

.1 Tiled or marble surfaces and other special areas: Stainless steel with brushed satin or polished finish as directed by Consultant.

.2 All other areas: Prime coated steel.

.5 Fire Rating

.1 Access doors fire rating to match that of wall, ceiling or floor the access door is installed in. Coordinate

PART 3 EXECUTION

3.1 INSTALLATION

.1 Installation in accordance with Manufacturer's installation instructions for particular surface.

3.2 LOCATION

.1 Location: Ensure that equipment is clearly within view and accessible for operating, inspecting, adjusting, servicing without the need for special tools.

END OF SECTION

DIVISION 21 INDEX

PORTABLE FIRE EXTINGUISHERS

PART 1 GENERAL

1.1 RELATED SECTIONS

.1 This section shall be read in conjunction with:

.1 Specification Section 20 05 01 - Mechanical General Requirements;

.2 All mechanical sections in Divisions 20, 21, 22, 23, & 25.

1.2 REFERENCES

.1 National Fire Protection Association NFPA

.1 NFPA (Fire) 10, Portable Fire Extinguishers.

.2 Underwriters Laboratories of Canada

.1 CAN/ULC S508-2018, Standard for the Rating and Fire Testing of Fire Extinguishers.

PART 2 PRODUCTS

2.1 MULTI-PURPOSE DRY CHEMICAL EXTINGUISHERS

.1 (FE1) Stored pressure dry chemical type with heavy duty steel cylinder, positive on/off operation, waterproof stainless steel gauge, shut-off nozzle, ULC labelled for A, B and C class protection c/w wall mounting bracket. Size 2.25 kg, 3A-10BC rating.

.2 (FE2) Stored pressure dry chemical type with heavy duty steel cylinder, positive on/off operation, waterproof stainless steel gauge, shut-off nozzle, ULC labelled for A, B and C class protection c/w wall mounting bracket. Size 2.25 kg, 3A-40BC rating.

2.2 SEMI-RECESSED CABINET

.1 Semi-recessed canopy type cabinet with 18 gauge primed & painted tub, white baked enamel finish, and 14 gauge polished stainless steel hinged door and curved transparent canopy.

.2 Acceptable material: National Fire CE-950-3-2 series, Canadian Fire Equipment.

2.3 RECESSED CABINET

.1 Recessed type cabinet with 18 gauge primed & painted tub, white baked enamel finish, and 14 gauge polished stainless steel hinged door and clear glass front.

.2 Acceptable material: National Fire CE-950-3 series, Canadian Fire Equipment.

2.4 INDENTIFICATION

.1 Identify extinguishers in accordance with recommendations of NFPA (Fire) 10 and CAN/ULC S508.

PART 3 EXECUTION

3.1 INSTALLATION

.1 Install extinguishers where indicated and in accordance with NFPA (Fire) 10.

.2 All fire extinguishers in vehicle storage areas, including units mounted in fire hose cabinets, shall be Type FE2.

END OF SECTION

DIVISION 22 INDEX

PLUMBING SPECIALTIES AND ACCESSORIES

PART 1 GENERAL

1.1 RELATED SECTIONS

.1 This section shall be read in conjunction with:

.1 Specification Section 20 05 01 - Mechanical General Requirements;

.2 All mechanical sections in Divisions 20, 21, 22, 23, and 25.

1.2 REFERENCES

.1 American Water Works Association (AWWA)

.1 AWWA C700-20, Cold Water Meters-Displacement Type, Bronze Main Case.

.2 American Society of Sanitary Engineering (ASSE)

.1 ASSE (Plumbing) 1017-2009, Performance Requirements for Temperature Actuated Mixing Valves for Hot Water Distribution Systems.

.2 ASSE (Plumbing) 1018-2001, Performance Requirements for Trap Seal Primer Valves-Potable Water Supplied.

.3 ASSE (Plumbing) 1070-2015/ASME A112.1070-2015/CSA B125.70-15, Performance Requirements for Water Temperature Limiting Devices.

.3 Canadian Standards Association (CSA)

.1 CAN/CSA B64 Series-11 (R2016), Backflow preventers and vacuum breakers.

.2 CSA B64.10-17/B64.10.1-17, Selection and Installation of Backflow Preventers/Maintenance and Field Testing of Backflow Preventers.

.3 CSA B79-08 (R2018), Floor, Area and Shower Drains, and Cleanouts for Residential Construction.

.4 CAN/CSA B125-01 Plumbing Fittings.

.5 CAN/CSA B356-10 (R2020), Water Pressure Reducing Valves for Domestic Water Supply Systems.

.4 NSF International

.1 NSF/ANSI/CAN 61-2020, Drinking Water System Components - Health Effects).

.5 Plumbing and Drainage Institute (PDI)

.1 PDI WH201-2017, Water Hammer Arresters Standard.

PART 2 PRODUCTS

2.1 GENERAL NOTES

.1 Plumbing fixtures to be from a single source as far as possible.

.2 All fixtures to be as schedule found on drawings. Alternates to be approved by addendum only prior to close of tender as per Section 20 05 01.

2.2 TRAP SEAL PRIMERS

.1 Electronic Trap Primer - Timer Type

.1 Electronic activated type, all brass construction with "O" ring seals, 12 mm (NPT ½) female inlet & 12 mm (NPT ½) female outlet drip line connection with air gap, viewing holes, and removable filter screen. Trap primer shall have no flow flow adjustment. Operating range shall be 138 kPa (20 psi) to 861 kPa (125 psi). Operates on pre-set 24 h clock with manual override switch/test button. Unit shall have 120 V solenoid valve and calibrated manifold for equal water distribution. One (1) to ten (10) drain taps per unit.

.2 Identify on as-built drawings the location of each trap seal primer.

.3 Ensure all trap seal primers are accessible for maintenance purposes and are connected to cold water line. Trap line shall be from top of cold water line and include a service valve. All to be installed in steel cabinet and serviceable from access door.

.4 Acceptable material: Watts, Precision Plumbing Product PT-10, Mifab MI-100, Zurn Z-1020 (1 to 5) for 10 - 2 distribution units will be required.

2.3 WATER HAMMER ARRESTORS

.1 Copper construction, bellows or piston type: to PDI-WH201.

.2 Acceptable material: Watts & Zurn Z-1700.

2.4 BACK FLOW PREVENTORS

.1 To CSA B64.10.1.

.2 Application: as indicated.

.3 Reduced pressure principal type c/w quarter turn ball valves.

.1 Acceptable material: Watts Model 009QT, Wilkins.

.4 Double check valve assembly.

.1 Acceptable material: Watts Series LF009, Wilkins.

.5 Back flow preventer with intermediate atmospheric vent or vacuum breaker.

2.5 VACUUM BREAKERS

.1 To CSA B64.

.2 Atmospheric vacuum breaker:

.1 Acceptable material: Zurn, Watts.

2.6 PRESSURE REGULATORS

.1 Performance:

.1 Inlet pressure: 1034 kPa (150 psi).
.2 Outlet pressure: 413 kPa (60 psi).

.2 NPS ½ to NPS 2 bronze body Z3 sealed spring cage, stainless steel adjusting and cage screws, integral stainless steel strainer, EPDM diaphragm, replaceable seat, bypass feature, threaded or soldered: certified to CAN/CSA B356.

.1 Acceptable material: Watts 25AUB-Z3, Wilkins NR3.

2.7 BACKWATER VALVES

.1 Coated extra heavy cast iron body with bronze seat, revolving bronze flapper and threaded cover.

.1 Acceptable material: Watts.

.2 Access:

.1 Surface access.
.2 Steel housing with gasketted steel cover.
.3 Concrete access pit with cover, as indicated.

2.8 HOSE BIBBS AND SEDIMENT FAUCETS

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

.2 Acceptable material: Watts.

2.9 STRAINERS

.1 860 kPa (125 psi), Y type with 20 mesh, monel, bronze or stainless steel removable screen.

.2 NPS 2 and under, bronze body, screwed ends, with brass cap.

.1 Acceptable material: Watts, Wilkins S-XL.

.3 NPS 2½ and over, cast iron body, flanged ends, with bolted cap.

.1 Acceptable material: Watts, Wilkins FS.

2.10 UNDER SINK THERMOSTATIC MIXING VALVE

.1 Thermostatic Mixing Valve:

.2 The valve shall be ASSE 1070 and IAPMO CUPC listed and control the temperature of the hot water. It shall have a lead free brass 4-port, "H" pattern body. Lead free* under counter thermostatic valves shall comply with codes and standards, where applicable, requiring reduced lead content. The valve shall include integral check valves, integral screens and an adjustment nut with locking feature. The valve shall be provided with 10 mm (3/8"), male compression or quick-connect fittings.

.3 Acceptable material: Watts series LFUSG-B.

PART 3 EXECUTION

3.1 INSTALLATION

.1 Install in accordance with provincial codes, and local authority having jurisdiction.

.2 Install in accordance with manufacturer's instructions and as specified.

3.2 FLOOR DRAINS

.1 Floor drains to be installed at lowest point in floor and placed to ensure floor finishing is flush/slightly higher than strainer. Contractor to chip concrete around drains, lower assembly, patch concrete and provide floor finish should the installed elevation be unacceptable to Engineer.

.2 Contractor to provide suitable means of protecting floor drains and cleanouts from damage during construction. Contractor to be responsible for turning over facility to Owner with floor drains and strainers in new condition. Damaged material shall be replaced with new at contractor's expense.

3.3 CLEANOUTS

.1 In addition to those required by code, and as indicated, install at base of soil and waste stacks, and rainwater leaders.

.2 Bring cleanouts to wall or finished floor unless serviceable from below floor.

.3 Building drain cleanout and stack base cleanouts: line size to maximum NPS4.

3.4 NON-FREEZE WALL HYDRANTS

.1 Install 600 mm (24") above finished grade unless otherwise indicated.

3.5 WATER HAMMER ARRESTORS

.1 Install on branch supplies to fixtures or group of fixtures.

3.6 BACK FLOW PREVENTORS

.1 Pipe discharge to terminate over nearest drain.

.2 Valves to be installed as per CSA, no between 900 mm and 1200 mm above finished floor.

.3 Test and certify each backflow preventor and provide report for inclusion in the commissioning report.

3.7 TRAP SEAL PRIMERS

.1 Install for floor drains and elsewhere, as indicated.

.2 Install on cold water supply to nearest frequently used plumbing fixture, in concealed space, to approval of Engineer.

.3 Install plastic tubing to floor drain.

.4 Identify on as-built drawings the location of each trap seal primer.

.5 Ensure all trap seal primers are accessible for maintenance purposes. Install access doors if required.

3.8 STRAINERS

.1 Install with sufficient room to remove basket.

3.9 START-UP

.1 General:

.1 In accordance with commissioning section.
.2 Requirements, supplemented as specified herein.

.2 Timing: Start-up only after:

.1 Pressure tests have been completed.
.2 Disinfection procedures have been completed.
.3 Certificate of static completion has been issued.
.4 Water treatment systems operational.

.3 Provide continuous supervision during start-up.

3.10 TESTING AND ADJUSTING

.1 General:

.1 In accordance with commissioning section.
.2 Requirements, supplemented as specified herein.

.2 Timing:

.1 After start-up deficiencies rectified.
.2 After certificate of completion has been issued by authority having jurisdiction.

.3 Application tolerances:

.1 Pressure at fixtures: +/- 70 kPa.
.2 Flow rate at fixtures: +/- 20%.

.4 Adjustments:

.1 Verify that flow rate and pressure meet design criteria.
.2 Make adjustments while flow rate or withdrawal is (1) maximum and (2) 25% of maximum and while pressure is (1) maximum and (2) minimum.

.5 Floor drains:

.1 Verify operation of trap seal primer.
.2 Prime, using trap primer. Adjust flow rate to suit site conditions.
.3 Check operations of flushing features.
.4 Check security, accessibility, removeability of strainer.
.5 Clean out baskets.

.6 Vacuum breakers, backflow preventers, backwater valves:

.1 Test tightness, accessibility for O&M of cover and of valve.
.2 Simulate reverse flow and back-pressure conditions to test operation of vacuum breakers, backflow preventers.
.3 Verify visibility of discharge from open ports.

.7 Access doors:

.1 Verify size and location relative to items to be accessed.

.8 Cleanouts:

.1 Verify covers are gas-tight, secure, yet readily removable.

.9 Water hammer arrestors:

.1 Verify proper installation of correct type of water hammer arrester.

.10 Wall hydrants:

.1 Verify complete drainage, freeze protection.
.2 Verify operation of vacuum breakers.

.11 Pressure regulators, PRV assemblies:

.1 Adjust settings to suit locations, flow rates, pressure conditions.

.12 Strainers:

.1 Clean out repeatedly until clear.
.2 Verify accessibility of cleanout plug and basket.
.3 Verify that cleanout plug does not leak.

.13 Commissioning Reports:

.1 In accordance with commissioning section and as supplemented herein.

.14 Training:

.1 In accordance with commissioning section - Training of O&M Personnel, supplemented as specified herein.
.2 Demonstrate full compliance with Design Criteria.

END OF SECTION

INCOMING WATER SUPPLY PIPING – DUCTILE IRON & PVC

PART 1 GENERAL

1.1 RELATED SECTIONS

.1 This section shall be read in conjunction with:

.1 Specification Section 20 05 01 - Mechanical General Requirements;

.2 All mechanical sections in Divisions 20, 21, 22, 23, and 25.

1.2 REFERENCES

.1 American Society for Testing and Materials International, (ASTM)

.1 ASTM C117-17, Standard Test Method for Materials Finer than 75- micro m (No. 200) Sieve in Mineral Aggregates by Washing.

.2 ASTM C136/C136M-19, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.

.3 ASTM D698-12e2, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft.-lbf/ft3 (600 kN-m/m3)).

.2 American Water Works Association (AWWA)

.1 AWWA C600-17, Installation of Ductile Iron Water Mains, and their Appurtenances.

.2 AWWA C900-16, Polyvinyl Chloride (PVC) Pressure Pipe, 4 Inch through 12 Inch for Water Distribution.

.3 Canadian General Standards Board (CGSB)

.1 CAN/CGSB 8.1-88, Sieves, Testing, Woven Wire, Inch Series.

PART 2 PRODUCTS

2.1 PVC PIPE

.1 Application: Service water pipe from 1 m outside of building or as indicated, to first isolation valve inside building.

.2 Polyvinyl chloride pressure pipe: to AWWA C900, pressure class 150, 1 MPa gasket bell end.

.3 Acceptable material: IPEX Blue Brute..

2.2 PIPE BEDDING AND SURROUND MATERIAL

.1 Granular material to Aggregates: General and following requirements:

.1 Crushed or screened stone, gravel or sand.

.2 Gradations to be within limits specified when tested to ASTM C136 and ASTM C117. Sieve sizes to CAN/CGSB-8.1.

.2 Concrete mixes and materials required for bedding cradles, encasement, supports, thrust blocks: to concrete sections.

2.3 BACKFILL MATERIAL

.1 In accordance with Civil Engineering contract documents.

PART 3 EXECUTION

3.1 INSTALLATION

.1 Install in accordance with Canadian Plumbing Code Provincial Plumbing Code and local authority having jurisdiction.

.2 Piping cut square, reamed, free of cuttings and foreign material.

.3 Minimum depth of bury: as indicated.

.4 Lay buried piping in compacted washed sand in accordance with AWWA Class "B" bedding. Where existing ground below bedding is unstable, install pipe on continuous concrete support.

.5 Where piping enters building, provide support, and seal against ingress of moisture; to approval of authority having jurisdiction.

.6 Assemble piping using fittings manufactured to ANSI standards and in accordance with manufacturer's instructions.

.7 Apply one layer of protective coating to ductile iron buried piping.

3.2 DISINFECTION

.1 Coordinate with civil works.

.2 Flushing and disinfecting operations shall be under direct control of Civil Engineer.

3.3 CONCRETE BEDDING AND ENCASEMENT

.1 Do concrete work in accordance with concrete sections. Place concrete to details as indicated or as directed by Engineer.

.2 Pipe may be positioned on concrete blocks to facilitate placing of concrete. When necessary, rigidly anchor or weight pipe to prevent flotation when concrete is placed.

.3 Do not backfill over concrete within 24 h after placing.

3.4 GRANULAR BEDDING

.1 Place granular bedding material in uniform layers not exceeding 150 mm compacted thickness to depth of 150 mm below bottom of pipe.

.2 Do not place material in frozen condition.

.3 Shape bed true to grade to provide continuous uniform bearing surface for pipe.

.4 Shape transverse depressions in bedding as required to suit joints.

.5 Compact each layer full width of bed to at least 95% maximum density to ASTM D698.

.6 Fill authorized or unauthorized excavation below design elevation of bottom of specified bedding in accordance with compacted bedding material.

3.5 PIPE INSTALLATION

.1 Install coupling necessary for connection to building plumbing. If plumbing is already installed, make connection; otherwise cap or seal end of pipe and place temporary marker to locate pipe end.

.2 Lay pipes to AWWA C600, AWWA Manual of Practice and manufacturer's standard instructions and specifications. Do not use blocks except as specified.

.3 Join pipes in accordance with AWWA C600 AWWA Manual of Practice and manufacturer's recommendations.

.4 Bevel or taper ends of PVC pipe to match fittings.

.5 Handle pipe by methods recommended by pipe manufacturer. Do not use chains or cables passed through pipe bore so that weight of pipe bears on pipe ends.

.6 Face socket ends of pipe in direction of laying. For mains on a grade of 2% or greater, face socket ends up-grade.

.7 Do not exceed permissible deflection at joints as recommended by pipe manufacturer.

.8 Keep jointing materials and installed pipe free of dirt and water and other foreign materials. Whenever work is stopped, install a removable watertight bulkhead at open end of last pipe laid to prevent entry of foreign materials.

.9 Cut pipes in an approved manner as recommended by pipe manufacturer, without damaging pipe or its coating and to leave smooth end at right angles to axis of pipe.

.10 Align pipes carefully before jointing.

.11 Install gaskets to manufacturer's recommendations. Support pipes with hand slings or crane as required to minimize lateral pressure on gasket and maintain concentricity until gasket is properly positioned.

.12 Avoid displacing gasket or contaminating with dirt or other foreign material. Gaskets so disturbed or contaminated shall be removed, cleaned, lubricated and replaced before jointing is attempted again.

.13 Minimize deflection after joint has been made.

.14 Apply sufficient pressure in making joints to ensure that joint is completed to manufacturer's recommendations.

.15 Ensure completed joints are restrained by compacting bedding material alongside and over installed pipes or as otherwise approved by Engineer.

.16 When stoppage of work occurs, block pipes in an approved manner to prevent creep during down time.

.17 Recheck plastic pipe joints assembled above ground after placing in trench to ensure that no movement of joint has taken place.

.18 Do not lay pipe on frozen bedding.

3.6 THRUST BLOCKS AND RESTRAINED JOINTS

.1 Place concrete thrust blocks between plugs, caps, bends, changes in pipe diameter, reducers, and fittings and undisturbed ground as indicated.

.2 Keep joints and couplings free of concrete.

.3 Do not backfill over concrete within 24 h after placing.

.4 For restrained joints: only use restrained joints approved by Engineer.

3.7 HYDROSTATIC AND LEAKAGE TESTING

.1 Do tests in accordance with AWWA C600.

.2 Provide labour, equipment and materials required to perform hydrostatic and leakage tests hereinafter described.

.3 Notify Engineer at least 48 h in advance of all proposed tests. Perform tests in presence of Engineer.

.4 Where any section of system is provided with concrete thrust blocks, conduct tests at least 7 days after placing concrete or 2 days if high early strength concrete is used.

.5 Apply hydrostatic test pressure of 860 kPa based on elevation of lowest point in main and corrected to elevation of test gauge, for a period of 1 h.

.6 Examine exposed pipe, joints, fittings and appurtenances while system is under pressure.

.7 Repeat hydrostatic test until all defects have been corrected.

3.8 BACKFILL

.1 Place backfill material, above pipe surround, in uniform layers not exceeding 150 mm compacted thickness up to grades as indicated.

.2 Do not place backfill in frozen condition.

.3 Under paving and walks, compact backfill to at least 95% maximum density to ASTM D698. In other areas, compact to at least 90% maximum density to ASTM D698.

END OF SECTION

DOMESTIC WATER PIPING - COPPER

PART 1 GENERAL

1.1 RELATED SECTIONS

.1 This section shall be read in conjunction with:

.1 Specification Section 20 05 01 - Mechanical General Requirements;

.2 All mechanical sections in Divisions 20, 21, 22, 23, and 25.

1.2 REFERENCES

.1 American Society of Mechanical Engineers (ASME)

.1 ASME B16.15-2018, Cast Bronze Threaded Fittings, Classes 125 and 250.

.2 ASME B16.18-2018, Cast Copper Alloy Solder Joint Pressure Fittings.

.3 ASME B16.22-2018, Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings.

.4 ASME B16.24-2016, Cast Copper Alloy Pipe Flanges and Flanged Fittings, Class 150 and 300.

.5 ASME B16.26-13, Cast Copper Alloy Fittings for Flared Copper Tubes.

.2 American Society for Testing and Materials (ASTM)

.1 ASTM A182/A 182M-16, Standard Specification for Forged or Rolled Alloy and Stainless-Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service.

.2 ASTM A307-14e1, Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength.

.3 ASTM A351/A351M-16, Castings, Austenitic, for Pressure Containing Parts.

.4 ASTM B32-08(2014), Standard Specification for Solder Metal.

.5 ASTM B42-15a, Seamless Copper Tube, Standard Sizes.

.6 ASTM B88M-20, Specification for Seamless Copper Water Tube (Metric).

.3 American Water Works Association (AWWA)

.1 AWWA C111/A21.11-17, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.

.4 Canadian Standards Association (CSA)

.1 CSA B242-05 (R2016), Groove- and Shoulder-Type Mechanical Pipe Couplings.

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

.1 Material Safety Data Sheets (SDS).

.6 Manufacturer's Standardization Society of the Valve and Fittings Industry (MSS).

.1 MSS-SP-71-05, Grey Iron Swing Check Valves, Flanged and Threaded Ends.

.2 MSS-SP-80-03, Bronze Gate, Globe, Angle and Check Valves.

.7 National Research Council (NRC)

.1 National Plumbing Code of Canada (NPC) 2015.

PART 2 PRODUCTS

2.1 PIPING

.1 Domestic hot, cold and recirculation systems, within building.

.1 Above ground: copper tube, hard drawn, type L: to ASTM B88M.

2.2 FITTINGS

.1 Bronze pipe flanges and flanged fittings, Class 150 and 300: to ASME B16.24.

.2 Cast bronze threaded fittings, Class 125 and 250: to ASME B16.15.

.3 Cast copper, solder type: to ASME B16.18.

.4 Wrought copper and copper alloy, solder type: to ASME B16.22.

.5 NPS 2 and larger:

.1 ANSI/ASME B16.18 or ANSI/ASME B16.22 roll grooved to CSA B242.

.6 NPS 1 ½ and smaller:

.1 Wrought copper to ANSI/ASME B16.22 cast copper to ANSI/ASME B16.18 ; with 301 stainless steel internal components and EPDM seals. Suitable for operating pressure to 1380 kPa.

2.3 JOINTS

.1 Rubber gaskets, latex-free 1.6 mm thick: to AWWA C111.

.2 Bolts, nuts, hex head and washers: to ASTM A307, heavy series.

.3 Solder: lead free.

.4 Teflon tape: for threaded joints.

.5 Grooved couplings: designed with angle bolt pads to provide rigid joint, complete with EPDM gasket.

.6 Dielectric connections between dissimilar metals: dielectric fitting, complete with thermoplastic liner.

2.4 GATE VALVES

.1 NPS 2 and under, soldered:

.1 Rising stem: to MSS-SP-80, Class 125, 860 kPa, bronze body, screw-in bonnet, solid wedge disc

.2 NPS 2 and under, screwed:

.1 Rising stem: to MSS-SP-80, Class 125, 860 kPa, bronze body, screw-in bonnet, solid wedge disc

2.5 BALL VALVES

.1 NPS 2 and under, soldered:

.1 To ANSI/ASME B16.18, Class 150.

.2 Bronze body, stainless steel or chrome plated brass ball, PTFE adjustable packing, brass gland and PTFE seat, steel lever handle, with NPT to copper adaptors

PART 3 EXECUTION

3.1 INSTALLATION

.1 Install in accordance with Canadian Plumbing Code, Provincial Plumbing Code and local authority having jurisdiction.

.2 Be aware of very limited ceiling space for any piping modification. Allow for 8 hr site conditions survey of domestic water piping system. Provide site specific field installation sketches for review prior to commencing the work.

.3 Cut square, ream and clean tubing and tube ends, clean recesses of fittings and assemble without binding.

.4 Install pipe work in accordance with Section 23 05 15 – Common Installation Requirements for HVAC Piping, supplemented as specified herein.

.5 Assemble piping using fittings manufactured to ASME standards.

.6 Install DCW piping below and away from DHW and DHWR and other hot piping so as to maintain temperature of cold water as low as possible.

.7 Connect to fixtures and equipment in accordance with manufacturer's written instructions unless otherwise indicated.

.8 Install isolation valves at all branch take-offs and to isolate each piece of equipment, and as indicated.

3.2 PRESSURE TESTS

.1 Test pressure: greater of 1½ times maximum system operating pressure or 860 kPa.

3.3 FLUSHING AND CLEANING

.1 Flush entire system for 8 h. Ensure outlets flushed for 2 hours. Let stand for 24 hours, then draw one sample off longest run. Submit to testing laboratory to verify that system is clean to Ontario potable water guidelines. Let system flush for additional 2 hours, then draw off another sample for testing.

.2 Upon completion, provide laboratory test reports on water quality for Departmental Representative approval.

3.4 PRE-START-UP INSPECTION

.1 Systems to be complete, prior to flushing, testing and start-up.

.2 Verify that system can be completely drained.

.3 Ensure that pressure booster systems are operating properly.

.4 Ensure that air chambers, expansion compensators are installed properly.

3.5 DISINFECTION

.1 Flush out, disinfect and rinse system to requirements of authority having jurisdiction and to the approval of Engineer.

.2 Upon completion, provide laboratory test reports on water quality for Engineer approval.

3.6 START-UP

.1 Timing: Start up after:

.1 Pressure tests have been completed.
.2 Disinfection procedures have been completed.
.3 Certificate of static completion has been issued.

.2 Provide continuous supervision during start-up.

.3 Start-up procedures:

.1 Establish circulation and ensure that air is eliminated.
.2 Check pressurization to ensure proper operation and to prevent water hammer, flashing and/or cavitation.
.3 Bring DHW storage tank up to design temperature slowly.

.4 Monitor DHW and DHWR piping systems for freedom of movement, pipe expansion as designed.

.5 Check control, limit, safety devices for normal and safe operation.

.4 Rectify start-up deficiencies.

3.7 PERFORMANCE VERIFICATION

.1 Timing:

.1 After pressure and leakage tests and disinfection completed, and certificate of completion has been issued by authority having jurisdiction.

.2 Procedures:

.1 Verify that flow rate and pressure meet Design Criteria.

.2 TAB DHWR in accordance with Section 23 05 93 - Testing Adjusting and Balancing (TAB) of Mechanical Systems.

.3 Adjust pressure regulating valves while withdrawal is maximum and inlet pressure is minimum.

.4 Verify performance of temperature controls.

.5 Verify compliance with safety and health requirements.

.6 Check for proper operation of water hammer arrestors. Run 10% of outlets for 10 seconds, then shut off water immediately. If water hammer occurs, replace water hammer arrestor or re-charge air chambers. Repeat for outlets and flush valves.

.7 Confirm water quality consistent with supply standards, verifying that no residuals remain as a result of flushing and/or cleaning.

.3 Reports:

.1 In accordance with Section 20 05 01 - Mechanical General Requirements: Reports, using report forms as specified in Section 20 05 01 - Mechanical General Requirements: Report Forms and Schematics.

.2 Include certificate of water flow and pressure tests conducted on incoming water service, demonstrating adequacy of flow and pressure.

END OF SECTION

DRAINAGE WATER AND VENT PIPING – CAST IRON & COPPER

PART 1 GENERAL

1.1 RELATED SECTIONS

.1 This section shall be read in conjunction with:

.1 Specification Section 20 05 01 - Mechanical General Requirements;

.2 All mechanical sections in Divisions 20, 21, 22, 23, and 25.

1.2 REFERENCES

.1 American Society for Testing and Materials (ASTM)

.1 ASTM B32-20, Specification for Solder Metal.

.2 ASTM B306-20, Specification for Copper Drainage Tube (DWV).

.2 Canadian Standards Association (CSA)

.1 CAN/CSA B125-01 Plumbing Fittings.

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.

.2 Wrought copper: to CAN/CSA B125.

.2 Solder: 95/5, lead free, to ASTM B32, type 50A.

.2 Below grade: Copper and cast iron piping is not to be used in new installation, refer to Section 22 13 16.16 – Drainage Waste and Vent Piping – Plastic.

2.2 CAST IRON PIPING AND FITTINGS

.1 Above ground sanitary, storm and vent 75 mm or larger.

.1 Pipe:

.1 Cast Iron with one layer of protective coating to: CAN/CSA-B70.

.2 Joints:

.1 Mechanical joints.

.1 Neoprene or butyl rubber compression gaskets: to ASTM C 564 or CAN/CSA-B70.

.2 Stainless steel clamps.

PART 3 EXECUTION

3.1 INSTALLATION

.1 Install in accordance with Canadian Plumbing Code, Provincial Plumbing Code and local authority having jurisdiction.

.2 Install above ground piping parallel and close to walls and ceilings to conserve headroom and space, and to grade as indicated.

.3 On pumped discharge, cast iron with mechanical joint shall not be allowed.

3.2 TESTING

.1 Test in accordance with OBC Part 7 requirements.

.2 Hydraulically test to verify grades and freedom from obstructions.

.3 Dye Testing:

.1 The sanitary and storm plumbing systems shall be dye-tested.

.2 On storm system dye tables (Fluorescein) shall be mixed with water to the manufacturer's instructions and introduced to each roof drain. The mechanical contractor shall determine if the dissolved fluorescein passed the downstream storm manhole, indicating a "Positive" dye test.

.3 On the sanitary system, dye tablets (fluorescein) shall be placed in each plumbing fixture or at discretion of certifying engineer. The mechanical contractor shall determine if the dissolved fluorescein passed the downstream sanitary manhole indicating a "Positive" dye test.

.4 A "Negative" dye test indicates that the building system is not connected to the appropriate system and mechanical contractor shall complete corrective action.

.5 Dye testing shall be conducted by contractor following below grade rough-in and following the complete above grade installation and finish work.

.6 Contractor to retain services of an independent professional engineer registered in Ontario to witness Dye testing. Provide letter stamped by engineer certifying successful completion of test.

END OF SECTION

DRAINAGE WASTE AND VENT PIPING - PLASTIC

PART 1 GENERAL

1.1 RELATED SECTIONS

.1 This section shall be read in conjunction with:

.1 Specification Section 20 05 01 - Mechanical General Requirements;

.2 All mechanical sections in Divisions 20, 21, 22, 23, and 25.

1.2 REFERENCES

.1 American Society for Testing and Materials (ASTM)

.1 ASTM D2564-20, Specification for Solvent Cements for Poly (Vinyl-Chloride) (PVC) Plastic Piping Systems.

.2 Canadian Standards Association (CSA)

.1 CSA B1800-21, Thermoplastic Nonpressure Piping Compendium.

.3 Underwriters Laboratories of Canada (ULC)

.1 CAN/ULC S102.2-2018-REV1, Method of Test for Surface Burning Characteristics of Flooring, Floor Coverings, and Miscellaneous Materials and Assemblies.

.2 CAN/ULC S115-2018, Standard Method of Fire Tests of Firestop Systems.

PART 2 PRODUCTS

2.1 PIPING AND FITTINGS

.1 DWV PVC (Polyvinyl Chloride):

.1 Application: below grade sanitary, storm & vent piping & fittings and above grade where combustible piping is permitted excluding OBC 3.2.6 (High-rise) applications and ceiling plenums.

.2 Pipe and Fittings: Drain, waste and vent pipe and fittings shall be certified to CSA B181.2. When combustible pipe and fittings are used in buildings required to be of non-combustible construction, they shall be listed by ULC to the Standard CAN/ULC S102.2 and clearly marked with the certification logo indicating a flame-spread rating not exceeding 25.

.3 Acceptable material: IPEX System 15 DWV.

.2 Fire & smoke resistant coated DWV PVC (Polyvinyl Chloride) piping & fittings:

.1 Application: Above grade sanitary, storm & vent piping & fittings where combustible piping is permitted including OBC 3.2.6 High-rise applications and within ceiling plenums.

.2 Pipe and Fittings: Drain, waste and vent pipe and fittings shall be certified to CSA B181.2 and when used in non-combustible construction, high-rise buildings and air plenums, they shall be tested and listed in accordance with ULC S102.2 and clearly marked with the certification logo indicating a flame-spread rating not exceeding 25 and a smoke-developed classification not exceeding 50.

.3 Acceptable material: IPEX System XFR 15/50 PVC-DWV.

.3 Firestopping Devices:

.1 All combustible pipe penetrations shall comply with the requirements described in the O.B.C. 3.1.9.4.(1) through (8) and provide a firestop system that has been Tested and Listed to the test Standard CAN/ULC S115 with a pressure differential of 50 Pa. In addition, the manufacturer shall provide a documentation confirming compliance with the Listed system.

.4 Solvent Welding:

.1 Solvent cements shall be CSA certified and meet the requirements of ASTM D2564. One-step cement may be used for sizes from NPS 40 to 150. Two-step cement must be used in conjunction with primer on larger pipe sizes. Proper solvent cementing procedures must be followed at all times.

.2 The manufacturer shall be consulted prior to installation for proper solvent welding procedures and proper solvent cement requirements.

.5 Expansion/Contraction:

.1 Compensation shall be made to accommodate expansion/contraction on the drainage system. It is recommended that there be compensation on every second floor for the vertical piping system. Consult pipe system manufacturer for specific details regarding approved compensation methods.

.6 Compatibility:

.1 To ensure compatibility, performance and material quality, all pipe and fitting drainage system shall be produced by the same manufacturer.

.7 Quality Control:

.1 The manufacturer of the pipe and fitting system shall be contacted prior to the installation to obtain precise installation instructions. Site meetings shall be arranged and include the Contractor, Manufacturer and Building Inspector.

PART 3 EXECUTION

3.1 INSTALLATION

.1 Install in accordance with Canadian Plumbing Code, Provincial Plumbing Code and local authority having jurisdiction.

.2 Bedding and backfilling should be in accordance with City of Ottawa standards and specifications. Install buried pipe on 150 mm (6") bed of compacted clean Granular A bedding compacted to 95% (min.) dry proctor density, shaped to accommodate hubs and fittings, to line and grade as indicated. The material should be placed in maximum 300 mm thick lifts. (If trench bottom is unstable, bring to Engineers attention before bedding is laid). Limit vertical deflection and increase pipe support by compacting soil in both directions away from the pipe toward trench walls. Initial backfill to begin at springline of pipe to 300 mm (12") above pipe using compacted clean Granular A bedding compacted to 95% (min.) dry proctor density. Final backfill shall be in accordance with Geotechnical Report and as minimum utilize clean Granular A compacted to 95% dry proctor density in 300 mm thick lifts. Bedding and backfill shall be provided by this division and in accordance with Div. 02 - Site Work.

3.2 TESTING

.1 Test in accordance with OBC Part 7 requirements.

.2 Pressure test buried systems before backfilling.

.3 Hydraulically test to verify grades and freedom from obstructions.

.4 Dye Testing:

.1 The sanitary and storm plumbing systems shall be dye-tested.

.2 On storm system dye tables (Fluorescein) shall be mixed with water to the manufacturer's instructions and introduced to each roof drain. The mechanical contractor shall determine if the dissolved fluorescein passed the downstream storm manhole, indicating a "Positive" dye test.

.3 On the sanitary system, dye tablets (fluorescein) shall be placed in each plumbing fixture or at discretion of certifying engineer. The mechanical contractor shall determine if the dissolved fluorescein passed the downstream sanitary manhole indicating a "Positive" dye test.

.4 A "Negative" dye test indicates that the building system is not connected to the appropriate system and mechanical contractor shall complete corrective action.

.5 Dye testing shall be conducted by contractor following below grade rough-in and following the complete above grade installation and finish work.

.6 Contractor to retain services of a independent professional engineer registered in Ontario to witness Dye testing. Provide letter stamped by engineer certifying successful completion of test.

.5 Video Testing:

.1 Provide video scanning of underground sanitary and storm piping for contractor's review and approval prior to pouring of concrete. Repair deficiencies and re-scan as required. Submit final video to Engineer for record.

.2 Flush & video scan sanitary and storm piping for contractor's review and approval prior to building turnover. Repair deficiencies and re-scan as required. Submit final video to Engineer for record.

3.3 PERFORMANCE VERIFICATION

.1 Cleanouts:

.1 Ensure accessible and that access doors are correctly located.

.2 Open, cover with linseed oil and re-seal.

.3 Verify cleanout rods can probe as far as the next cleanout, at least.

.2 Test to ensure traps are fully and permanently primed.

.3 Storm water drainage:

.1 Verify domes are secure.

.2 Ensure weirs are correctly sized and installed correctly.

.3 Verify provisions for movement of roof system.

.4 Ensure that fixtures are properly anchored, connected to system and effectively vented.

.5 Affix applicable label (storm, sanitary, vent, pump discharge etc.) c/w directional arrows every floor or 4.5 m (whichever is less).

END OF SECTION

DOMESTIC WATER HEATERS

PART 1 GENERAL

1.1 RELATED SECTIONS

.1 This section shall be read in conjunction with:

.1 Specification Section 20 05 01 - Mechanical General Requirements;

.2 All mechanical sections in Divisions 20, 21, 22, 23, and 25.

1.2 REFERENCES

.1 American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE)

.1 ANSI/ASHRAE 90.1-2019 (I-P) Energy Efficient Design of New Buildings Except Low-Rise Residential Buildings.

.2 American Society of Mechanical Engineers (ASME).

.3 Canadian Standards Association (CSA)

.1 CSA B149.1-20, Natural Gas and Propane Installation Code.

.2 CSA ANSI Z21.10.3-2019/CSA 4.3-2019, Gas Water Heaters - Volume III, Storage Water Heaters, With Input Ratings Above 75,000 Btu Per Hour, Circulating and Instantaneous.

.4 Underwriters Laboratories of Canada (ULC)

.1 ULC S636-08, Standard for Type BH Gas Venting Systems.

PART 2 PRODUCTS

2.1 ELECTRIC TANKLESS ELECTRIC WATER HEATER

.1 Unit shall have copper clad immersion heating element with brass terminations.

.2 External temperature control and display adjustment in 1°F increments with a range of 80° - 140°F.

.3 Size as per schedule.

.4 Acceptable material: Rheem RETEX6

PART 3 EXECUTION

3.1 INSTALLATION

.1 Install in accordance with manufacturer's recommendations and authority having jurisdiction.

.2 All hot water heating tanks are to be supplied with a pressure and temperature relief valve as per manufacturer's requirements.

.3 All pipe connections to the heating shall be supplied with unions.

.4 Provide insulation between tank and supports.

END OF SECTION

PLUMBING FIXTURES AND TRIM

PART 1 GENERAL

1.1 RELATED SECTIONS

.1 This section shall be read in conjunction with:

.1 Specification Section 20 05 01 - Mechanical General Requirements;

.2 All mechanical sections in Divisions 20, 21, 22, 23, and 25.

1.2 REFERENCES

.1 Canadian Standards Association (CSA)

.1 CAN/CSA B45 Series-02 (R2013), Plumbing Fixtures.

.2 CAN/CSA B125-01 Plumbing Fittings.

.3 CSA B651-18, Accessible Design for the Built Environment.

PART 2 PRODUCTS

2.1 MANUFACTURED UNITS

.1 Fixture piping.

.1 Hot and cold water supplies to each fixture:

.1 Stops supplies shall be all brass with full turn brass seams and washer replaceable attachment shall be IPS inlet x compression OD outlet to fixture. All fixture stop valves shall be ¼ turn handler type.

.2 Chrome plated in all exposed places.

.2 Waste:

.1 Cast brass adjustable style P-trap with cleanout on each fixture not having integral trap.

.2 Chrome plated in all exposed places.

.3 Sink and lavatory heavy gauge P-traps shall be cast brass adjustable style with 17 ga. seamless brass wall bend. Attachment nuts shall be brass, no zinc allowed. P-traps to be removable/union type or to include cleanout.

.4 Lavatory strainers shall be chrome plated cast brass with 17 ga. seamless brass tailpiece.

.5 All barrier-free lavatories and sinks shall have chrome plated offset tail piece in addition to P-trap with cleanout. Insulate P-trap and hot & cold water pipes with pre-formed & finished surface insulation. Armaflex insulation and tape not acceptable.

.2 Fixtures:

.1 Manufacture in accordance with CSA B45.

.2 All products, where applicable, shall be marked with manufacturer's name or product #.

.3 Trim, fittings: manufacture in accordance with CAN/CSA B125.

.4 Number, locations: Architectural drawings to govern.

.5 Fixtures in any one location to be product of one manufacturer and of same type.

.6 Trim in any one location to be product of one manufacturer and of same type unless otherwise indicated.

.7 Reference drawing schedule for configuration and type.

2.2 CARRIERS

.1 Provide for all wall mounted plumbing fixtures.

2.3 ROUGHING-IN OF FIXTURES

.1 Rough-in for equipment supplied by other to be complete with valved supplies, wastes and vents, capped and associated fitting piping & reducers.

2.4 PLUMBING FIXTURES

.1 Reference fixture schedule on Drawings.

PART 3 EXECUTION

3.1 INSTALLATION

.1 Mounting heights:

.1 Standard: to comply with manufacturer's recommendations unless otherwise indicated or specified.

.2 Wall-hung fixtures: as indicated on architectural elevations.

.3 Physically handicapped: to comply with most stringent of either NBCC, OBC or CAN/CSA B651.

3.2 URINALS

.1 Urinal waste pipe & fittings shall be DWV PVC equivalent to IPEX System 15 in accordance with specification Section 22 13 16.16 - Drainage Waste and Vent - Plastic. Extend plastic piping up to combined waste from adjacent lavatory or other plumbing fixtures allowing dilution of waste.

.2 Copper and steel piping is not to be used on waste discharge from urinals.

3.3 ADJUSTING

.1 Conform to water conservation requirements specified in this section.

.2 Adjustments:

.1 Adjust water flow rate to design flow rates and sensors.
.2 Adjust pressure to fixtures to ensure no splashing at maximum pressures.
.3 Adjust flush valves to suit actual site conditions.

.3 Checks:

.1 Water closets: flushing action.
.2 Aerators: operation, cleanliness.
.3 Vacuum breakers, backflow preventers: operation under all conditions.

END OF SECTION

EMERGENCY PLUMBING FIXTURES

PART 1 GENERAL

1.1 RELATED SECTIONS

.1 This section shall be read in conjunction with:

.1 Specification Section 20 05 01 - Mechanical General Requirements;

.2 All mechanical sections in Divisions 20, 21, 22, 23, and 25.

1.2 REFERENCES

.1 International Safety Equipment Association (ISEA) 1. ANSI/ISEA Z358.1 – American National Standard for Emergency Eyewash and Shower Equipment.

PART 2 PRODUCTS

2.1 WALL-MOUNTED EMERGENCY PLUMBING FIXTURES:

.1 Wall mounted eye/face wash:

.1 Stainless steel 11" (27.9 cm) round bowl.

.2 Eye/face wash head shall feature inverted directional laminar flow which achieves zero vertical velocity supplied by an integral 3.7 gpm flow control, chrome-plated brass stay-open ball valve equipped with stainless steel ball and stem, and chrome-plated brass in-line 50 x 50 mesh water strainer.

.3 Unit shall also include cast-aluminum chromate protected wall bracket, drain trap and tailpiece, yellow plastic pop-off dust cover for eyewash head, tailpiece and trap, universal sign, 1/2" NPT inlet, and 1-1/2" NPT waste.

.4 In-Line Filter:

.1 Chrome-plated brass in-line 50 x 50 mesh water strainer

.2 Strainer is to be easily serviceable.

.5 Stainless steel dust cover for both the eye wash and the bowl.

.1 Acceptable Haws 9102.

.6 Thermostatic Mixing Valve:

.1 Paraffin filled thermostatic mixing element.

.2 Flow Rate: 10 gpm (38.8 L)

.3 Cold Water Bypass flow rate of 3.8 gpm (14.4 L).

.4 Brass design with supplied check valves, over-sized valve seats, and a funnel design to improve temperature control with better mixing at low flow rates.

.5 Lime and calcium resistant components are used throughout.

.6 The outlet temperature factory setting is 85° F (29° C).

.7 Inlets and outlet: 1/2" NPT(F).

.8 Thermostatically mixes hot and cold water to provide a safe fluid supply for a single emergency eye/face wash.

.9 Acceptable material: Haws Axion model 9201EW

.7 Acceptable Material: Haws 7360BT-7460BT

2.2 WATER TEMPERING EQUIPMENT

.1 Instantaneous Water Heater:

.1 Powder-coated, cold rolled, wall mounted, steel cabinet

.2 Active energy management to ensure optimal application of energy based on real-time systems demands. Multistage element turn-on. Visual interface for field programming. BMS capable. Industry-leading temperature response rate.

.3 System to provide safety showers and eyewashes with an unlimited supply of tepid water with flow rates up to 30 gpm.

.4 Refer to drawing schedule for performance.

.5 Acceptable Material: Haws model 9321

PART 3 EXECUTION

3.1 INSTALLATION

.1 Assemble fixtures and associated fittings and trim in accordance with manufacturer's instructions.

.2 Install fixture supports attached to building structure for fixtures requiring supports.

.3 Install fixtures onto waste-fitting seals or flanges and attach to supports or building structure.

.4 Install fixtures level, plumb, and firmly in place in accordance with manufacturer's rough-in drawings.

.5 Install water supply piping to each fixture requiring water supply connection. Provide stop on each supply in readily serviceable location. Fasten supply piping to supports or substrate.

.6 Install trap and waste piping to each fixture requiring sanitary system connection.

.7 Install escutcheons at exposed piping penetrations in finished locations and within cabinets.

.8 Seal joints between fixtures and walls, floors, and countertops with mildew-resistant silicone sealant.

3.2 TESTING AND ADJUSTING

.1 Set field-adjustable temperature set points of temperature-actuated water mixing valves. Adjust set point within allowable temperature range.

.2 Test and adjust installation.

.3 Remove and replace malfunctioning thermostatic mixing valves and retest.

END OF SECTION

DIVISION 23 INDEX

USE OF MECHANICAL SYSTEMS DURING CONSTRUCTION

PART 1 GENERAL

1.1 RELATED SECTIONS

.1 This section shall be read in conjunction with:

.1 Specification Section 20 05 01 - Mechanical General Requirements;

.2 All mechanical sections in Divisions 20, 21, 22, 23, and 25.

1.2 USE OF SYSTEMS

.1 Use of new and/or existing permanent heating and ventilating systems for supplying temporary heat and ventilation is permitted only under the following conditions:

.1 Entire system is complete, pressure tested, cleaned, flushed out.

.2 Specified water treatment system has been commissioned, water treatment is being continuously monitored.

.3 Building has been closed in. Areas to be heated/ventilated are clean and will not thereafter be subjected to dust-producing processes.

.4 There is no possibility of damage from any cause.

.5 Supply ventilation systems are protected by 60% filters, which shall be inspected daily, changed every 2 weeks or more frequently as required.

.6 Return systems have approved filters over all openings, inlets, outlets.

.7 All systems will be:

.1 operated as per manufacturer's recommendations or instructions.

.2 operated by Contractor.

.3 monitored continuously by Contractor.

.8 Warranties and guarantees do not commence until equipment is turned over to owner.

.9 Regular preventive and all other manufacturers recommended maintenance routines are performed by Contractor at his own expense and under supervision of Engineer.

.10 Before turn-over to owner, entire system to be refurbished, cleaned internally and externally and restored to "as- new" condition. Filters in air and water systems are to be replaced.

.2 Filters referred to herein are over and above those specified elsewhere in this specification.

.3 Exhaust systems are not included in any approvals for temporary heating ventilation.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

MOTORS, DRIVES & GUARDS FOR MECHANICAL SYSTEMS

PART 1 GENERAL

1.1 RELATED SECTIONS

.1 This section shall be read in conjunction with:

.1 Specification Section 20 05 01 - Mechanical General Requirements;

.2 All mechanical sections in Divisions 20, 21, 22, 23, and 25.

1.2 REFERENCES

.1 American Society of Heating, Refrigeration and Air-Conditioning Engineers.

.1 ANSI/ASHRAE 90.1-2019 (I-P), Energy Code for Buildings Except Low-Rise Residential Buildings.

.2 Electrical Equipment Manufacturers' Advisory Council (EEMAC)

.3 National Electrical Manufacturers Association (NEMA)

.1 NEMA MG 1-2016, Motors and Generators.

.4 Ontario Regulation

.1 ONTARIO OBC-2012, 2012 Ontario Building Code Compendium.

1.3 ELECTRICAL

.1 Electrical work to conform to Division 26 including the following:

.1 Control wiring and conduit is specified in Division 26 except for conduit, wiring and connections below 50 V which are related to control systems specified in Divisions 20, 21, 22, 23, & 25. Refer to Division 26 for quality of materials and workmanship.

PART 2 PRODUCTS

2.1 GENERAL

.1 Motors to be premium efficiency, in accordance with NEMA 1 premium motor standards and the requirements of ASHRAE 90.1 unless superceded by Ontario Building Code (OBC) Supplementary Standard SB-10.

2.2 MOTORS

.1 Provide premium efficiency motors for mechanical equipment to NEMA MG 1 Part 31.

.2 Motors under 373 W (½ HP): speed as indicated, continuous duty, built-in overload protection, resilient mount, single phase, 120 V, unless otherwise specified or indicated.

.3 Motors 373 W (½ HP) to 14.92 kW (20 HP): EEMAC Class B/F, squirrel cage induction, speed as indicated, continuous duty, drip proof, ball bearing, maximum temperature rise 45°C/60°C over ambient of 30°C, 3 phase, 600 V, unless otherwise specified or indicated.

.4 Motors 18.65 kW (25 HP) and larger: EEMAC Class B/F, squirrel cage induction, speed as indicated, continuous duty, drip proof, ball bearing, maximum temperature rise 45°C/60°C over ambient of 30°C, 3 phase, 600 V, c/w integral thermistor protection, unless otherwise specified or indicated. Thermistors shall be factory installed, copper RTD type, one on each phase, wired to identified terminals in motor terminal box and wired to starter/VFD (wiring, conduit & connections by Div. 26).

.5 Two speed motors shall be double winding type.

.6 Motors coupled with VFD shall be premium efficiency, inverter duty type to NEMA MG 1 Part 31 and shall have as a minimum EEMAC Class F insulation. Inverter ready motors shall not be acceptable.

.7 Motors coupled with VFD's shall include a shaft grounding ring.

.8 Motors located outside to be TEFC type, unless located in insulated weatherproof enclosure.

2.3 TEMPORARY MOTORS

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

2.4 BELT DRIVES

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

.2 Use cast iron or steel sheaves secured to shafts with removable keys unless otherwise specified.

.3 For motor under 7.5 kW (10 HP): standard adjustable pitch drive sheaves, having plus or minus 10% range. Use mid-position of range for specified r/min.

.4 For motors 7.5 kW (10 HP) and over: sheave with split tapered bushing and keyway having fixed pitch unless specifically required for item concerned. Provide sheave of correct size to suit balancing.

.5 Correct size of sheave to be determined during start-up and commissioning.

.6 Minimum drive rating: 1½ times nameplate rating on motor. Keep overhung loads within manufacturer's design requirements on prime mover shafts.

.7 Motor slide rail adjustment plates to allow for centre line adjustment.

2.5 DRIVE GUARDS

.1 Provide guards for unprotected drives.

.2 Guards for belt drives;

- .1 Expanded metal screen welded to steel frame.
- .2 Minimum 1.6 mm (16 ga). sheet metal tops and bottoms.
- .3 38 mm (1½") dia. holes on both shaft centres for insertion of tachometer.
- .4 Removable for servicing.

.3 Provide means to permit lubrication and use of test instruments with guards in place.

.4 Install belt guards to allow movement of motors for adjusting belt tension.

PART 3 EXECUTION

3.1 INSTALLATION

.1 Fasten securely in place.

.2 Ensure motor installation is easily removable for servicing.

END OF SECTION

COMMON INSTALLATION REQUIREMENTS FOR HVAC PIPING

PART 1 GENERAL

1.1 RELATED SECTIONS

.1 This section shall be read in conjunction with:

.1 Specification Section 20 05 01 - Mechanical General Requirements;

.2 All mechanical sections in Divisions 20, 21, 22, 23, and 25.

1.2 REFERENCES

.1 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-1.181-99, Ready-Mixed Organic Zinc-Rich Coating.

.2 CSA Group (CSA):

.1 CAN/CSA B139-04, Installation Code for Oil Burning Equipment

.3 Green Seal Environmental Standards (GS):

.1 Standard GS-11-2008, 2nd Edition, Environmental Standard for Paints and Coatings

.4 National Research Council Canada (NRC):

.1 National Fire Code of Canada 2015 (NFC)

.5 South Coast Air Quality Management District (SCAQMD), California State, Regulation XI:

.1 SCAQMD Rule 1113-2016, Architectural Coatings

.2 SCAQMD Rule 1168-2017, Adhesive and Sealant Applications

PART 2 PRODUCTS

2.1 MATERIALS

.1 Paint: zinc-rich to CAN/CGSB-1.181.

.2 Primers, Paints, and Coating: in accordance with manufacturer's recommendations for surface conditions.

.3 Primer: maximum VOC limit 250 g/L to Standard GS-11 and SCAQMD Rule 1113.

.4 Paints: maximum VOC limit 150] g/L to Standard GS-11 and SCAQMD Rule 1113.

.5 Sealants: in accordance with Section 07 92 00 - Joint Sealants.

.6 Sealants: maximum VOC limit to SCAQMD Rule 1168.

.7 Sealants: maximum VOC limit to SCAQMD Rule 1168 and GS-36.

.8 Adhesives: maximum VOC limit to SCAQMD Rule 1168 and GS-36.

.9 Fire Stopping: in accordance with Section 07 84 00 - Fire Stopping.

PART 3 EXECUTION

3.1 APPLICATION

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

3.2 CONNECTION TO EQUIPMENT

.1 In accordance with manufacturer's instructions unless otherwise indicated.

.2 Use valves and either unions or flanges for isolation and ease of maintenance and assembly.

.3 Use double swing joints when equipment mounted on vibration isolation and when piping subject to movement.

3.3 CLEARANCES

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

.2 Provide space for disassembly, removal of equipment and components as recommended by manufacturer or as indicated (whichever is greater) without interrupting operation of other system, equipment, components.

3.4 DRAINS

.1 Install piping with grade in direction of flow except as indicated or specified otherwise.

.2 Install drain valve at low points in piping systems, at equipment at section isolating valves and at base of all risers.

.3 Pipe each drain valve discharge separately to above floor drain. Discharge to be visible.

.4 Drain valves: NPS ¾ full port ball valves unless indicated otherwise, with hose end male thread, cap and chain.

3.5 AUTOMATIC AIR VENTS

.1 Install automatic air vents at high points of piping systems.

.2 Install full port ball at each automatic air vent.

.3 Air vents must have minimum connection of 13 mm (½").

3.6 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.

3.7 PIPEWORK INSTALLATION

.1 Screwed fittings to be jointed with Teflon tape.

.2 Protect openings against entry of foreign material.

.3 Install so that equipment can be isolated and removed without interruption to operation of any other equipment or systems.

.4 Assemble piping using fittings manufactured to ANSI standards.

.5 Weldolets sockolets Saddle type branch fittings may be used on mains if branch line is no larger than half the size of the main.

.1 Hole saw (or drill) and ream main so as to maintain full inside diameter of branch line prior to welding saddle. Provide isolation valves at each branch connection.

.6 Install exposed piping, equipment, rectangular cleanouts and similar items parallel or perpendicular to building lines.

.7 Install concealed pipework so as to minimize furring space, maximize headroom, conserve space.

.8 Except where indicated otherwise, slope piping in direction of flow for positive drainage and venting.

.9 Except where indicated, install so as to permit separate thermal insulation of each pipe.

.10 Group piping wherever possible and as indicated.

.11 Ream pipes, remove scale and other foreign material before assembly.

.12 Use eccentric reducers at pipe size changes to ensure positive drainage and venting.

.13 Provide for thermal expansion as indicated and specified.

.14 Valves:

.1 Install in accessible locations.
.2 Remove interior parts before soldering.
.3 Install with stems above horizontal position unless indicated.
.4 Valves accessible for maintenance without removing adjacent piping.
.5 Install globe valves in bypass around control valves.
.6 Use ball or butterfly valves at branch take-offs for isolating purposes except where specified.
.7 Install butterfly valves on chilled water and related condenser water systems only.
.8 Install butterfly valves between weld neck flanges to ensure full compression of liner.
.9 Install plug cocks or ball valves for glycol service.
.10 Use chain operators on valves NPS 2 1/2 and larger where installed more than 2400 mm above floor in Mechanical Rooms.

.15 Check Valves:

.1 Install silent check valves on discharge of pumps and in vertical pipes with downward flow and as indicated.
.2 Install swing check valves in horizontal lines on discharge of pumps and as indicated.

3.8 SLEEVES

.1 General: Install where pipes pass through masonry, concrete structures, fire rated assemblies, and elsewhere as indicated.

.2 Material: Schedule 40 black steel pipe.

.3 Construction: Foundation walls and where sleeves extend above finished floors - to have annular fins continuously welded on at mid-point.

.4 Sizes: 6 mm minimum clearance all round between sleeve and uninsulated pipe or between sleeve and insulation.

.5 Installation:

.1 Concrete, masonry walls, concrete floors on grade: Terminate flush with finished surface.

.2 Other floors: Terminate 25 mm above finished floor.

.3 Before installation, paint exposed exterior surfaces with heavy application of zinc-rich paint to CAN/CGSB-1.181.

.6 Sealing:

.1 Foundation walls and below grade floors: Fire retardant, waterproof non-hardening mastic.

.2 Elsewhere: Provide space for firestopping. Maintain fire rating integrity.

.3 Sleeves installed for future use: Fill with lime plaster or other easily removable filler.

.4 Ensure no contact between copper pipe or tube and sleeve.

3.9 ESCUTCHEONS

.1 Install on pipes passing through walls, partitions, floors, and ceilings in finished areas.

.2 Construction: One piece type with set screws. Chrome or nickel plated brass or type 302 stainless steel.

.3 Sizes: Outside diameter to cover opening or sleeve. Inside diameter to fit around pipe or outside of insulation if so provided.

3.10 FLUSHING OUT OF PIPING SYSTEMS

.1 In accordance with Section 23 08 16 - Cleaning and Start-up of Mechanical Piping Systems.

.2 Preparatory to acceptance, clean and refurbish equipment and leave in operating condition, including replacement of filters in piping systems.

.3 Provide test results upon completion and retain written report on status after complete.

3.11 PRESSURE TESTING OF EQUIPMENT AND PIPEWORK

.1 Advise Engineer 48 hours minimum prior to performance of pressure tests.

.2 Pipework: Test to 1½ times normal operating pressure to a maximum of the piping systems working pressure including devices (i.e. valves, fittings, accessories). Minimum test pressure to be 862 kPa (125 psi).

.3 Maintain specified test pressure without loss for four 4 hours minimum. Temperature of system to remain constant during of test.

.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 Engineer.

.6 Bear costs for repairs or replacement, retesting, and making good. Engineer to determine whether repair or replacement is appropriate.

.7 Insulate or conceal work only after approval and certification of tests by Engineer.

END OF SECTION

VALVES

PART 1 GENERAL

1.1 RELATED SECTIONS

.1 This section shall be read in conjunction with:

.1 Specification Section 20 05 01 - Mechanical General Requirements;

.2 All mechanical sections in Divisions 20, 21, 22, 23, and 25.

1.2 REFERENCES

.1 American Society of Mechanical Engineers (ASME).

.1 ASME B1.20.1-2013 (R2018), Pipe Threads, General Purpose (Inch).

.2 ASME B16.1-2020, Gray Iron Pipe Flanges and Flanged Fittings, Class 25, 125 and 250.

.3 ASME B16.34-2020, Valves - Flanged, Threaded and Welding End.

.2 American Society for Testing and Materials (ASTM).

.1 ASTM A126-04(2019), Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.

.2 ASTM A193/A193M-20, Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High Temperature or High Pressure Service and Other Special Purpose Applications.

.3 ASTM A194/A194M-20a, Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both.

.4 ASTM A216/A216M-18, Standard Specification for Steel Castings, Carbon, Suitable for Fusion Welding, for High-Temperature Service.

.5 ASTM B16/B16M-19, Standard Specification for Free-Cutting Brass Rod, Bar and Shapes for Use in Screw Machines.

.6 ASTM B62-17, Specification for Composition Bronze or Ounce Metal Castings.

.3 Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS).

.1 MSS SP-67-2017, Butterfly Valves.

.2 MSS SP-80-2019, Bronze Gate Globe, Angle and Check Valves.

PART 2 PRODUCTS

2.1 GENERAL

.1 All valves of the same type to be from one manufacturer.

.2 All valves to have CRN registration numbers.

2.2 GATE VALVE

.1 NPS 2 and under, bronze, solid wedge disc:

.1 Standard specification: MSS SP-80.
.2 Bonnet: with hex. shoulders.
.3 Connections: with hex. shoulders.
.4 Inspection and pressure testing: to MSS SP-80. Tests to be hydrostatic.
.5 Packing: high grade non-asbestos packing.
.6 Handwheel: non-ferrous. Nut: bronze to ASTM B62.
.7 Body: with long disc guides, screwed bonnet with stem retaining nut.

2.3 CHECK VALVES

.1 NPS 2 and under, bronze swing type, bronze disc:

.1 Standard specification: MSS SP-80.
.2 Connections: with hex. shoulders.
.3 Body: Y-pattern with integral seat at 45°, screw-in cap with hex head.
.4 Disc and seat: renewable rotating disc, two-piece hinge disc construction; seat: regrindable.

2.4 SEWAGE CHECK VALVES

.1 NPS 1¼ to 3 full flow no restriction cast iron type:

.1 Application: Vertical or horizontal sewage installation.
.2 Neoprene polyester reinforced flapper with cast iron & non-corrosive metal backing plates and stainless steel hardware.
.3 Corrosion resistant powder coated epoxy finish.
.4 Rated at 345 kPa (50 psi) at 54°C (130°F).

2.5 BALL VALVES

.1 NPS 4 and under:

.1 Body and cap: cast high tensile bronze to ASTM B62 or brass to ASTM B16/B16M C36000.
.2 Stem: tamperproof ball drive.
.3 Stem packing nut: external to body.
.4 Ball and seat: replaceable chrome plated brass solid full port ball and Teflon seats.
.5 Stem seal: TFE with external packing nut.
.6 Operator: removable lever handle.

2.6 BUTTERFLY VALVES

.1 NPS 2½ and over, lug body, dead end type:

.1 To MSS SP-67, Class 150, 1.4 Mpa WOG, cast iron or semi-steel body, or ductile iron bronze disc, stainless steel stem, replaceable EPDM liner and nylon coated ductile iron seat, locking handle.

.2 Operators:

.1 NPS 2½ to 5: locking type lever handle.

.2 NPS 6 and over: gear operator.

2.7 LUBRICATED PLUG VALVES

.1 Valve:

.1 Body: cast iron to ASTM A126 Class B semi-steel.

.2 Plug: cylindrical or tapered, with regular Venturi or round pattern port - 90° from full open to fully closed.

.3 Number of ports: 2.

.4 Ends: with hexagon shoulders, ends screwed to ASME B1.20.1 up to NPS 3; Flanged to ASME B16.1 NPS 4 and over.

.5 Lubrication system, nickel-plated.

.6 Lubricant: to suit type, temperature and pressure of contained fluid.

.7 Feeding system: lubricant forced into lubrication grooves between seating surfaces of plug and body to form positive seal, leakproof operation, and corrosion preventing film. Lubricant receptacle to hold additional lubricant. Lubricant screw for lubrication. Check valve to prevent reverse flow of lubricant. O-rings between body and plug.

.2 Operator: manual - lever.

.3 Accessories: lubricant gun.

.4 Testing: to ASME B16.34.

2.8 ACCEPTABLE PRODUCTS TABLE:

Domestic, Chilled & Heating Water/Glycol up to 200 psi:							
Valve Type	**Size**	**Connection**	**Crane**	**Jenkins**	**Toyo**	**Victaulic**	**Kitz**
Ball	NPS 4 & under	Solder	9202 (up to 3")	202J (up to 3")	5049A	-	59
		Threaded	9201 (up to 4")	201J (up to 4")	5044A	722	58
Butterfly	NPS 2-1/2 & Over	Flanged	44BXZ	2232EJ	928BESL/G	-	6122 EL/G
		Grooved	-	-	-	Vic-300	-
		Grooved	-	-	-	Vic-608	-
Check	NPS 2 & under	Solder	1342	4093J	237	-	23
		Threaded	37	4037	236	-	22
	NPS 2-1/2 & over	Flanged	373	587J	435	-	78
		Grooved	-	-	-	716	-
			Tour & Andersson	**Armstrong**	**Bell & Gossett**		
Balancing	NPS 2 & under	Solder	STAS	CBV-S	CB-S		
		Threaded	STAD	CBV-T	CB		
	NPS 2-1/2 & over	Flanged	STAF-SG	CBV-G	CB-F		
		Grooved	STAG	CBV-G	CB-G		
Water Entry:							
Valve Type	**Size**	**Connection**	**Watts**				
Gate	NPS 4 & over	Flanged	4080 SYRW				
Natural Gas:							
Valve Type	**Size**	**Connection**	**Crane**	**Jenkins**	**Toyo**	**Kitz**	
Ball	2" and under	Threaded	9201	201J	5044A	58	
			Newmann Miliken	**Kitz**			
Lubricated Plug	¾"-2"	Threaded	170M	-			
	2-1/2" & over	Flanged	171M	150 SCTAM-FS			

PART 3 EXECUTION

3.1 INSTALLATION

.1 Install rising stem valves in upright position with stem above horizontal.

.2 Handwheel with chain operators are to be installed on all valves more than 3 metres above floor.

.3 Remove internal parts before soldering or brazing.

.4 Install all valves such that adequate clearance is provided to allow for obstruction free operation.

.5 Install valves at all branch take-offs and to isolate each piece of equipment, and as indicated.

.6 For all threaded valves provide one screwed union beside each valve to allow easy replacement of valve.

.7 Install all valves as per manufacturer's recommendation.

END OF SECTION

PART 1 GENERAL

1.1 RELATED SECTIONS

.1 This section shall be read in conjunction with:

.1 Specification Section 20 05 01 - Mechanical General Requirements;

.2 All mechanical sections in Divisions 20, 21, 22, 23, and 25.

1.2 REFERENCES

.1 American Society of Mechanical Engineers (ASME)

.1 ASME B31.1-2020 Power Piping, (SI Edition).

.2 American Society for Testing and Materials (ASTM)

.1 ASTM A123/A123M-17, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

.2 ASTM A125-96(2018), Specification for Steel Springs, Helical, Heat-Treated.

.3 ASTM A153/A153M-16a, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

.4 ASTM A307-14e1, Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.

.5 ASTM A563-15, Specification for Carbon and Alloy Steel Nuts (Metric).

.6 ASTM D1929-20, Standard Test Method for Determining Ignition Temperature of Plastics.

.3 Manufacturer's Standardization Society of the Valves and Fittings Industry (MSS)

.1 MSS SP-58-2018, Pipe Hangers and Supports - Materials, Design, Selection, Manufacture, Application, and Installation.

.4 Underwriter's Laboratories of Canada (ULC).

1.3 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 SP-58.

.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 all 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 to be in accordance with MSS SP-58.

1.4 DESIGN FOR SEISMIC EVENTS

.1 Design supports, platforms, hangers, racks to withstand seismic events as specified Section 20 05 49 - Seismic Restraint Systems (SRS).

PART 2 PRODUCTS

2.1 GENERAL

.1 Fabricate hangers, supports and sway braces in accordance with ASME B31.1 and MSS SP-58.

.2 Use components for intended design purpose only. Do not use for rigging or erection purposes.

2.2 PIPE HANGERS

.1 Finishes: Ensure steel hangers in contact with copper piping are copper plated or epoxy coated.

.2 Upper attachment structural: Suspension from lower flange of I-Beam.

.1 Cold piping NPS 2 maximum: Malleable iron C-clamp with hardened steel cup point setscrew, locknut and carbon steel retaining clip.

.1 Rod: 9 mm UL listed.

.2 Cold piping NPS 2½ or greater, all hot piping: Malleable iron beam clamp, eye rod, jaws and extension with carbon steel retaining clip, tie rod, nuts and washers, UL listed to MSS SP-58.

.3 Upper attachment structural: Suspension from upper flange of I-Beam.

.1 Cold piping NPS 2 maximum: Ductile iron top-of-beam C-clamp with hardened steel cup point setscrew, locknut and carbon steel retaining clip, UL listed to MSS SP-58.

.2 Cold piping NPS 2½ or greater, all hot piping: Malleable iron top-of-beam jaw-clamp with hooked rod, spring washer, plain washer and nut UL listed.

.4 Upper attachment to concrete.

.1 Ceiling: Carbon steel welded rod, clevis plate, clevis pin and cotters with forged weldless steel nut.

.2 Concrete wedge anchor with knockout protector plate UL listed to MSS SP-58. Anchor installation to be via concrete pre-drilling. Impact insert type anchor not allowed.

.5 Manufacturer assemblies:

.1 Sway braces for seismic restraint systems: to Section 20 05 49 - Seismic Restraint Systems (SRS).

.6 Hanger rods: threaded rod material to MSS SP-58.

.1 Ensure that hanger rods are subject to tensile loading only.

.2 Provide linkages where lateral or axial movement of pipework is anticipated.

.3 Do not use 22 mm or 28 mm rod.

.7 Pipe attachments: material to MSS SP-58.

.1 Attachments for steel piping: carbon steel black.

.2 Attachments for copper piping: copper plated black steel.

.3 Use insulation shields for hot pipework.

.4 Oversize pipe hangers and supports.

.8 Adjustable clevis: material to MSS SP-58 UL listed, clevis bolt with nipple spacer and vertical adjustment nuts above and below clevis. Ensure "U" has hole in bottom for riveting to insulation shields.

.9 Yoke style pipe roll: carbon steel yoke, rod and nuts with cast iron roll, to MSS SP-58.

.10 U-bolts: carbon steel to MSS SP-58 with 2 nuts at each end to ASTM A563.

.1 Finishes for steel pipework: black.

.2 Finishes for copper, glass, brass or aluminum pipework: black, with portion formed epoxy coated.

.11 Pipe rollers: cast iron roll and roll stand with carbon steel rod to MSS SP-58, Type 43.

.1 Finish: Hot dipped galvanized steel.

.2 Acceptable material: Tolco or approved equal.

2.3 RISER CLAMPS

.1 Steel or cast iron pipe: black carbon steel to MSS SP-58, type 42, UL listed.

.2 Copper pipe: carbon steel copper plated to MSS SP-58, type 42.

.3 Bolts: to ASTM A307.

.4 Nuts: to ASTM A563.

2.4 INSULATION PROTECTION SHIELDS

.1 Insulated cold piping: 64 kg/m3 density insulation plus insulation protection shield to: MSS SP-58, galvanized sheet carbon steel. Length designed for maximum 3 m span.

.2 Insulated hot piping: Curved plate 300 mm long, with edges turned up, welded-in centre plate for pipe sizes NPS 12 and over, carbon steel to comply with MSS SP-58.

2.5 CONSTANT SUPPORT SPRING HANGERS

.1 Springs: alloy steel to ASTM A125, shot peened, magnetic particle inspected, with +/-5% spring rate tolerance, tested for free height, spring rate, loaded height and provided with CMTR.

.2 Load adjustability: 10% minimum adjustability each side of calibrated load. Adjustment without special tools. Adjustments not to affect travel capabilities.

.3 Provide upper and lower factory set travel stops.

.4 Provide load adjustment scale for field adjustments.

.5 Total travel to be actual travel + 20%. Difference between total travel and actual travel 25 mm minimum.

.6 Individually calibrated scales on each side of support calibrated prior to shipment, complete with calibration record.

2.6 VARIABLE SUPPORT SPRING HANGERS

.1 Vertical movement: 13 mm minimum, 50 mm maximum, use single spring pre-compressed variable spring hangers.

.2 Vertical movement greater than 50 mm: use double spring pre-compressed variable spring hanger with 2 springs in series in single casing.

.3 Variable spring hanger to be complete with factory calibrated travel stops.

.4 Steel alloy springs: to ASTM A125, shot peened, magnetic particle inspected, with +/-5% spring rate tolerance, tested for free height, spring rate, loaded height and provided with CMTR.

2.7 EQUIPMENT SUPPORTS

.1 Fabricate equipment supports not provided by equipment manufacturer from structural grade steel meeting requirements of structural steel sections. Submit calculations with shop drawings.

2.8 EQUIPMENT ANCHOR BOLTS TEMPLATES

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

.2 For attachment to concrete, provide concrete wedge anchors with knockout protection plate UL listed. Anchor installation to be via concrete pre-drilling. Impact insert type anchor not allowed.

2.9 HOUSE-KEEPING PADS

.1 For base-mounted equipment: Concrete, at least 100 mm high, 50 mm larger than equipment all around, with chamfered edges and anchored to the structural slab.

.2 Concrete: refer to structural specifications.

2.10 PIPE, DUCT, CONDUIT PENETRATIONS SLABS

.1 Where piping or conduits penetrate through the floor of mechanical room, a 100 mm through high housekeeping pad shall be installed with minimum 150 mm between conduit/pipe and the edge of the pad. This pad shall be bonded to the existing slab through which the pipes, ducts or conduit shall pass.

2.11 ROOF MOUNTED SUPPORTS

.1 Pressure treated lumber supports are only acceptable when roofed in/covered by general trades. Exposed applications are not acceptable.

.2 Portable Support System: Engineered, portable system specifically designed for installation without the need for roof penetrations or flashings, and without damage to the roofing membrane.

.1 Design system using high density polypropylene bases and structural steel framing.

.2 Custom design system to fit piping, conduits, equipment, or walkways to be installed and actual conditions of service and loading.

.3 Piping Supports: Provide suitable hangers and supports.

.4 Pipe support system shall have seismic ratings and meet Section 20 05 49 - Seismic Restraint Systems (SRS).

.3 Bases: Injection molded high density polypropylene with UV-inhibitors or recycled rubber conforming to the following:

.1 Moisture content: Negligible.

.2 Shrinkage/swelling due to moisture: Negligible.

.3 Density: 894 kg/m3 (55.8 lbs./ft.3).

.4 Insect resistance: No known insect damage potential.

.5 Chemical resistance (oil, brake fluid, gasoline, diesel, antifreeze, battery acid, sulfuric acid: no visual or physical change apparent.

.6 Flammability: No ignition after 10 minutes, 25 kW/m, when tested in accordance with ASTM D1929.

.7 Sized as required by loading conditions and as indicated on the drawings.

.8 Shop fabricated with inserts for square tubing or threaded rods as required.

.9 Colour: Integral black colour as molded.

.4 Steel Framing:

.1 Strut Types: 1-5/8 in. (41.3 mm) B22TH or 1-7/8 in. (47.6 mm) BTS22H, as required for loading conditions.

.2 Thickness: 12 gauge (2.7 mm).

.3 Form: Roll-formed 3-sided or tubular shape, perforated with 9/16 in. (14.3 mm) holes at 1-7/8 in. (47.6 mm) centres on three (3) sides.

.4 Finish: Hot dip galvanize in accordance with ASTM A123/A123M after fabrication, free of roughness, whiskers, unsightly spangles, icicles, runs, barbs, sags, droplets, and other surface blemishes.

.5 Pipe Supports and Hangers: Conform to MSS SP-58 and as follows:

.1 Fabricate of carbon steel where framing is carbon steel; fabricate of stainless steel where framing is stainless steel; finished same as framing.

.2 Sizes 2-1/2 in. (63 mm) and smaller: Single roller supports for piping subject to expansion and contraction; 3-sided channels and pipe clamps.

.3 Sizes 3 in. (76 mm) and larger: Rollers, clevis hangers, or band hangers, to allow for expansion and contraction without movement of the bases or framing.

.6 Accessories: Clamps, bolts, nuts, washers, and other devices as required for a complete system:

.1 Carbon steel: Hot-dip galvanized in accordance with ASTM A153/A153M.

.2 Stainless steel: mill finish.

.7 Acceptable material: Portable Pipe Hangar Model PPH-D, Miro Industries Model 8-DS, Mifab CPORT-2015, Big Foot Systems, or approved equal.

PART 3 EXECUTION

3.1 INSTALLATION

.1 Install in accordance with: manufacturer's instructions and recommendations.

.2 Vibration Control Devices:

.1 Install on piping systems at pumps and elsewhere as indicated.

.3 Clamps on riser piping:

.1 Support independent of connected horizontal pipework using riser clamps and riser clamp lugs welded to riser.

.2 Bolt-tightening torques to be to industry standards.

.3 Steel pipes: Install below coupling or shear lugs welded to pipe.

.4 Cast iron pipes: Install below joint.

.4 Clevis plates:

.1 Attach to concrete with 4 minimum concrete inserts, one at each corner.

.5 Provide supplementary structural steelwork where structural bearings do not exist or where concrete inserts are not in correct locations.

.6 Use approved constant support type hangers where:

.1 vertical movement of pipework is 13 mm or more,

.2 transfer of load to adjacent hangers or connected equipment is not permitted.

.7 Use variable support spring hangers where:

.1 transfer of load to adjacent piping or to connected equipment is not critical.

.2 variation in supporting effect does not exceed 25% of total load.

.8 When attaching to open web steel joists provide additional hangers for pipes with diameters of 75 mm or greater in order to reduce the magnitude of the concentrated load and spread the load to the joists equally. In these cases the allowable spacing of hangers for pipes permitted under ASME /MSS SP-58 will be reduced and additional hangers will be required as directed by steel fabricator and/or structural engineer.

.9 Locate hangers at the top of open web steel joists where the horizontal and diagonal members meet at a joint.

.10 All installations must be in conjunction with Section 20 05 49 - Seismic Restraint System.

3.2 HANGER SPACING

.1 Plumbing piping: most stringent requirements of Manufacturer's recommendations, Canadian Plumbing Code, Provincial Code, or authority having jurisdiction.

.2 Fire protection: to applicable fire code.

.3 Gas & fuel piping: to applicable code.

.4 Copper piping: up to NPS ½: every 1.5 m.

.5 Flexible joint roll groove pipe: in accordance with table below, but not less than one hanger at joints.

.6 Within 300 mm of each elbow.

.7 Maximum spacing to be as follows:

Maximum Pipe Size: (NPS)	Maximum Spacing (Steel)	Maximum Spacing (Copper)	Maximum Spacing (XFR)
Up to 1-1/4”	2.1m	1.8m	1.6m
1-1/2”	2.7m	2.4m	1.6m
2”	3.0m	2.7m	1.8m
2-1/2”	3.6m	3.0m	1.8m
3	3.6m	3.0m	2.2m
4	4.2m	3.6m	2.6m
6	5.1m	-	3.1m
8	5.7m	-	3.6m
10	6.6m	-	4.0m
12	6.9m	-	4.4m

.8 Pipework greater than NPS 12: to MSS SP-58.

3.3 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.

3.4 HORIZONTAL MOVEMENT

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

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

.4 Beam clamps: Hammer jaw firmly against underside of beam.

END OF SECTION

VIBRATION ISOLATION

PART 1 GENERAL

1.1 RELATED SECTIONS

.1 This section shall be read in conjunction with:

.1 Specification Section 20 05 01 - Mechanical General Requirements;

.2 All mechanical sections in Divisions 20, 21, 22, 23, and 25.

PART 2 PRODUCTS

2.1 ACCEPTABLE MATERIALS

.1 Approved manufacturers:

.1 Amber Booth.

.2 Mason Industries.

.3 Vibro-Acoustics.

.4 Vibron.

2.2 GENERAL

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

2.3 ELASTOMERIC PADS

.1 Type EP1 - neoprene waffle or ribbed; 9 mm minimum thick; 50 durometer; maximum loading 350 kPa.

.2 Type EP2 - rubber waffle or ribbed; 9 mm minimum thick; 30 durometer natural rubber; maximum loading 415 kPa.

.3 Type EP3 - neoprene-steel-neoprene; 9 mm minimum thick neoprene bonded to 1.71 mm steel plate; 50 durometer neoprene, waffle or ribbed; holes sleeved with isolation washers; maximum loading 350 kPa.

.4 Type EP4 - rubber-steel-rubber; 9 mm minimum thick rubber bonded to 1.71 mm steel plate; 30 durometer natural rubber, waffle or ribbed; holes sleeved with isolation washers; maximum loading 415 kPa.

2.4 ELASTOMERIC MOUNTS

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

2.5 SPRINGS

.1 Design stable springs so that ratio of lateral to axial stiffness is equal to or greater than 1.2 times the ratio of static deflection to working height. Select for 50% travel beyond rated load. Units to be complete with levelling devices.

.2 Ratio of height when loaded to diameter of spring to be between 0.8 to 1.0.

.3 Cadmium plate for all installations.

.4 Colour code springs.

2.6 SPRING MOUNTS

.1 Zinc or cadmium plated hardware; housings coated with rust resistant paint.

.2 Type M2 - stable open spring: support on bonded 6 mm minimum thick ribbed neoprene or rubber friction and acoustic pad.

.3 Type M3 - stable open spring: 6 mm minimum thick ribbed neoprene or rubber friction and acoustic pad, bonded under isolator and on isolator top plate; levelling bolt for rigidly mounting to equipment.

.4 Type M4 - restrained stable open spring: supported on bonded 6 mm minimum thick ribbed neoprene or rubber friction and acoustic pad; built-in resilient limit stops, removable spacer plates.

.5 Type M5 - enclo sed spring mounts with snubbers for isolation up to 950 kg maximum.

.6 Performance: to suit application.

2.7 HANGERS

.1 Colour coded springs, rust resistant, painted box type hangers. Arrange to permit hanger box or rod to move through a 30° arc without metal to metal contact.

.2 Type H1 - neoprene - in-shear, molded with rod isolation bushing which passes through hanger box.

.3 Type H2 - stable spring, elastomeric washer, cup with molded isolation bushing which passes through hanger box.

.4 Type H3 - stable spring, elastomeric element, cup with molded isolation bushing which passes through hanger box.

.5 Type H4 - stable spring, elastomeric element with precompression washer and nut with deflection indicator.

.6 Performance: to suit application.

2.8 STRUCTURAL BASES

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

.2 Type B2 - Steel rail base: structural steel, positioned for alignment of drive and driven equipment; without supplementary hold down devices; complete with isolation element attached to base brackets arranged to minimize height; and pre-drilled holes to receive equipment anchor bolts.

.3 Bases to clear housekeeping pads by 100 mm minimum.

2.9 INERTIA BASES

.1 Type B3 - Full depth perimeter structural or formed channels, frames: welded in place reinforcing rods running in both directions; spring mounted, carried by gusseted height-saving brackets welded to frame; and clear housekeeping pads by 50 mm minimum.

.2 Pump bases: "T" shaped, where applicable, to provide support for elbows.

.3 Concrete: as per schedule.

2.10 VIBRATION ISOLATION SCHEDULE

.1 Schedule:

Equipment	Type of Isolator	Deflection (mm)	Remarks
Fans	H3/HTR/B2	25	External
In-Line Transfer Fans	M	6	External
Fan Coil Unit	M	6	External
DX Split Air Condenser	EP	-	External
Unit Heaters	H1	13	External
Piping	H3	25	External

[1] Design in conjunction with seismic restraint Section 15011
[2] Base mounted pump shall be mounted on inertia pads and concrete housekeeping pads
[3] Depth of inertia pad shall be sized based on pump weight & size of assembly.

PART 3 EXECUTION

3.1 INSTALLATION

.1 Install vibration isolation equipment in accordance with manufacturers instructions and adjust mountings to level equipment.

.2 Ensure piping, ducting and electrical connections to isolated equipment do not reduce system flexibility and that piping, conduit and ducting passage through walls and floors do not transmit vibrations.

.3 Unless indicated otherwise, support piping connected to isolated equipment with spring mounts or spring hangers with 25 mm (1") minimum static deflection as follows:

.1 Up to NPS 4: first 3 points of support. NPS 5 to NPS 8: first 4 points of support. NPS 10 and Over: first 6 points of support.

.2 First point of support shall have a static deflection of twice deflection of isolated equipment, but not more than 50 mm (2").

.4 Where isolation is bolted to floor use vibration isolation rubber washers.

.5 Block and shim level bases so that ductwork and piping connections can be made to a rigid system at the operating level, before isolator adjustment is made. Ensure that there is no physical contact between isolated equipment and building structure.

3.2 SITE VISIT

.1 Manufacturer to visit site and provide written certification that installation is in accordance with manufacturer's instructions and submit report to Consultant.

.2 Provide Consultant with notice 24 h in advance of visit.

.3 Make adjustments and corrections in accordance with written report.

END OF SECTION

MECHANICAL IDENTIFICATION

PART 1 GENERAL

1.1 RELATED SECTIONS

.1 This section shall be read in conjunction with:

.1 Specification Section 20 05 01 - Mechanical General Requirements;

.2 All mechanical sections in Divisions 20, 21, 22, 23, and 25.

1.2 REFERENCES

.1 Canadian General Standards Board (CGSB).

.1 CAN/CGSB-24.3-92, Identification of Piping Systems.

.2 Canadian Standards Association (CSA).

.1 CSA B139, Fuel Installation Code with Ontario Ammendments.

.2 TSSA

.3 CSA Z7396.1-17. Medical gas pipeline systems - Part 1: Pipelines for

.3 National Fire Protection Association

.1 NFPA (Fire) 13, Installation of Sprinkler Systems, 2013 Edition.

PART 2 PRODUCTS

2.1 MANUFACTURER'S EQUIPMENT NAMEPLATES

.1 Plastic laminate nameplate mechanically fastened to each piece of equipment by manufacturer.

.2 Lettering and numbers to be raised or recessed.

.3 Information to include, as appropriate:

.1 Equipment: Manufacturer's name, model, size, serial number, capacity.

.2 Motor: voltage, Hz, phase, power factor, duty, frame size.

2.2 SYSTEM NAMEPLATES

.1 Colours:

.1 Hazardous: red letters, white background.

.2 Elsewhere: black letters, white background.

.2 Construction:

.1 1/8" thick laminated plastic, matte finish, with square corners, letters accurately aligned, and machine engraved into core.

.3 Sizes:

.1 Conform to following table:

Size #	Height Sizes (mm)	No. of Lines	Height of Letters (mm)
1	40	1	20
2	75	1	50

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

.4 Locations:

.1 Terminal cabinets, control panels: Use size #1.

.2 Equipment in Mechanical Rooms: Use size #2.

2.3 PIPING SYSTEMS GOVERNED BY CODES

.1 Identification:

.1 Fuel Oil: To CSA B139-ON.

.2 Sprinklers: To NFPA (Fire) 13.

2.4 INDENTIFICATION OF PIPING SYSTEMS

.1 Identify contents by background colour marking, legend; direction of flow by arrows. To CAN/CGSB-24.3 except where specified otherwise.

.2 Legend:

.1 Block capitals to sizes and colours listed in CAN/CGSB-24.3.

.3 Arrows showing direction of flow:

.1 Continuous wrap full diameter of pipe at each end of pipe identification markers.

.4 Extent of background colour marking:

.1 To full circumference of pipe or insulation.

.2 Length to accommodate full length of legend and arrows.

.5 Materials for background colour marking, legend, arrows:

.1 Pipes and tubing 3/4" and smaller: Waterproof and heat-resistant pressure sensitive plastic marker tags.

.2 All other pipes: Pressure sensitive plastic-coated cloth or vinyl with protective overcoating, waterproof contact adhesive undercoating, suitable for ambient of 100% RH and continuous operating temperature of 300°F and intermittent temperature of 400°F.

.6 Colours and Legends:

.1 Where not listed, obtain direction from Engineer.

.2 Colours for legends, arrows: To following table:

Contents	Background Colour	Marking Legend
Domestic Hot Water Supply	Green	DOM. HW SUPPLY
Dom. HWS recirculation	Green	DOM. HW CIRC
Domestic Cold Water Supply	Green	DOM. CWS
Storm Water	Green	STORM
Sanitary	Green	SAN
Plumbing Vent	Green	SAN. VENT
Refrigeration Suction	Yellow	REF. SEUCTION
Refrigeration Liquid	Yellow	REF. LIQUID
Refrigeration Hot Gas	Yellow	REF. HOT GAS
Engine Exhaust	Yellow	ENGINE EXHAUST
Fuel Oil	To Code	

2.5 IDENTIFICATION DUCTWORK SYSTEMS

.1 150 mm (6") high stencilled letters and directional arrows 150 mm (6") long x 50 mm (2") high.

.2 Colours: Black, or co-ordinated with base colour to ensure strong contrast.

2.6 MECHANICAL EQUIPMENT, VALVES CONTROLLERS, PUMPS, BOILERS, FAN COIL ETC.

.1 Lamicoid tag with 13 mm (½") 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.

.3 Brass tags with 13 mm (½") stamped identification data filled with black paint.

.4 Brass tags to be stamped with system identification and valve number system as outlined below:

System	Brass Tag Stamp
Domestic Cold Water	DC-1, 2, ….
Domestic Hot Water	DH-1, 2 ,…

Storm	ST-1, 2, …
Sanitary	SA-1, 2, …
Fuel Oil	FO-1, 2, …
Refrigerant	Re-1, 2, …

2.7 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.

2.8 LANGUAGE

.1 Identification to be in English.

PART 3 EXECUTION

3.1 TIMING

.1 Provide identification only after all painting specified in Architectural section is complete re: Interior Painting has been completed.

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 in any way.

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 (55 ft.) 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, other confined spaces, at entry and exit points, and at each access opening.

.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, dampers, etc. Where this is not possible, place identification as close as possible, preferably on upstream side.

.9 Identification to be easily and accurately readable from usual operating areas and from access points.

.10 Position of identification to be 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.

.11 At branch take-offs on both main and branch.

3.5 MECHANICAL EQUIPMENT, 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.

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

.3 Number valves in each system consecutively.

END OF SECTION

TESTING, ADJUSTING & BALANCING (TAB)

PART 1 GENERAL

1.1 RELATED SECTIONS

.1 This section shall be read in conjunction with:

.1 Specification Section 20 05 01 - Mechanical General Requirements;

.2 All mechanical sections in Divisions 20, 21, 22, 23, and 25.

1.2 GENERAL

.1 TAB means to test, adjust and balance to perform in accordance with requirements of Contract Documents and to do all other work as specified in this section.

1.3 QUALIFICATIONS OF TAB PERSONNEL

.1 Names of all personnel it is proposed to perform TAB to be submitted to and approved by Engineer within 90 days of award of contract.

.2 Provide documentation confirming qualifications, successful experience.

.3 The following are acceptable TAB contractors:

.1 TAB Inspecting

.2 Aerodynamics & Associates Testing Services Ltd. (N.B.C.T.A., ASHRAE)

.3 Maxima Technical Services Inc.

.4 Kanata Air Balancing & Engineering (C.A.A.B.C.)

1.4 PURPOSE OF TAB

.1 Test to verify proper and safe operation, determine actual point of performance, evaluate qualitative and quantitative performance of equipment, systems and controls at design, average and low loads using actual or simulated loads

.2 Adjust and regulate equipment and systems so as to meet specified performance requirements and to achieve specified interaction with all other related systems under all normal and emergency loads and operating conditions.

.3 Balance systems and equipment to regulate flow rates to match load requirements over full operating ranges.

1.5 EXCEPTIONS

.1 TAB of systems and equipment regulated by codes, standards to be to satisfaction of authority having jurisdiction.

1.6 CO-ORDINATION

.1 Schedule time required for TAB (including repairs, re-testing) into project construction and completion schedule so as to ensure completion before acceptance of project.

.2 Do TAB of each system independently and subsequently, where interlocked with other systems, in unison with those systems.

.3 Coordinate TAB with controls, mechanical and electrical contractors.

1.7 PRE-TAB REVIEW

.1 Review contract documents before project construction is started and confirm in writing to Engineer adequacy of provisions for TAB and all other aspects of design and installation pertinent to success of TAB.

.2 Review specified standards and report to Engineer in writing all proposed procedures which vary from standard.

.3 During construction, co-ordinate location and installation of all TAB devices, equipment, accessories, measurement ports and fittings.

1.8 START-UP

.1 Follow start-up procedures as recommended by equipment manufacturer unless specified otherwise.

.2 Follow special start-up procedures specified elsewhere in Divisions 20, 21, 22, 23, & 25.

1.9 OPERATION OF SYSTEMS DURING TAB

.1 Operate systems for length of time required for TAB and as required by Engineer for verification of TAB reports.

1.10 START OF TAB

.1 Notify Engineer 7 days prior to start of TAB.

.2 Start TAB only when building is essentially completed, including:

.1 Installation of ceilings, doors, windows, other construction affecting TAB.
.2 Application of weatherstripping, sealing, caulking.
.3 All pressure, leakage, other tests specified elsewhere in Division 15.
.4 All provisions for TAB installed and operational.

.3 Start-up, verification for proper, normal and safe operation of all mechanical and associated electrical and control systems affecting TAB including but not limited to:

.1 Proper thermal overload protection in place for electrical equipment.

.2 Air systems:

.1 Filters in place, clean.

.2 Duct systems clean.

.3 Ducts, air shafts, ceiling plenums are airtight to within specified tolerances.

.4 Correct fan rotation.

.5 Fire, smoke, volume control dampers installed and open.

.6 Coil fins combed, clean.

.7 Access doors, installed, closed.

.8 All outlets installed, volume control dampers open.

.3 Combustion air:

.1 With all heating appliances, within the boiler room, operating on high fire, measure:

.1 Combustion air volume entering boiler room from outside.

.2 Differential pressure to:

.1 Outside

.2 Adjacent areas of the building.

.3 With all heating appliances on high fire, check each natural draft appliance diverter for any back draft.

1.11 APPLICATION TOLERANCES

.1 Do TAB to following tolerances of design values:

.1 HVAC systems: plus 5%, minus 5%.

1.12 ACCURACY TOLERANCES

.1 Measured values to be accurate to within plus or minus 2% of actual values.

1.13 INSTRUMENTS

.1 Prior to TAB, submit to Engineer list of instruments to be used together with serial numbers.

.2 Calibrate in accordance with requirements of most stringent of referenced standard for either applicable system or HVAC system.

.3 Calibrate within 3 months of TAB. Provide certificate of calibration to Engineer.

1.14 SUBMITTALS

.1 Submit, prior to commencement of TAB:

.2 Proposed methodology and procedures for performing TAB if different from referenced standard.

1.15 PRELIMINARY TAB REPORT

.1 Submit for checking and approval of Engineer, prior to submission of formal TAB report, sample of rough TAB sheets. Include:

.1 Details of instruments used.
.2 Details of TAB procedures employed.
.3 Calculations procedures.
.4 Summaries.

1.16 TAB REPORT

.1 .1 Format to be in accordance with Associated Air Balancing Council (AABC/CAABC).

.2 TAB report to show all results in SI units or Imperial (IP), to match drawings and specifications, and to include:

.1 Project record drawings.
.2 System schematics.

.3 Submit pdf electronic copy of TAB Report to Engineer for verification and approval.

1.17 VERIFICATION

.1 All reported results subject to verification by Engineer.

.2 Provide manpower and instrumentation to verify up to 30% of all reported results.

.3 Number and location of verified results to be at discretion of Engineer.

.4 Bear costs to repeat TAB as required to satisfaction of Engineer.

.5 At request of commissioning agent, provide manpower and instrumentation to verify an additional 30% of all reported results.

1.18 SETTINGS

.1 After TAB is completed to satisfaction of Engineer, replace drive guards, close all access doors, lock all devices in set positions, ensure sensors are at required settings.

.2 Permanently mark all settings to allow restoration at any time during life of facility. Markings not to be eradicated or covered in any way.

1.19 COMPLETION OF TAB

.1 TAB to be considered complete only when final TAB Report received and approved by Engineer.

1.20 SYSTEMS

.1 Quality assurance: Perform TAB under direction of supervisor qualified by AABC.

.2 Air Systems: Include both specified and measured data.

- .1 Air Handling Equipment:
  - .1 Maximum air flow volume.
  - .2 Fan total pressure.
  - .3 Motor volts, amps and power.
  - .4 Minimum outside air volume.
  - .5 Fan rotational speed.
  - .6 Fan Power, calculate fan efficiency.
  - .7 Inlet and outlet dry bulb, wet bulb and dewpoint temperatures.
  - .8 Equipment static pressure profile.
  - .9 Noise.
  - .10 Vibration.
- .2 Duct Air Quantities - Mains and Branches:
  - .1 Duct size.
  - .2 Number of pressure/velocity readings per traverse.
  - .3 Sum of velocity measurements.
  - .4 Average velocity.
  - .5 Duct air flow volume.
  - .6 Barometric pressure and duct air temperature.
- .3 Air Outlets:
  - .1 Outlet location and designation.
  - .2 Manufacturers catalogue identification and type.
  - .3 Air outlet flow factors. Use 1.0 when flow hood is used.
  - .4 Air flow volumes.
  - .5 Deflector vane or diffuser cone settings.
- .4 Emergency Generator:
  - .1 Air flow volume. Air flow volume includes cooling plus combustion air.
  - .2 Static pressure profile.
  - .3 Vibration.
  - .4 Fluid used. Identify fluid used; water, % water/ethylene glycol

1.21 PLUMBING SYSTEMS

.1 Inlet and outlet temperature of each heater or tank.

.2 Main supply piping main branch piping.

.3 Flush valves adjusted to suit project pressure conditions.

1.22 OTHER SYSTEMS

.1 Plumbing systems:

.1 Controlled flow roof drain systems: adjust weirs to suit actual roof conditions, slopes, areas drained.

.2 Pumped sanitary and storm water systems: test for proper operation at all possible flow rates.

PART 2 PRODUCTS (NOT USED)

2.1 NOT USED

.1 Not used.

PART 3 EXECUTION

3.1 BALANCING AND ADJUSTING PREPARATION

.1 Perform testing, adjusting and balancing work after equipment and systems starting procedures have been properly completed.

.2 Perform balancing during heating and cooling season of first year of operation, and at times when directed by Engineer, to ensure proper settings of controls under both summer and winter peak load conditions.

.3 Vary load to verify operation of system under partial load conditions. Test start-up, shut-down, emergency conditions, safety controls operation and automatic and manual resets and interlocks.

.4 Cap all instrument test ports. Obtain caps from sheet metal contractor and install.

END OF SECTION

THERMAL INSULATION FOR DUCTING

PART 1 GENERAL

1.1 RELATED SECTIONS

.1 This section shall be read in conjunction with:

.1 Specification Section 20 05 01 - Mechanical General Requirements;

.2 All mechanical sections in Divisions 20, 21, 22, 23, and 25.

1.2 REFERENCES

.1 American Society for Testing and Materials (ASTM).

.1 ASTM B209-14, Specification for Aluminum and Aluminum Alloy Sheet and Plate.

.2 ASTM C335/C335M-17, Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.

.3 ASTM C449-07(2019), Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.

.4 ASTM C921-10(2015), Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.

.2 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-51.10-92, Mineral Fibre Board Thermal Insulation.

.2 CAN/CGSB-51.11-92, Mineral Fibre Thermal Insulation Blanket.

.3 CGSB 51-GP-52Ma, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.

.3 Manufacturer's Trade Associations: Thermal Insulation Association of Canada (TIAC): National Insulation Standards.

.4 Underwriters Laboratories (UL)

.1 UL 723, Tests for Surface Burning Characteristics of Building Materials.

.5 .5 Underwriters Laboratories of Canada (ULC)

.1 CAN/ULC S102-2018-REV1, Surface Burning Characteristics of Building Materials and Assemblies.

1.3 DEFINITIONS

.1 For purposes of this section:

.1 "CONCEALED" - insulated mechanical services and equipment in suspended ceilings and non-accessible chases and furred-in spaces.

.2 "EXPOSED" - will mean "not concealed" as defined herein.

.3 Insulation systems - insulation material, fasteners, jackets, and other accessories.

.2 TIAC Codes:

.1 CRD: Code Round Ductwork,

.2 CRF: Code Rectangular Finish.

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 as specified herein includes glass fibre, rock wool, slag wool.

.2 Thermal conductivity ("k" factor) not to exceed specified values at 24°C mean temperature when tested in accordance with ASTM C335/C335M.

.3 TIAC Code C-1: Rigid mineral fibre board to CAN/CGSB-51.10, with factory applied vapour retarder jacket to CGSB 51-GP-52Ma (as scheduled in PART 3 of this Section).

.4 TIAC Code C-2: Mineral fibre blanket to CAN/CGSB-51.11 faced with factory applied vapour retarder jacket to CGSB 51-GP-52Ma (as scheduled in PART 3 of this section).

.1 Mineral fibre: to CAN/CGSB-51.11.

.2 Jacket: to CGSB 51-GP-52Ma.

.3 Maximum "k" factor: to CAN/CGSB-51.11.

.4 Density: 24 kg/m3.

2.3 JACKETS

.1 Canvas: 220 gm/m2 cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C921.

.2 Lagging adhesive: Compatible with insulation.

.3 Aluminum:

.1 To ASTM B209 with moisture barrier as scheduled in PART 3 of this section.

.2 Thickness: 0.50 mm sheet.

.3 Finish: Stucco embossed.

.4 Jacket banding and mechanical seals: 19 mm (3/4") wide, 0.5 mm thick stainless steel.

.4 Acrylic Adhesive (Indoor Applications only):

.1 Thickness: 0.18 mm.
.2 Finish: Stucco embossed.
.3 Peel Adhesion: 18N/25 mm (65 oz./in.)
.4 Puncture: 130N (30 lbs.).
.5 UL 723 listed (10/20 flame/smoke rating).
.6 Acceptable material: VentureClad 1577CW.

2.4 ACCESSORIES

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

.2 Indoor Vapour Retarder Finish: Vinyl emulsion type acrylic, compatible with insulation.

.3 Insulating Cement: hydraulic setting on mineral wool, to ASTM C449.

.4 Outdoor Vapour Retarder Mastic:

.1 Vinyl emulsion type acrylic, compatible with insulation.
.2 Reinforcing fabric: Fibrous glass, untreated 305 g/m2.

.5 Tape: self-adhesive, aluminum, reinforced, 75 mm (3") wide minimum.

.6 Contact adhesive: quick-setting

.7 Canvas adhesive: washable.

.8 Tie wire: 1.5 mm stainless steel.

.9 Banding: 19 mm (3/4") wide, 0.5 mm thick stainless steel.

.10 Facing: 25 mm (1") galvanized steel hexagonal wire mesh stitched on one face of insulation.

.11 Fasteners: 2 mm diameter pins with 38 mm (1½") diameter clips, length to suit thickness of insulation.

PART 3 EXECUTION

3.1 PRE-INSTALLATION REQUIREMENTS

.1 Pressure testing of ductwork systems to be complete, witnessed and certified.

.2 Surfaces to be clean, dry, free from foreign material.

3.2 INSTALLATION

.1 Install in accordance with TIAC National Standards.

.2 Apply materials in accordance with manufacturers instructions and this specification.

.3 Use two layers with staggered joints when required nominal thickness exceeds 75 mm (3").

.4 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.

.1 Hangers, supports to be outside vapour retarder jacket.

.5 Supports, Hangers in accordance with Section 15061 - Bases, Hangers and Supports

.1 Apply high compressive strength insulation where insulation may be compressed by weight of ductwork.

.6 Fasteners: At 300 mm (12") oc in horizontal and vertical directions, minimum two rows each side.

3.3 DUCTWORK INSULATION SCHEDULE

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

TIAC	Vapour Code	Retarder	Thickness
Supply & Exhaust ducts	C-1	yes	50 (2”)

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

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

.3 Finish to conform to following table:

TIAC Code	Rectangular Duct	Round Duct
Indoor, exposed within mechanical room	CRF/1	CRD/2

END OF SECTION

THERMAL INSULATION FOR PIPING

PART 1 GENERAL

1.1 RELATED SECTIONS

.1 This section shall be read in conjunction with:

.1 Specification Section 20 05 01 - Mechanical General Requirements;

.2 All mechanical sections in Divisions 20, 21, 22, 23, and 25.

1.2 REFERENCES

.1 American Society for Testing and Materials (ASTM) (latest edition).

.1 ASTM B209-14, Specification for Aluminum and Aluminum Alloy Sheet and Plate.

.2 ASTM C335/C335M-17, Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.

.3 ASTM C449-07(2019), Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.

.4 ASTM C921-10(2015), Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.

.2 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-51.9-92 Mineral Fibre Thermal Insulation for Piping and Round Ducting.

.2 CAN/CGSB-51.12-95, Cement, Thermal Insulating and Finishing.

.3 CGSB 51-GP-52Ma, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.

.3 Manufacturer's Trade Associations (latest edition).

.1 Thermal Insulation Association of Canada (TIAC): National Insulation Standards.

.4 Underwriters' Laboratories of Canada (ULC)

.1 CAN/ULC S102-2018-REV1, Surface Burning Characteristics of Building Materials and Assemblies.

1.3 DEFINITIONS

.1 For purposes of this section:

.1 "CONCEALED" - insulated mechanical services in suspended ceilings and non-accessible chases and furred-in spaces.

.2 "EXPOSED" - will mean "not concealed" as defined herein.

.2 TIAC ss:

.1 CRF: Code Rectangular Finish.

.2 CPF: Code Piping Finish.

PART 2 PRODUCTS

2.1 FIRE AND SMOKE RATING

.1 In accordance with CAN/ULC S102:

.1 Maximum flame spread rating: 25.

.2 Maximum smoke developed rating: 50.

2.2 INSULATION

.1 Mineral fibre as specified herein includes glass fibre, rock wool, slag wool.

.2 Thermal conductivity ("k" factor) not to exceed specified values at 24°C mean temperature when tested in accordance with ASTM C335/C335M.

.3 TIAC Code A-1: Rigid moulded mineral fibre without factory applied vapour retarder jacket (as scheduled in PART 3 of this section).

.1 Mineral fibre: to CAN/CGSB-51.9.

.2 Maximum "k" factor: to CAN/CGSB-51.9.

.4 TIAC Code A-3: Rigid moulded mineral fibre with factory applied vapour retarder jacket (as scheduled in PART 3 of this section).

.1 Mineral fibre: to CAN/CGSB-51.9.

.2 Jacket: to CGSB 51-GP-52Ma.

.3 Maximum "k" factor: to CAN/CGSB-51.9.

2.3 INSULATION SECUREMENT

.1 Tape: Self-adhesive, aluminum, reinforced, 50 mm wide minimum.

.2 Contact adhesive: Quick setting.

.3 Canvas adhesive: Washable.

.4 Tie wire: 1.5 mm diameter stainless steel.

.5 Bands: Stainless steel, 19 mm wide, 0.5 mm thick.

2.4 CEMENT

.1 Thermal insulating and finishing cement:

.1 To CAN/CGSB-51.12.

.2 Hydraulic setting or Air drying on mineral wool, to ASTM C449.

2.5 VAPOUR RETARDER ADHESIVE

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

2.6 JACKETS

.1 PVC:

- .1 Ontario Building Code compliant for 25/50 flame spread and smoke developed.
- .2 Minimum thickness 0.015 mil.
- .3 Colour white unless otherwise specified.
- .4 Non yellowing UV stabilized.
- .5 Minimum service temperatures: -20°C.
- .6 Maximum service temperature: 65°C.
- .7 Moisture vapour transmission: 0.02 perm.
- .8 Fastenings:
  - .1 Use solvent weld adhesive compatible with insulation to seal laps and joints.
  - .2 Tacks.
  - .3 Pressure sensitive vinyl tape of matching colour.

PART 3 EXECUTION

3.1 PRE-INSTALLATION REQUIREMENT

.1 Pressure testing of piping systems and adjacent equipment to be complete, witnessed, and certified.

.2 Surfaces to be clean, dry, free from foreign material.

3.2 INSTALLATION

.1 Install in accordance with TIAC National Standards.

.2 Apply materials in accordance with manufacturers instructions and this specification.

.3 Use two layers with staggered joints when required nominal wall thickness exceeds 75 mm.

.4 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.

- .1 Hangers, supports to be outside vapour retarder jacket.
- .2 Saddles to have ridges to limit movement while in hanger.
- .3 To be edge flared to prevent cutting/damage to insulation coverage.

.5 Supports, Hangers:

.1 .1 Apply high compressive strength insulation, suitable for service, at oversized saddles and shoes where insulation saddles have not been provided.

3.3 REMOVABLE, PRE-FABRICATED, INSULATION AND ENCLOSURES

.1 Application: At expansion joints, valves, primary flow measuring elements flanges and unions at equipment.

.2 Design: To permit movement of expansion joint and to permit periodic removal and replacement without damage to adjacent insulation.

.3 Insulation:

.1 Insulation, fastenings and finishes: same as system.

.2 Jacket: PVC.

3.4 INSTALLATION OF ELASTOMERIC INSULATION

.1 Insulation to remain dry at all times. Overlaps to manufacturers instructions. Ensure tight joints.

.2 Provide vapour retarder as recommended by manufacturer.

3.5 PIPING INSULATION SCHEDULES

.1 Includes valves, valve bonnets, strainers, flanges and fittings unless otherwise specified.

.2 TIAC Code: A-1

.1 Securements: Tape at 300 mm oc.

.2 Seals: lap seal adhesive, lagging adhesive.

.3 Installation: TIAC Code 1501-H.

.3 TIAC Code: A-3.

.1 Securements: Tape at 300 mm oc.

.2 Seals: VR lap seal adhesive, VR lagging adhesive.

.3 Installation: TIAC Code: 1501-C.

.4 Thickness of insulation to be as listed in following table:

Application	**Pipe Sizes**			
	½" to 1-1/4"	**1-1/2" to 3"**	**4" to 6"**	**8" and over**
Domestic Hot Water	25	38	38	38
Domestic Cold Water	25	25	25	25
Storm Piping	25	25	25	25

.4 Finishes:

.1 Exposed indoors: PVC.

.2 Finish attachments: Stainless steel bands at 150 mm oc. Seals: wing or closed.

.3 Installation: To appropriate TIAC code CRF/1 through CPF/5.

.5 Domestic hot & cold and recirc piping shall be completely thermally insulated to fixtures, except exposed supply assembly at fixtures.

3.6 INSULATING HEAT TRACED DOMESTIC HOT WATER PIPING

.1 Insulation thickness to conform to following table:

Pipe Size (mm)	Fibreglass Insulation Thickness (mm)
12 – 25	25
32 – 50	40
65 - 150	50

.2 For pipe sizes 32 mm and smaller, use insulation sized for a 6 mm (¼") larger pipe to allow room for installation over cable.

.3 For other insulation installation details refer to Heat Trace manufacturer's recommendation.

END OF SECTION

PERFORMANCE VERIFICATION MECHANICAL PIPING SYSTEMS

PART 1 GENERAL

1.1 RELATED SECTIONS

.1 This section shall be read in conjunction with:

.1 Specification Section 20 05 01 - Mechanical General Requirements;

.2 All mechanical sections in Divisions 20, 21, 22, 23, and 25.

1.2 REFERENCES

.1 American Society for Testing and Materials (ASTM)

.1 ASTM E202-18, Standard Test Methods for Analysis of Ethylene Glycols and Propylene Glycols.

1.3 SANITARY AND STORM DRAINAGE SYSTEM

.1 Buried systems: Perform tests prior to back-filling. Perform hydraulic tests to verify grades and freedom from obstructions.

.2 Ensure that traps are fully and permanently primed.

.3 Ensure that fixtures are properly anchored, connected to system.

.4 Operate flush valves, tank and operate each fixture to verify drainage and no leakage.

.5 Cleanouts: Refer to Section 22 05 15 - Plumbing Specialities and Accessories.

.6 Roof drains:

.1 Refer to Section 22 05 15 - Plumbing Specialities and Accessories.

.2 Remove caps as required.

1.4 REPORTS

.1 In accordance with Section 20 05 01 and 01.

1.5 1.10 TRAINING

.1 In accordance with Section 20 05 01 and 01.

PART 2 PRODUCTS

2.1 NOT USED

.1 Not used.

PART 3 EXECUTION

3.1 NOT USED

.1 Not used.

END OF SECTION

CLEANING AND START-UP OF MECHANICAL PIPING SYSTEMS

PART 1 GENERAL

1.1 RELATED SECTIONS

.1 This section shall be read in conjunction with:

.1 Specification Section 20 05 01 - Mechanical General Requirements;

.2 All mechanical sections in Divisions 20, 21, 22, 23, and 25.

PART 2 PRODUCTS

2.1 CLEANING SOLUTIONS

.1 Tri-sodium phosphate: 0.40 kg per 100 L water in system.

.2 Sodium carbonate: 0.40 kg per 100 L water in system.

.3 Low-foaming detergent: 0.01 kg per 100 L water in system.

PART 3 EXECUTION

3.1 GENERAL

.1 Provide all material & labour associated with flushing and cleaning of system including full size bypass and associated accessories.

3.2 CLEANING HYDRONIC AND STEAM SYSTEMS

.1 Timing: Systems to be operational, hydrostatically tested and with safety devices functional, before cleaning is carried out.

.2 Cleaning Agency: Retain qualified water treatment specialist to perform system cleaning.

.3 Install instrumentation such as flow meters, orifice plates, pitot tubes, flow metering valves only after cleaning is certified as complete by water treatment specialist.

.4 Cleaning procedures:

.1 Provide detailed report outlining proposed cleaning procedures at least 4 weeks prior to proposed starting date. Report to include:

.1 Cleaning procedures, flow rates, elapsed time.

.2 Chemicals and concentrations to be used.

.3 Inhibitors and concentrations.

.4 Specific requirements for completion of work.

.5 Special precautions for protecting piping system materials and components.

.6 Complete analysis of water to be used to ensure water will not damage systems or equipment.

.5 Conditions at time of cleaning of systems

.1 Systems to be free from construction debris, dirt and other foreign material.

.2 Control valves to be operational, fully open to ensure that terminal units can be cleaned properly.

.3 Strainers to be clean prior to initial fill.

.4 Install temporary filters on pumps not equipped with permanent filters.

.5 Install pressure gauges on strainers to detect plugging.

.6 Report on Completion of Cleaning. When cleaning is completed, submit report, complete with certificate of compliance with specifications of cleaning component supplier.

.7 Hydronic Systems:

.1 Fill system with water, ensure air is vented from system.

.2 Fill expansion tanks 1/3 to 1/2 full, charge system with compressed air to at least 35 kPa (does not apply to diaphragm type expansion tanks).

.3 Use water meter to record volume of water in system to +/- 0.5%.

.4 Add chemicals under direct supervision of chemical treatment supplier.

.5 Closed loop systems: circulate system cleaner at 60°C for at least 36 h. Drain as adjust to recommqueincdkelyd levels. as possible. Refill with water plus inhibitors. Test concentrations and

.6 Flush velocity in system mains and branches to be adequate so as to ensure removal of debris. System pumps may be used for circulating cleaning solution provided that velocities are adequate.

.7 Add chemical solution to system.

.8 Establish circulation, raise temperature slowly to maximum design or 82°C minimum. Circulate for 12 h, ensuring flow in all circuits. Remove heat, continue to circulate until temperature is below 38°C. Drain as quickly as possible. Refill with clean water. Circulate for 6 h at design temperature. Drain and repeat procedures specified above. Flush through low point drains in system. Refill with clean water adding to sodium sulphite (test for residual sulphite).

3.3 START-UP OF HYDRONIC SYSTEM

.1 After cleaning is completed and system is filled:

.1 Establish circulation and expansion tank level, set pressure controls.

.2 Ensure all air is removed.

.3 Check pumps to be free from air, debris, possibility of cavitation when system is at design temperature.

.4 Dismantle system pumps used for cleaning, inspect, replace worn parts, install new gaskets and new set of seals.

.5 Clean out strainers repeatedly until system is clean.

.6 Check pressurization to ensure proper operation and to prevent water hammer, flashing, cavitation. Eliminate water hammer and all other noises.

.7 Bring system up to design temperature and pressure slowly over a 24 hour period.

.8 Perform TAB as specified Section 15950 - Testing, Adjusting and Balancing (TAB).

.9 Adjust pipe supports, hangers, springs as necessary.

.10 Monitor pipe movement, performance of expansion joints, loops, guides, anchors.

.11 If sliding type expansion joints bind or if bellows type expansion joints flex incorrectly, shut down system, re-align, repeat start-up procedures.

.12 Re-tighten all bolts, etc. using torque wrench, to compensate for heat-caused relaxation. Repeat several times during commissioning.

.13 Check operation of drain valves.

.14 Adjust valve stem packings as systems settle down.

.15 Fully open all balancing valves (except those that are factory-set).

.16 Check operation of over-temperature protection devices on circulating pumps.

.17 Adjust alignment of piping at pumps to ensure flexibility, adequacy of pipe movement, absence of noise or vibration transmission.

END OF SECTION

PIPING, VALVES AND FITTINGS - GAS

PART 1 GENERAL

1.1 RELATED SECTIONS

.1 This section shall be read in conjunction with:

.1 Specification Section 20 05 01 - Mechanical General Requirements;

.2 All mechanical sections in Divisions 20, 21, 22, 23 & 25.

1.2 REFERENCES

.1 American Society of Mechanical Engineers (ASME)

.1 ASME A120.1-2014, Safety Requirements for Powered Platforms and Traveling Ladders and Gantries for Building Maintenance.

.2 ASME B16.5-2020, Pipe Flanges and Flanged Fittings, NPS ½ through NPS 24, Metric/Inch..

.3 ASME B16.20-2017, Metallic Gaskets for Pipe Flanges.

.4 ASME B16.21-2016, Nonmetallic Flat Gaskets for Pipe Flanges.

.5 ASME B18.2.1-2012, Square, Hex, Heavy Hex, and Askew Head Bolts and Hex, Heavy Hex, Hex Flange, Lobed Head, and Lag Screws (Inch Series).

.6 ASME BPVC.IV-2021, 2021 ASME Boiler and Pressure Vessel Code, Section IV: Heating Boilers.

.2 American Society for Testing and Materials (ASTM)

.1 ASTM A47/A47M-99(2018)e1, Specification for Ferritic Malleable Iron Castings.

.2 ASTM A53/A53M-20 Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated, Welded and Seamless.

.3 Canadian Standards Association (CSA)

.1 CSA B149.1-20, Natural Gas and Propane Installation Code.

.2 CSA B149.2-20, Propane Storage and Handling Code

.3 CSA W47.1-19, Certification of Companies for Fusion Welding of Steel Structures.

PART 2 PRODUCTS

2.1 PIPE

.1 Steel pipe: to ASME A120.1 or ASTM A53/A53M, Schedule 40, seamless as follows:

.1 NPS ½ to 2, screwed outside, with socket welded fittings inside building.

.2 NPS 2½ and over, welded.

2.2 JOINING MATERIAL

.1 Screwed fittings: pulverized lead paste.

.2 Welded fittings: to CSA W47.1.

.3 Flange gaskets: to ASME B16.21 or ASME B16.20.

2.3 FITTINGS

.1 Steel pipe fittings, screwed, flanged or welded:

.1 Malleable iron: screwed, banded, Class 150.
.2 Steel pipe flanges and flanged fittings: to ASME B16.5.
.3 Steel butt-welding fittings.
.4 Unions: malleable iron, brass to iron, ground seat, to ASTM A47/A47M.
.5 Bolts and nuts: to ASME B18.2.1.
.6 Nipples: Schedule 40, to ASTM A53/ A53M.

2.4 VALVES

.1 Provincial Code approved, lubricated plug or ball type as per specification Section 23 05 23 - Valves.

2.5 PRESSURE REDUCING VALVE

.1 (PRV): Provide gas service regulator self-contained to reduce pressure to design capacity.

.2 Spring loaded self-operated regulator, molded diaphragm, 6:1 lever ratio, c/w internal or remote relief valve.

.3 Extend remote safety relief valve to atmosphere; terminate in safe location.

.4 Reference equipment schedules for performance & capacities.

.5 Acceptable material: Norgas/Itron, Sensus, Maxitrol, Fisher.

2.6 METER REGULATOR ASSEMBLY

.1 Assist in coordination of new Enbridge Gas meter/regulator assembly.

PART 3 EXECUTION

3.1 INSTALLATION

.1 Install in accordance with ASME Boiler and Pressure Vessels Code Section IV, regulations of Province having jurisdiction, except where specified otherwise, and manufacturers recommendations.

.2 Make required piping connections recommended by equipment manufacturer.

.3 Maintain clearances as indicated or if not indicated, as recommended by manufacturer installation instruction for operation, servicing and maintenance without disruption of operation of any other equipment/system.

.4 All equipment, venting and gas assembly work shall be installed & certified by a provincially certified gas fitter I Level mechanic.

3.2 PIPING

.1 Install in accordance with applicable Provincial/Territorial Codes.

.2 Install in accordance with CSA B149.1 and CSA B149.2.

.3 Assemble piping using fittings manufactured to ASME standards.

.4 Connect to equipment in accordance with manufacturer's instruction unless otherwise indicated.

.5 Slope piping down in direction of flow to low points as per Gas Utilization Code.

.6 Install drip points:

.1 At all low points in piping system.

.2 At each connection to equipment.

.7 Use eccentric reducers at pipe size change installed to provide positive drainage.

.8 Provide clearance for access and for maintenance.

.9 Ream pipes, clean scale and dirt, inside and out.

.10 Install piping to minimize pipe dismantling for equipment removal.

3.3 VALVES

.1 Install valves with stems upright or horizontal unless otherwise approved by Engineer.

.2 Install valves at all branch take-offs to isolate each piece of equipment, and as indicated.

.3 Vent reliefs at pressure regulating valves to outdoors and minimum 3 metres for intakes.

.4 All valves on exterior of building or where prone to vandalism, install lubricated plug type valve, regardless of size.

3.4 TESTING

.1 Test system in accordance with CSA B149.1 and CSA B149.2.

.2 On new natural gas service, Enbridge gas or authority having jurisdiction shall conduct a field review of all new equipment appliance venting & piping systems and submit a certificate of acceptance from a Certified G-1 Gas Fitter.

3.5 PURGING

.1 Purge after pressure test in accordance with CSA B149.1 and CSA B149.2.

3.6 PRE-START-UP INSPECTIONS

.1 Check vents from regulators, control valves, terminate outside building in approved location, protected against blockage, damage.

.2 Check gas trains, entire installation is approved by authority having jurisdiction.

3.7 CLEANING AND START-UP

.1 In accordance with requirements of CSA B149.1 & CSA B149.2.

END OF SECTION

HYDRONIC PIPING – COPPER PIPING AND FITTINGS

PART 1 GENERAL

1.1 RELATED SECTIONS

.1 This section shall be read in conjunction with:

.1 Specification Section 20 05 01 - Mechanical General Requirements;

.2 All mechanical sections in Divisions 20, 21, 22, 23 & 25.

1.2 REFERENCES

.1 American Society of Mechanical Engineers (ASME)

.1 ASME B16.15-2018, Cast Bronze Threaded Fittings: Classes 125 and 250.

.2 ASME B16.18-2018, Cast Copper Alloy, Solder Joint Pressure Fittings.

.3 ASME B16.22-2018, Wrought Copper and Copper-Alloy Solder Joint Pressure Fittings.

.2 American Society for Testing and Materials (ASTM)

.1 ASTM B32-20, Specification for Solder Metal.

.2 ASTM B88M-20, Specification for Seamless Copper Water Tube Metric.

.3 ASTM E202-18, Test Methods for Analysis of Ethylene Glycols and Propylene Glycols.

.3 American Welding Society (AWS)

.1 AWS A5.8/A5.8M:2019, Specification Filler Metals for Brazing and Bronze Welding.

PART 2 PRODUCTS

2.1 PIPING

.1 Type L hard drawn copper tubing: to ASTM B88M.

2.2 FITTINGS

.1 Cast bronze threaded fittings: to ASME B16.15.

.2 Wrought copper and copper alloy solder joints pressure fittings: to ASME B16.22.

.3 Cast copper alloy solder joint pressure fittings: to ASME B16.18.

2.3 DI-ELECTRIC

.1 Provide wherever pipes of dissimilar metals are jointed.

.2 For pipe sizes 2 NPS and under, provide di-electric unions or couplings.

2.4 JOINTS

.1 Solder, tin-antimony, 95:5: to ASTM B32.

.2 Silver solder BCUP: to AWS A5.8.

.3 Brazing: as indicated.

.4 Application: All closed loop hydronic systems except steam & condensate systems; refer to Section 23 21 13.02 - Steel Piping and Fittings - Hydronic Systems.

2.5 VALVES

.1 Refer to Section 23 05 23 - Valves.

PART 3 EXECUTION

3.1 PIPING INSTALLATION

.1 Connect to equipment in accordance with manufacturer's instruction unless otherwise indicated.

.2 Install concealed pipes close to building structure to keep furring space to minimum. Install to conserve headroom and space. Run exposed piping parallel to walls. Group piping wherever practical.

.3 Slope piping in direction of drainage and for positive venting.

.4 Use eccentric reducers at pipe size change installed to provide positive drainage or positive venting.

.5 Provide clearance for installation of insulation and access for maintenance of equipment, valves and fittings.

.6 Ream pipes, clean scale and dirt, inside and outside, before and after assembly.

.7 Assemble piping using fittings manufactured to ASME standards.

.8 Saddle type branch fittings may be used on mains if branch line is no larger than half the size of main. Hole saw or drill and ream main to maintain full inside diameter of branch line prior to welding saddle.

.9 Install all pipe wells or other devices supplied by Section 25 01 11.

3.2 FLUSHING AND CLEANING

.1 As per Section 23 08 02 - Cleaning and Start-up of Mechanical Piping Systems.

3.3 FILLING OF SYSTEM

.1 Refill system with clean water adding water treatment as specified and/or glycol as per Section 23 25 00 -HVAC Water Treatment Systems where indicated.

3.4 TESTING

.1 Test system in accordance with Section 23 05 05 - Installation of Pipework.

.2 For glycol systems, retest with specified quality of glycol after cleaning. Repair any leaking joints, fittings or valves.

3.5 BALANCING

.1 Install flow measuring stations and flow balancing valves as indicated.

.2 Refer to Section 23 05 93 - Testing Adjusting and Balancing of Systems for applicable procedures.

3.6 GLYCOL CHARGING

.1 Provide mixing tank and positive displacement pump for glycol charging.

.2 Retest for concentration to ASTM E202 after cleaning.

.3 Provide report to Engineer.

END OF SECTION

HYDRONIC PIPING – STEEL PIPING AND FITTINGS

PART 1 GENERAL

1.1 RELATED SECTIONS

.1 This section shall be read in conjunction with:

.1 Specification Section 20 05 01 - Mechanical General Requirements;

.2 All mechanical sections in Divisions 20, 21, 22, 23 & 25.

1.2 REFERENCES

.1 American Society of Mechanical Engineers (ASME).

.1 ASME B16.1-2020, Gray Iron Pipe Flanges and Flanged Fittings, Class 25, 125 and 250.

.2 ASME B16.3-2016, Malleable-Iron Threaded Fittings, Classes 150 and 300.

.3 ASME B16.5-2020, Pipe Flanges and Flanged Fittings, NPS ½ through NPS 24, Metric/Inch.

.4 ASME B16.9-2018, Factory-Made Wrought Steel Buttwelding Fittings.

.5 ASME B18.2.1-2012, Square, Hex, Heavy Hex, and Askew Head Bolts and Hex, Heavy Hex, Hex Flange, Lobed Head, and Lag Screws (Inch Series).

.6 ASME B18.2.2-2015, Nuts for General Applications: Machine Screw Nuts, Hex, Square, Hex Flange and Coupling Nuts (Inch Series).

.2 American Society for Testing and Materials (ASTM).

.1 ASTM A47/A47M-99(2018)e1, Specification for Ferritic Malleable Iron Castings.

.2 ASTM A53/A53M-20 Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless.

.3 ASTM A536-84(2019)e1, Specification for Ductile Iron Castings.

.3 American Water Works Association (AWWA)

.1 AWWA C111/A21.11-17, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.

.4 Canadian Standards Association (CSA).

.1 CSA W47.1-19, Certification of Companies for Fusion Welding of Steel.

PART 2 PRODUCTS

2.1 PIPE

.1 Steel pipe: to ASTM A53/A53M, Grade B, as follows:

.1 NPS 2½ to 8, Schedule 40.

.2 NPS 10-14, Schedule 30.

2.2 PIPE JOINTS

.1 .1 Application: Hydronic water & glycol systems: NPS 2½ and over.

.1 NPS 2 and under: shall be copper - refer to Section 23 21 13.01 - Copper Piping and Fittings -Hydronic Systems.

.2 Cooling systems NPS 2½ and over: welded, flanged or grooved mechanical couplings. No grooved coupling on glycol systems.

.3 Heating and glycol systems NPS 2½ and over: welded or flanged. Grooved joints are not accepted.

.4 Welding fittings and flanges to CSA W47.1. Reference Section 23 05 17 - Pipe Welding.

.5 Flanges: raised face, weld neck.

.6 Flange gaskets: to AWWA C111/A21.11.

.7 Pipe thread: taper.

.8 Bolts and nuts: to ASME B18.2.1 and ASME B18.2.2.

.9 Grooved mechanical couplings c/w stainless steel hardware as manufactured by Victaulic are acceptable as listed. Style 07; ZeroFlex for rigid connections. Style 77 for flexible connections.

2.3 FITTINGS

.1 Screwed fittings: malleable iron, to ASME B16.3, Class 150.

.2 Pipe flanges and flanged fittings:

.1 Cast iron: to ASME B16.1, Class 125.

.2 Steel: to ASME B16.5.

.3 Butt-welding fittings: steel, to ASME B16.9.

.4 Unions: malleable iron, to ASTM A47/A47M and ASME B16.3.

.5 Fittings for roll grooved piping: malleable iron to ASTM A47/A47M, ductile iron to ASTM A536, manufactured by Victaulic are acceptable as listed.

2.4 VALVES

.1 Refer to Section 23 05 23 - Valves.

PART 3 EXECUTION

3.1 APPLICATIONS

.1 For hydronic closed loop water & glycol systems, reference Section 23 05 17 - Pipe Welding.

3.2 PIPING INSTALLATION

.1 In accordance with Section 23 05 05 - Installation of Pipework.

3.3 FLUSHING AND CLEANING

.1 As per Section 23 08 02 - Cleaning and Start-up of Mechanical Piping Systems.

3.4 FILLING OF SYSTEM

.1 Refill system with clean water adding water treatment or ethylene glycol as per Section 23 25 00 – HVAC Water Treatment Systems.

3.5 TESTING

.1 Test system in accordance with Section 23 05 05 - Installation of Pipework.

3.6 BALANCING

.1 Refer to Section 23 05 93 - Testing Adjusting and Balancing for applicable procedures.

END OF SECTION

HYDRONIC PIPING – CROSS-LINKED POLYETHYLENE (PEX)

PART 1 GENERAL

1.1 RELATED SECTIONS

.1 This section shall be read in conjunction with:

.1 Specification Section 20 05 01 - Mechanical General Requirements;

.2 All mechanical sections in Divisions 20, 21, 22, 23 & 25.

PART 2 PRODUCTS

2.1 PEX TUBING - UNDERGROUND - EXTERIOR

.1 Application: Heating water below grade only, exterior, direct buried.

.2 The PEX tubing shall be cross-linked polyethylene (PEX). PEX tubing shall be for heating use only.

.1 PEX with oxygen barrier, surrounded by a solid layer of CFC-free polyurethane foam insulation and an LDPE outer jacket.

.3 Pressure rated to 82°C (180°F) at 690 kPa (100 psi) and 93°C (200°F) at 550 kPa (80 psi).

.4 Fittings: No fitting allowed; tubing to extend continuously from interior above grade to interior above grade.

.5 Protection: Provide tubing protection at all metal stud crossings.

.6 Acceptable materials: Uponor, Watts, Rehau

PART 3 EXECUTION

3.1 INSTALLATION

.1 Install in accordance with Canadian Plumbing Code, Provincial Plumbing Code and local authority having jurisdiction.

.2 Install pipe work in accordance with manufacturer's instructions.

.3 Assemble piping using fittings manufactured to manufacturer's standards.

.4 Connect to equipment in accordance with manufacturer's written instructions unless otherwise indicated.

.5 Bend tubing without crimping or constriction.

.6 Provide single piece chrome plated escutcheons at all wall or floor penetrations.

3.2 PRESSURE TESTS

.1 Conform to requirements of Section 20 05 01 - Mechanical General Requirements.

.2 Test pressure: is piping pressure of 690 kPa @ 82°C.

3.3 FLUSHING AND CLEANING

.1 Flush entire system in accordance with Section 23 08 02 Cleaning and Start-up of Mechanical Piping Systems.

3.4 PRE-START-UP INSPECTIONS

.1 Systems to be complete, prior to flushing, testing and start-up.

.2 Verify that system can be completely drained.

.3 Ensure that pumping systems are operating properly.

.4 Ensure that automatic air vents are installed properly.

3.5 START-UP

.1 Timing: Start up after:

.1 Pressure tests have been completed.
.2 Flushing & cleaning procedures have been completed.

.2 Provide continuous supervision during start-up.

.3 Start-up procedures:

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

.4 Rectify start-up deficiencies.

END OF SECTION

HYDRONIC PUMPS

PART 1 GENERAL

1.1 RELATED SECTIONS

.1 This section shall be read in conjunction with:

.1 Specification Section 20 05 01 - Mechanical General Requirements;

.2 All mechanical sections in Divisions 20, 21, 22, 23, and 25.

1.2 REFERENCES

.1 Canadian Standards Association (CSA).

.2 Hydraulic Institute Standards.

.3 National Electrical Manufacturers Association (NEMA)

.1 NEMA MG 1-2016, Motors and Generators.

.4 Underwriters Laboratories (UL)

.1 UL 778, Motor Operated Water Pumps.

1.3 MOTORS

.1 Provide motors in accordance with Section 20 05 01 - Mechanical General Requirements, and hereafter.

1.4 VARIABLE SPEED DRIVE

.1 All pump motors served by variable speed drives shall be Inverter duty class motors to NEMA MG 1 Part 31.

1.5 INERTIA BASES

.1 All base mounted pumps shall be mounted on inertia bases unless noted otherwise. Reference Vibration Isolation specification section.

PART 2 PRODUCTS

2.1 DRY ROTOR CIRCULATORS

.1 Casing: volute bronze or cast iron radially split, with screwed or flanged design suction and discharge connections.

.2 Impeller: 30% glass - filled Noryl.

.3 Shaft: stainless steel with permanently lubricated stainless steel bearing, integral thrust collar.

.4 Seal assembly: EnviroSeal silicon carbide mechanical seal with EPDM gasket.

.5 Motor: closed coupled dry motor to Section 23 05 13 - Motors, Drives and Guards for Mechanical Systems.

.6 Maximum design pressure: 1034 kPa (150 psi).

.7 Maximum design temperature: 110°C (230°F).

.8 Capacity: as per drawing schedule.

.9 Acceptable material: Armstrong Armflow E Series, Plad, Flo Fab.

2.2 VERTICAL AND DUAL ARM IN-LINE CIRCULATORS

.1 Casing: volute cast iron closed-coupled up to 3.73 kW (5 HP), split coupled 5.6 kW (7.5 HP) & above with tapped openings for venting, draining and gauge connections, flanged suction and discharge connections. Casing radially split to allow removal of rotating element without disturbing the pipe connections. Casing shall be ductile iron for pressure to 2585 kPa (375 psi) at 65.5°C (150°F).

.2 Impeller: brass or bronze, fully enclosed type and secured to pump shaft with stainless steel hardware. Impeller to be dynamically balanced.

.3 Shaft: stainless steel with bronze sleeve bearing, integral thrust collar.

.4 Coupling: rigid high tensile aluminum alloy spacer.

.5 Seals shall be stainless steel outside multi-spring balanced type with Viton secondary seal; on all heating water or glycol heating solutions, seal shall be Tungsten Carbide, seat gasket, stainless steel spring & hardware. Seal vent line shall be factory installed and piped from seal area to the pump suction connection.

.6 Motor:

.1 High efficiency motor to Section 23 05 13 - Motors, Drives and Guards for Mechanical Systems.

.2 Motor power requirements shown on the pump schedule are the minimum acceptable and have been sized for continuous operation without exceeding the full load nameplate rating over the entire pump curve, exclusive of service factor.

.7 Discharge Spool Section: Cast iron or steel flanged spool section sized to pump discharge outlet, factory painted and suitable for pump working pressure.

.8 Provide seismic rated floor mounting brackets, secured to pump flanges.

.9 Pressure: suitable for 1205 kPa (175 psi) working pressure up to 65.5°C (150°F). Hydro statically tested to 15% maximum working pressure.

.10 Capacity: Refer to schedule on drawing.

.11 Acceptable material: Armstrong or approved equal.

2.3 WET ROTOR CIRCULATING PUMP

.1 Wet rotor:

.1 Integrated pump and motor assembly without shaft seal and with only two gaskets for sealing. The bearings are lubricated by the pumped liquid.

.1 Motor with three speeds,

.2 Ceramic radial bearings,

.3 Carbon thrust bearing,

.4 Stainless steel rotor can, bearing plate and rotor cladding,

.5 Stator housing in aluminum alloy,

.6 Cast iron or bronze housing,

.7 Stator with built-in thermal overload switch.

.2 In-line cast iron and bronze spiral pump housing:

.1 Flange dimensions for USA are according to individual submittal data the flanges have ¼ NPT pressure gauge tappings. Tapped holes are provided on the underside of the pumps. These holes can be used for fitting the pump to a base plate or bracket by means of hexagon screws. The pump housing is provided with a receptacle stainless steel/Teflon neck ring. The ring reduces to a minimum amount of liquid running from the discharge side of the impeller to the suction side.

.3 Impeller:

.1 The impeller is made of stainless steel, AISI 304 SS.

.4 Motors: High efficiency to Section 23 05 13 - Motors, Drives and Guards for Mechanical Systems.

.5 Design maximum pressure: 860 kPa (125 psi).

.6 Design maximum temperature: 110°C (230°F).

.7 Capacity: as per drawing schedule.

.8 Acceptable material: Armstrong Astro or approved equal.

2.4 ACCESSORIES

.1 Pipe Flanges: To ANSI/ASME B16.5, Class 150.

.2 Suction Diffuser: For ANSI Class 150 pipe flange and ANSI 125 pump flange.

.1 Acceptable Material: ARMSTRONG, SG.

.3 Triple Duty Valve: Cast iron/[Ductile iron valve body, tight shut-off, spring -closure type silent non-slam check valve with effective throttling design capability.

.1 Valve stem: Stainless steel with flat surfaces for adjustment with open-end wrench.

.2 Acceptable Material: ARMSTRONG, Model FTV Flo-Trex Combination Valve.

.4 Pressure Gauges: 4-1/2 inch diameter sized to meet system pressure requirements.

PART 3 EXECUTION

3.1 INSTALLATION

.1 In line circulators: install as indicated by flow arrows. Support at inlet and outlet flanges or unions. Install with bearing lubrication points accessible. Install motor in orientation as recommended by manufacturer.

.2 Allow for on site alignment and certification of base mounted end suction pumps by manufacturer's representative.

.3 Ensure that pump body does not support piping or equipment. Provide stanchions or hangers for this purpose. Refer to manufacturer's installation instructions for details.

.4 Pipe drain tapping to nearest floor drain c/w full port ball valve.

.5 Install volute venting pet cock in accessible location.

.6 Check rotation prior to start-up.

.7 Install ball valves on pump suction & discharge tap-ins for pressure gauge.

.8 All pumps to be installed in accordance with Hydraulic Institute Standards.

.9 Provide flexible connectors on suction and discharge of all pumps with exception of in-line circulators.

.10 On vertical in-line pumps, where specified, replace flush line filter following commissioning & startup.

3.2 START-UP

.1 General

.1 In accordance with Section 25 01 11 - Commissioning - Mechanical Systems; supplemented as specified herein.

.2 In accordance with manufacturer's recommendations & Hydraulic Institute Standards.

.2 Procedures:

.1 Before starting pump, check that cooling water system, over-temperature and other protective devices are installed and operative.

.2 Provide on site alignment and certification by manufacturer's representative of base mounted end suction pumps.

.3 After starting pump, check for proper, safe operation.

.4 Check installation, operation of mechanical seals. Adjust as necessary.

.5 Check base for free-floating, no obstructions under base.

.6 Run-in pumps for 12 continuous hours.

.7 Verify operation of over-temperature and other protective devices under low- and no-flow condition.

.8 Eliminate air from scroll casing.

.9 Adjust water flow rate through water-cooled bearings.

.10 Adjust flow rate from pump shaft stuffing boxes to manufacturer's recommendation.

.11 Adjust alignment of piping and conduit to ensure true flexibility at all times.

.12 Eliminate cavitation, flashing and air entrainment.

.13 Adjust pump shaft seals, stuffing boxes, glands.

.14 Measure pressure drop across strainer when clean and with flow rates as finally set.

.15 Replace seals if pump used to degrease system or if pump used for temporary heat.

.16 Verify lubricating oil levels.

3.3 PERFORMANCE VERIFICATION (PV)

.1 General

.1 In accordance with Section 25 01 11 - Commissioning - Mechanical Systems, supplemented as specified herein.

.2 In accordance with manufacturer's recommendations.

.2 Exclusions:

.1 Performance verification does not apply to small in-line circulators.

.3 Assumptions: These PV procedures assume that:

.1 Manufacturer's performance curves are accurate.

.2 Valves on pump suction and discharge provide tight shut-off.

.4 Net Positive Suction Head (NPSH):

.1 Application: Measure NPSH for pumps which operate on open systems and with water at elevated temperatures.

.2 Measure using procedures prescribed in the Standard.

.3 Where procedures do not exist, discontinue PV, report to Engineer and await instructions.

.5 Multiple Pump Installations - Series and Parallel:

.1 Repeat PV procedures specified above for pump performance and pump BHP for combinations of pump operations.

.6 Mark points of design and actual performance at design conditions as finally set upon completion of TAB.

.7 Commissioning Reports to include:

.1 Record of point(s) of actual performance at maximum and minimum conditions and for single and parallel operation as finally set at completion of commissioning on pump curves.

.2 Pump performance curves (family of curves).

END OF SECTION

HVAC WATER TREATMENT SYSTEMS

PART 1 GENERAL

1.1 RELATED SECTIONS

.1 This section shall be read in conjunction with:

.1 Specification Section 20 05 01 - Mechanical General Requirements;

.2 All mechanical sections in Divisions 20, 21, 22, 23, and 25.

PART 2 PRODUCTS

2.1 MANUFACTURER

.1 Equipment, chemicals & service by one supplier:

.1 Ashland Canada Corp.

.2 Magnus.

.3 Klenzoid.

.4 Water Management Consultant (WMC).

2.2 CHEMICAL FEED PIPING

.1 Resistant to chemicals employed. Pressure rating: 125 psi.

2.3 CHEMICAL FEED PUMPS

.1 Top-mounted electronic metering diaphragm type: flow range 0-100%, adjustable, plus or minus 1.0% accuracy (repetitive), on-off operation, with pressure relief valve, check valve, foot valve, injection fitting, 115 V, include low level and no flow alarms to B.A.S.

2.4 CONDUCTIVITY CONTROLLER

.1 Fully transistorized, suitable for wall or flush panel mounting, LCD display, linear over full measuring range of 0-5000 micro ohms, 4-20 mA output, suitable for BAS interface.

.2 Insensitive to phase angle shifts, capable of operating on 95-130 Volts without affecting accuracy, power, bleed off status lights.

.3 Lakewood Model 2412, or equal.

2.5 CONDUCTIVITY CONTROLLER

.1 Dual carbon elements in PVC holder, quick disconnect, self-locking connection.

2.6 WATER TREATMENT FOR CLOSED HYDRONIC SYSTEMS

.1 Application: Hot water heating system and chilled water system: chemical feed pump c/w water meter.

.2 Micron filter:

.1 Capacity 5% of pump recirculating rate at operating pressure.

.2 Six (6) sets of filter cartridges for each type, size of micron filter.

.3 Betz Dearborn LMO, or equal.

.3 Pot Feeder:

.1 Welded steel, pressure rating of 1200 kPa, and temperature rating of 90°C.

.2 Size: 20 L.

2.7 CHEMICALS

.1 Heating water: CorrShield OR4407.

.2 Provide 1 year supply.

2.8 TEST EQUIPMENT

.1 Provide one set of test equipment for each system to verify performance.

.2 Complete with carrying case, reagents for chemicals, all specialized or supplementary equipment.

PART 3 EXECUTION

3.1 INSTALLATION

.1 Install HVAC water treatment systems in accordance with ASME Boiler Code Section VII, and requirements and standards of authorities having jurisdiction, except where specified otherwise.

.2 Ensure adequate clearances to permit performance of servicing and maintenance of equipment.

3.2 CHEMICAL FEED PIPING

.1 Install crosses at all changes in direction. Install plugs in all unused connections.

3.3 CLEANING OF MECHANICAL SYSTEM

.1 Provide copy of recommended cleaning procedures and chemicals for approval by Engineer.

.2 Thoroughly flush all mechanical systems and equipment with approved cleaning chemicals designed to remove deposition from construction such as pipe dope, oils, loose mill scale and other extraneous materials. Chemicals to inhibit corrosion of various system materials and be safe to handle and use.

.3 During circulation of cleaning solution, periodically examine and clean filters and screens and monitor changes in pressure drop across equipment.

.4 Drain and flush systems until alkalinity of rinse water is equal to make-up water. Refill with clean water treated to prevent scale and corrosion during system operation.

.5 Disposal of cleaning solutions to be approved by authority having jurisdiction.

3.4 WATER TREATMENT SERVICES

.1 Provide water treatment monitoring and consulting services for period of one year after system start-up. Service to include:

.1 System start-up assistance.
.2 Operating staff training.
.3 Visit plant as required until system stabilizes and advise on treatment system performance.
.4 Provide necessary recording charts and log sheets for one year operation.
.5 Provide necessary laboratory and technical assistance.
.6 Instructions and advice to operating staff to be clear, concise and in writing.

3.5 START-UP

.1 Start up water treatment systems in accordance with manufacturer's instructions.

.2 Coordinate startup within schedule for all mechanical systems.

3.6 COMMISSIONING

.1 Timing:

.1 After start-up deficiencies rectified.
.2 After start-up and before TAB of connected systems.

.2 Pre-commissioning Inspections:

.1 Verify:

.1 Presence of test equipment, reagents, chemicals, details of specific tests to be performed, operating instructions.
.2 Suitability of log book.
.3 Currency and accuracy of initial water analysis.

.4 Required quality of treated water.

.3 Commissioning procedures - applicable to all Water Treatment Systems:

.1 Establish, adjust as necessary and record all automatic controls and chemical feed rates.

.2 Monitor performance continuously during commissioning of all connected systems and until acceptance of project.

.3 Establish test intervals, regeneration intervals.

.4 Record on approved report forms all commissioning procedures, test dates, procedures, times, quantities of chemicals added, raw water analysis, treated water analysis, test results, instrument readings, adjustments made, results obtained.

.5 Establish, monitor and adjust automatic controls and chemical feed rates as necessary.

.6 Visit project at specified intervals after commissioning is satisfactorily completed to verify that performance remains as set during commissioning (more often as required until system stabilizes at required level of performance).

.7 Advise Engineer in writing on all matters regarding installed water treatment systems.

.4 Commissioning procedures - Closed Circuit Hydronic Systems:

.1 Analyse water in system.

.2 Based upon an assumed rate of loss approved by Engineer, establish rate of chemical feed.

.3 Record types, quantities of chemicals applied.

.5 Training:

.1 Commission systems, perform tests in presence of, and using assistance of, assigned O&M personnel.

.6 Certificates:

.1 Upon completion, furnish certificates confirming satisfactory installation and performance.

.7 Commissioning Reports:

.1 To include system schematics, test results, test certificates, raw and water treated analyses, design criteria, all other data required by Engineer.

.8 Demonstrations: Co-ordinate as part of schedule for all mechanical systems.

.9 Commissioning activities during Warranty Period:

.1 Check out water treatment systems on regular basis and submit written report to Engineer.

END OF SECTION

DUCTWORK LOWER PRESSURE – METALLIC TO 500 Pa

PART 1 GENERAL

1.1 RELATED SECTIONS

.1 This section shall be read in conjunction with:

.1 Specification Section 20 05 01 - Mechanical General Requirements;

.2 All mechanical sections in Divisions 20, 21, 22, 23, and 25.

1.2 REFERENCES

.1 American Society for Testing and Materials (ASTM)

.1 ASTM A924/A924M-20, Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.

.2 Canadian Standards Association (CSA)

.1 CSA B228.1-1968, Pipe, Ducts and Fittings for Residential Type Air Conditioning Systems.

.3 National Fire Protection Association (NFPA)

.1 NFPA (Fire) 90A, Installation of Air Conditioning and Ventilating Systems, 2018 Edition.

.2 NFPA (Fire) 90B, Installation of Warm Air Heating and Air Conditioning Systems, 2018 Edition.

.4 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)

.1 SMACNA 016-2012, HVAC Duct Leakage Test Manual, 2nd Edition.

PART 2 PRODUCTS

2.1 SEAL CLASSIFICATION

.1 Classification as follows:

Maximum System Total Pressure	SMACNA Seal Class
500	A
250	A
125	A

.2 Seal classification:

.1 Class A: longitudinal seams, transverse joints, duct wall penetrations and connections made airtight with sealant.

.3 Application:

.1 All new & existing supply ductwork.

.2 All new return & exhaust ductwork.

2.2 SEALANT

.1 Sealant: oil resistant, polymer type flame resistant duct sealant. Temperature range of minus 22°F to plus 200°F.

.1 Acceptable material: Duro Dyne S-2.

2.3 DUCT LEAKAGE

.1 In accordance with SMACNA 016.

2.4 FITTINGS

.1 Fabrication: to SMACNA.

.2 Radiused elbows:

.1 Rectangular: standard radius: 1.5 times width of duct.

.2 Round: 1.5 times diameter.

.3 Mitred elbows, rectangular:

.1 To 400 mm (16"): with single thickness turning vanes.

.2 Over 400 mm (16"): with double thickness turning vanes.

.4 Branches:

.1 Rectangular main and branch: with 45° entry on branch.

.2 Round main and branch: enter main duct at 45° with conical connection.

.3 Provide volume control damper in branch duct near connection to main duct.

.4 Main duct branches: with splitter damper.

.5 Transitions:

.1 Diverging: 20° maximum included angle.

.2 Converging: 30° maximum included angle.

.6 Offsets:

.1 Full radiused elbows.

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

2.5 FIRESTOPPING

.1 Retaining angles all around duct, on both sides of fire separation.

.2 Firestopping material and installation must not distort duct.

2.6 GALVANIZED STEEL

.1 Lock forming quality: to ASTM A924/A924M, Z90 zinc coating.

.2 Thickness, fabrication and reinforcement: to SMACNA.

.3 Joints: to SMACNA.

2.7 ESCUTCHEON ANGLES

.1 40 mm x 40 mm angle iron frame on both sides of exposed rectangular or round ducts, on both sides of non-rated partitions. Escutcheon angles material & gauge shall be equal to base material.

2.8 HANGERS AND SUPPORTS

.1 Strap hangers: of same material as duct but next sheet metal thickness heavier than duct. Maximum size duct supported by strap hanger:. 500 mm (20").

.2 Hanger configuration: to SMACNA.

.3 Hangers: black steel angle with black steel rods to SMACNA and following table:

Duct Size (in)	Angle Size (in)	Rod Size (in)
Up to 30”	1 x 1 x 1/8	¼
31” to 42”	1-1/2 x 1-1/2 x 1/8	¼
43” to 60”	1-1/2 x 1-1/2 x 1/8	3/8
61” to 84”	2 x 2 x 1/8	3/8
85” to 96”	2 x 2 x 3/16	3/8
97” and over	2 x 2 x 1/4”	3/8

.4 Upper hanger attachments:

.1 For concrete: manufactured concrete inserts.

.2 For steel joist: manufactured joist clamp or steel plate washer.

.3 For steel beams: manufactured beam clamps.

PART 3 EXECUTION

3.1 GENERAL

.1 Do work in accordance with NFPA (Fire) 90A, NFPA (Fire) 90B, CSA B228.1 and SMACNA.

.2 Do not break continuity of insulation vapour barrier with hangers or rods. Insulate strap hangers 100 mm (4") beyond insulated duct.

.3 Support risers in accordance with ASHRAE and SMACNA.

.4 Install breakaway joints in ductwork on each side of fire separation.

.5 Install proprietary manufactured flanged duct joints in accordance with manufacturer's instructions.

.6 Manufacture duct in lengths to accommodate installation of acoustic duct lining.

.7 Install escutcheon sheet metal angles on both sides of exposed rectangular or round ducts on both sides of non-rated partitions. Seal void with acoustic sealant.

3.2 HANGERS

.1 Strap hangers: install in accordance with SMACNA.

.2 Angle hangers: complete with locking nuts and washers.

.3 Hanger spacing: in accordance with SMACNA as follows:

Duct Size mm (in)	Spacing m (ft)
To 1500 (60”)	3 (10’)
1525mm (61”) and over	2.5 (8’)

3.3 WATERTIGHT DUCT

.1 Provide watertight duct for:

.1 Fresh air intake.

.2 Form bottom of horizontal duct without longitudinal seams.

.1 Solder joints of bottom and side sheets.

.2 Seal other joints with duct sealer.

.3 Slope horizontal branch ductwork down towards louvre drains

.1 Slope header ducts down toward risers.

.4 Fit base of riser with 150 mm deep drain sump and 32 mm drain connected, with deep seal trap and discharging to open funnel drain.

3.4 SEALING AND TAPING

.1 Apply sealant to outside of joint to manufacturer's recommendations.

3.5 LEAKAGE TESTS

.1 In accordance with SMACNA 016.

.2 Do leakage tests for supply duct; maximum leakage rate 1% at 1½ times operating static pressure.

.3 Make trial leakage tests as instructed to demonstrate workmanship.

.4 Install no additional ductwork until trial test has been passed.

.5 Test section minimum of 100 ft. long with not less then 3 branch takeoffs and two 90° elbows.

.6 Complete test before insulation or concealment.

END OF SECTION

DUCT ACCESSORIES

PART 1 GENERAL

1.1 RELATED SECTIONS

.1 This section shall be read in conjunction with:

.1 Specification Section 20 05 01 - Mechanical General Requirements;

.2 All mechanical sections in Divisions 20, 21, 22, 23, and 25.

1.2 REFERENCES

.1 Canadian Standards Association (CSA)

.1 CSA B228.1-1968, Pipes, Ducts and Fittings for Residential Type Air Conditioning.

PART 2 PRODUCTS

2.1 GENERAL

.1 Manufacture in accordance with CSA B228.1.

2.2 FLEXIBLE CONNECTIONS

.1 Frame: galvanized sheet metal frame 0.6 mm thick with fabric clenched by means of double locked seams.

.2 Material:

.1 Fire resistant, self extinguishing, neoprene coated glass fabric, temperature rated at minus 40°C to plus 90°C, density of 1.3 kg/m2.

2.3 ACCESS DOORS IN DUCTS

.1 Non-insulated ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.6 mm thick complete with sheet metal angle frame.

.2 Insulated ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.6 mm thick complete with sheet metal angle frame and 25 mm thick rigid glass fibre insulation.

.3 Gaskets: neoprene.

.4 Hardware:

.1 Up to 300 x 300 mm: 2 sash locks complete with safety chain.

.2 301 to 450 mm: 4 sash locks complete with safety chain.

.3 451 to 1000 mm: piano hinge and minimum 2 sash locks.

.4 Doors over 1000 mm: piano hinge and 2 handles operable from both sides.

.5 Hold open devices.

2.4 INSTRUMENT TEST PORTS

.1 1.6 mm thick steel zinc plated after manufacture.

.2 Cam lock handles with neoprene expansion plug and handle chain.

.3 28 mm minimum inside diameter. Length to suit insulation thickness.

.4 Neoprene mounting gasket.

.5 Acceptable material: Duro Dyne IP1 or IP2.

2.5 SPIN-IN COLLARS

.1 Conical galvanized sheet metal spin-in collars with lockable butterfly damper.

.2 Sheet metal thickness to co-responding round duct standards.

PART 3 EXECUTION

3.1 INSTALLATION

.1 Flexible connections:

.1 Install in following locations:

.1 Inlets and outlets to supply air units and fans.

.2 Inlets and outlets of exhaust and return air fans.

.3 As indicated.

.2 Length of connection: 100 mm.

.3 Minimum distance between metal parts when system in operation: 75 mm.

.4 Install in accordance with recommendations of SMACNA.

.5 When fan is running:

.1 Ducting on each side of flexible connection to be in alignment.

.2 Ensure slack material in flexible connection.

.2 Access doors and viewing panels:

.1 Size:

.1 450 x 450 mm for person size entry

.2 450 x 450 mm for servicing entry.

.3 300 x 300 mm for viewing.

.4 As indicated.

.2 Location:

.1 At fire and smoke dampers.

.2 At control dampers.

.3 At devices requiring maintenance.

.4 At locations required by code.

.5 At reheat coils.

.6 Elsewhere as indicated.

.3 Instrument test ports.

.1 General:

.1 Install in accordance with recommendations of SMACNA and in accordance with manufacturer's instructions.

.2 Locate to permit easy manipulation of instruments.

.3 Install insulation port extensions as required.

.4 Locations.

.1 For traverse readings:

.1 At ducted inlets to roof and wall exhausters.

.2 At inlets and outlets of other fan systems.

.3 At main and sub-main ducts.

.4 And as indicated.

.2 For temperature readings:

.1 At outside air intakes.

.2 In mixed air applications in locations as approved by Engineer.

.3 At inlet and outlet of coils.

.4 Downstream of junctions of two converging air streams of different temperatures.

.5 And as indicated.

END OF SECTION

DAMPERS - BALANCING

PART 1 GENERAL

1.1 RELATED SECTIONS

.1 This section shall be read in conjunction with:

.1 Specification Section 20 05 01 - Mechanical General Requirements;

.2 All mechanical sections in Divisions 20, 21, 22, 23, and 25.

1.2 REFERENCES

.1 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)

.1 SMACNA 1966-2006, HVAC Duct Construction Standards - Metal and Flexible, 3rd Edition.

PART 2 PRODUCTS

2.1 GENERAL

.1 Manufacture to SMACNA standards.

2.2 SINGLE BLADE DAMPERS

.1 Of same material as duct, but one sheet metal thickness heavier. V-groove stiffened.

.2 Size and configuration to recommendations of SMACNA, except maximum height 100 mm (4").

.3 For rectangular ducts adjustable lever with shaft extension to accommodate insulation thickness.

.4 For round branch ducts adjustable lever with shaft extension to accommodate insulation thickness.

.5 Inside and outside nylon end bearings.

.6 Channel frame of same material as adjacent duct, complete with angle stop.

2.3 MULTI-BLADED DAMPERS

.1 Factory manufactured of material compatible with duct.

.2 Opposed blade: configuration, metal thickness and construction to recommendations of SMACNA.

.3 Maximum blade height: 100 mm (4").

.4 Bearings: self-lubricating nylon.

.5 Linkage: shaft extension with locking quadrant.

.6 Channel frame of same material as adjacent duct, complete with angle stop.

.7 Maximum leakage: 0.07% at 750 Pa.

PART 3 EXECUTION

3.1 INSTALLATION

.1 Install where indicated.

.2 Install in accordance with recommendations of SMACNA and in accordance with manufacturer's instructions.

.3 For supply, return and exhaust systems, locate balancing dampers in each branch duct.

.4 Runouts to registers and diffusers: install single blade damper located as close as possible to main ducts.

.5 All dampers to be vibration free.

.6 Ensure damper operators are observable and accessible.

END OF SECTION

DAMPERS - OPERATING

PART 1 GENERAL

1.1 RELATED SECTIONS

.1 This section shall be read in conjunction with:

.1 Specification Section 20 05 01 - Mechanical General Requirements;

.2 All mechanical sections in Divisions 20, 21, 22, 23, and 25.

1.2 REFERENCES

.1 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)

.1 SMACNA 1966-2006, HVAC Duct Construction Standards - Metal and Flexible, 3rd Edition.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURER

.1 Tamco.

.2 Nailor.

.3 Ruskin.

.4 Ventex.

2.2 MULTI-LEAF DAMPERS

.1 Opposed and parallel blade type as indicated.

.2 Extruded aluminum, interlocking blades, complete with extruded vinyl seals, spring stainless steel side seals, extruded aluminum frame.

.3 Pressure fit self-lubricated bronze bearings.

.4 Linkage: plated steel tie rods, brass pivots and plated steel brackets, complete with plated steel control rod.

.5 Control Damper Operators:

.1 Electronic:

.1 Push-pull proportional type as indicated.

.2 Spring return for "fail-safe" in Normally Open or Normally Closed position as indicated.

.3 Operator: size so as to control dampers against maximum pressure or dynamic closing pressure (whichever is greater).

.4 Power requirements: as required for application.

.5 Operating range: 0 - 20 V DC.

.6 Acceptable material: Belimo.

.6 Performance:

.1 Leakage Class: 1A.

.2 Pressure drop: at full open position to be less than 4 Pa differential across damper at 5 m/s.

.7 Insulated aluminum dampers:

.1 Frames: insulated with extruded polystyrene foam with R factor of 2.3.

.2 Blades: constructed from aluminum extrusions with internal hollows insulated with polyurethane or polystyrene foam, R factor of 2.3.

.8 Acceptable material:

.1 Exhaust & Intake: Tamco 9000, Ventex.

.2 Return: Tamco 1000, Ventex.

2.3 BACK DRAFT DAMPERS

.1 Automatic gravity operated, multi leaf, aluminum construction with nylon bearings, as indicated.

.2 Acceptable Material: Tamco 7000, Ventex.

PART 3 EXECUTION

3.1 INSTALLATION

.1 Install where indicated, and when supplied by others.

.2 Install in accordance with recommendations of SMACNA and manufacturer's instructions.

.3 Seal multiple damper modules with silicon sealant.

.4 Install access door adjacent to each damper. See Section 23 33 00 - Duct Accessories.

.5 Ensure dampers are observable and accessible.

END OF SECTION

DAMPERS - FIRE

PART 1 GENERAL

1.1 RELATED SECTIONS

.1 This section shall be read in conjunction with:

.1 Specification Section 20 05 01 - Mechanical General Requirements;

.2 All mechanical sections in Divisions 20, 21, 22, 23, and 25.

1.2 REFERENCES

.1 .1 National Fire Protection Association (NFPA)

.1 NFPA (Fire) 90A, Installation of Air Conditioning and Ventilating Systems, 2018 Edition.

.2 Underwriters Laboratories of Canada (ULC)

.1 CAN/ULC S112:2010-R2016, Fire Test of Fire Damper Assemblies.

PART 2 PRODUCTS

2.1 FIRE DAMPERS

.1 Fire dampers: arrangement Type B or C, listed and bear label of ULC, meet requirements of NFPA (Fire) 90A authorities having jurisdiction. Fire damper assemblies to be fire tested in accordance with CAN/ULC S112.

.2 Mild steel, factory fabricated for fire rating requirement to maintain integrity of fire wall and/or fire separation.

.3 Top hinged: offset single damper, round or square; interlocking type; sized to maintain full duct cross section as indicated.

.4 Fusible link actuated having negator-spring- closing operator.

.5 Fusible link actuated, weighted to close and lock in closed position when released.

.6 40 x 40 x 3 mm retaining angle iron frame, on full perimeter of fire damper, on both sides of fire separation being pierced.

.7 Rating: 1½ hr.

.8 Acceptable material: AMI, NCA, Nailor, Ruskin, Ventex.

PART 3 EXECUTION

3.1 INSTALLATION

.1 Install in accordance with NFPA (Fire) 90A and in accordance with conditions of ULC listing.

.2 Maintain integrity of fire separation.

.3 After completion and prior to concealment obtain approvals of complete installation from authority having jurisdiction.

.4 Install access door adjacent to each damper. See Section 23 33 00 - Duct Accessories.

.5 Coordinate with installer of firestopping.

.6 Ensure access door/panels, fusible links, and/or damper operators are easily observed and accessible.

END OF SECTION

COMMERCIAL FANS

PART 1 GENERAL

1.1 RELATED SECTIONS

.1 This section shall be read in conjunction with:

.1 Specification Section 20 05 01 - Mechanical General Requirements;

.2 All mechanical sections in Divisions 20, 21, 22, 23, and 25.

1.2 REFERENCES

.1 Air Movement and Control Association (AMCA)

.1 AMCA 99-16, Standards Handbook.

.2 ANSI/AMCA 210-16, Laboratory Methods of Testing Fans for Rating.

.3 ANSI/AMCA 300-14, Reverberant Room Method for Sound Testing of Fans.

.4 ANSI/AMCA 301-14, Methods for Calculating Fan Sound Ratings from Laboratory Test Data.

.2 American Bearing Manufacturers Association (ABMA)

.1 ABMA 9:2015, Load Ratings and Fatigue Life for Ball Bearings.

.2 ABMA 11:2014, Load Ratings and Fatigue Life for Roller Bearings.

.3 ASHRAE/Air Movement and Control Association

.1 ASHRAE 51-2016, Laboratory Methods of Testing Fans for Rating.

.4 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-1.181-99, Coating, Zinc Rich, Organic, Ready Mixed.

PART 2 PRODUCTS

2.1 FANS GENERAL

.1 Capacity: flow rate, total static pressure, bhp, efficiency, revolutions per minute, power, model, size, sound power data and as indicated on schedule.

.2 Statically and dynamically balanced. Constructed in conformity with AMCA 99.

.3 Sound ratings: comply with ANSI/AMCA 301, tested to ANSI/AMCA 300. Unit shall bear AMCA certified sound rating seal.

.4 Performance ratings: based on tests performed in accordance with ANSI/AMCA 210, and ASHRAE 51, unit to bear AMCA certified rating seal.

.5 Performance ratings: based on tests performed in accordance with ANSI/AMCA 210, and ASHRAE 51. Unit shall bear AMCA certified rating seal, except for propeller fans smaller than 300 mm diameter.

.6 Bearings: sealed lifetime oilite ball bearings heavy duty grease lubricated ball or roller bearings of self aligning type with oil retaining, dust excluding seals and a certified minimum rated life of 200,000 h in accordance with ABMA L50 life standard. Bearings to be rated and selected in accordance with ABMA 9 and ABMA 11.

.7 Motors:

.1 In accordance with Section 23 05 13 - Motors, Drives and Guards specified as supplemented herein.

.2 For use with variable speed controllers where applicable.

.3 Sizes as indicated.

.4 Two speed with two windings and speeds where applicable.

.5 Two speed with split winding, where applicable.

.8 Accessories and hardware: matched sets of V-belt drives, adjustable slide rail motor bases, belt guards, coupling guards fan inlet and/or outlet safety screens as indicated and as specified in Section 23 05 13 - Motors, Drives and Guards.

.9 Factory primed before assembly in colour standard to manufacturer.

.10 Scroll casing drains: as indicated.

.11 Bearing lubrication systems plus extension lubrication tubes where bearings are not easily accessible.

.12 Vibration isolation: to Section 23 05 48 - Vibration Isolation and Seismic Control.

.13 Flexible connections: to Section 23 33 00 - Duct Accessories.

2.2 CABINET FANS DIRECT DRIVE

.1 Fan shall have true centrifugal wheel (or wheels).

.2 Fans shall have acoustically insulated housings c/w eggcrate type inlet grille and shall have air deliveries and Sone levels as indicated. All fans shall bear the AMCA Certified Ratings Seal and the UL label. Manufacturer shall submit vibration amplitudes and magnetic motor hum levels in decibels.

.3 Integral backdraft damper shall be totally chatter-proof with no metal to metal contact.

.4 Entire fan, motor, and wheel assembly shall be easily removable without disturbing the housing. Motor speeds shall not exceed 1500 RPM and all fan

motors shall be c/w motor overload, suitably grounded, and mounted on rubber-in-shear vibration isolators.

.5 Fans shall be equipped with CSA motor rated disconnect switches.

.6 Supply variable speed controller and turn over to Div. 26 for installation and wiring where indicated.

.7 Supply line voltage thermostat and turn over to Div. 26 for installation and wiring where indicated.

.8 Performance: as indicated on drawing schedule.

.9 Acceptable material: PennBarry, Greenheck, Loren Cook, Twin City.

PART 3 EXECUTION

3.1 INSTALLATION

.1 Install in accordance with manufacturer's instructions.

END OF SECTION

DOMESTIC FANS

PART 1 GENERAL

1.1 RELATED SECTIONS

.1 This section shall be read in conjunction with:

.1 Specification Section 20 05 01 - Mechanical General Requirements;

.2 All mechanical sections in Divisions 20, 21, 22, 23, and 25.

1.2 REFERENCES

.1 Air Movement and Control Association (AMCA)

.1 AMCA 201-02 (R2011), Fans and Systems.

.2 ANSI/AMCA 210-16, Laboratory Methods of Testing Fans for Rating.

.3 ANSI/AMCA 300-14, Reverberant Room Method for Sound Testing of Fans.

.4 AMCA 302-73 (R2012), Application of Sone Ratings for Non-Ducted Air Moving Devices.

.5 AMCA 303-79 (R2012), Application of Sound Power Level Ratings for Fans.

.2 ASHRAE/Air Movement and Control Association

.1 ASHRAE 51-2016, Laboratory Methods of Testing Fans for Rating.

PART 2 PRODUCTS

2.1 FANS GENERAL

.1 Standard of rating:

.1 AMCA 201 for fan application.

.2 AMCA 302 for application of sone loudness ratings for non-ducted air moving devices.

.3 AMCA 303 for application of sound power ratings for ducted air moving devices.

.4 Performance: to ANSI/AMCA 210 and ASHRAE 51. Unit to bear AMCA certified seal.

.2 Sound power level (PWL) ratings to comply with AMCA 303, tested to ANSI/AMCA 300 Unit to bear AMCA certified sound rating seal.

.3 Capacities: as per schedules on drawings.

2.2 WASHROOM EXHAUST FANS

.1 Ceiling mounted exhaust fans shall be of the centrifugal direct drive type. The fan housing shall be constructed of zinc coated steel. The steel duct collar shall be the diameter as indicated and shall include a backdraft damper. The designer grille shall be constructed of non-yellowing high impact polystyrene and attached to the housing with hidden painted screws. The access for wiring shall be external. The motor disconnect shall be internal and of the plug in type.

.2 The motor shall be mounted on vibration isolators. The fan wheel shall be of the forward curved centrifugal type, constructed of calcium carbonate filled polypropylene and dynamically balanced. All fans shall bear the AMCA Certified Ratings Seal for sound and air performance and shall be UL/ULC listed.

.3 Performance: as indicated on drawing schedule.

.4 Acceptable material: Greenheck, Penn, Broan.

2.3 LOUVRED EXHAUST WALL BOXES

.1 Application: Exterior wall boxes for suite washroom exhaust fan and range hood wall termination.

.2 Wall boxes shall be installed on the building exterior wall and ducted to the fan discharges indicated on drawing.

.3 Wall boxes shall be fabricated from heavy gauge punched aluminum material, 13 mm spacing at 45° fixed angle and 300 mm deep plenum box, to provide maximum protection against water entering c/w aluminum bird screen. Box to have 125 mm dia. and 150 mmØ duct collars. Double, vertical wall boxes shall come complete with mounting frame; reference drawings for locations. Double boxes to have neoprene back draft dampers.

.4 Finish: baked enamel custom finish, colour to be selected by Architect.

.5 Acceptable materials: Reversomatic TVE-50.

PART 3 EXECUTION

3.1 INSTALLATION

.1 Install in accordance with manufacturer's recommendations.

3.2 ANCHOR BOLTS AND TEMPLATES

.1 Supply for installation by other Divisions.

.2 Size anchor bolts to withstand seismic 4 acceleration and 2 velocity forces.

END OF SECTION

GRILLES, REGISTERS, & DIFFUSERS

PART 1 GENERAL

1.1 RELATED SECTIONS

.1 This section shall be read in conjunction with:

.1 Specification Section 20 05 01 - Mechanical General Requirements;

.2 All mechanical sections in Divisions 20, 21, 22, 23, and 25.

PART 2 PRODUCTS

2.1 GENERAL

.1 To meet capacity, pressure drop, terminal velocity, throw, noise level, neck velocity as indicated in schedule on drawings.

.2 Frames:

.1 Full perimeter gaskets.

.2 Plaster frames where set into plaster or gypsum board and as specified.

.3 Concealed fasteners.

.3 Concealed operators.

.4 Size and type to be as per drawings and schedules.

.5 Acceptable material: E.H Price Ltd., Nailor, Titus, Krueger, Metal-aire.

PART 3 EXECUTION

3.1 INSTALLATION

.1 Install in accordance with manufacturers instructions.

.2 Install with flat head cadmium plated screws in countersunk holes where fastenings are visible.

END OF SECTION

LOUVRES & HOODS

PART 1 GENERAL

1.1 RELATED SECTIONS

.1 This section shall be read in conjunction with:

.1 Specification Section 20 05 01 - Mechanical General Requirements;

.2 All mechanical sections in Divisions 20, 21, 22, 23, and 25.

1.2 REFERENCES

.1 American Architectural Manufacturers Association (AAMA)

.1 AAMA 2605-2017, Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels.

.2 American Society for Testing and Materials International (ASTM)

.1 ASTM E90-09(2016), Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.

.3 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)

PART 2 PRODUCTS

2.1 STATIONARY LOUVRES (L)

.1 Construction: welded with exposed joints ground flush and smooth.

.2 Material: extruded aluminum alloy 6063-T5.

.3 Blade: stormproof pattern with centre watershed in blade, reinforcing bosses and maximum blade length of 1500 mm for all louvres.

.4 Frame, head, sill and jamb: depth as indicated on drawing schedule. One piece extruded aluminum, minimum 3 mm thick with approved caulking slot, integral to unit.

.5 Mullions: at 1500 mm maximum centres.

.6 Fastenings: stainless steel SAE-194-8F with SAE-194-SFB nuts and resilient neoprene washers between aluminum and head of bolt, or between nut, ss washer and aluminum body.

.7 Screen: 19 mm mesh, 2 mm diam wire aluminum birdscreen on inside face of louvres in formed U-frame.

.8 Finish:

.1 Finish exposed surfaces of exterior aluminum components with factory applied polyvinylidene fluoride (PVF2) coating meeting performance requirements of AAMA 2605, dry film thickness of 0.025 mm.

.1 Colours to match PPG Duranar colour as approved by Architect.

.2 Gloss: Medium.

.3 Appearance: visibly free of flow.

.9 Performance: as per drawing schedule.

.10 Acceptable Materials: Tamco, Ventex.

PART 3 EXECUTION

3.1 INSTALLATION

.1 In accordance with manufacturers and SMACNA recommendations.

.2 Reinforce and brace air vents, intakes and to withstand local wind speeds as indicated.

.3 Anchor securely into opening. Seal with caulking around to ensure weather tight.

END OF SECTION

BREECHING AND VENTING

PART 1 GENERAL

1.1 RELATED SECTIONS

.1 This section shall be read in conjunction with:

.1 Specification Section 20 05 01 - Mechanical General Requirements;

.2 All mechanical sections in Divisions 20, 21, 22, 23, and 25.

1.2 REFERENCES

.1 Underwriters Laboratories of Canada (ULC).

PART 2 PRODUCTS

2.1 BREECHING

.1 Shop or field venting not acceptable. ULC labelled is acceptable.

2.2 POSITIVE PRESSURE VENT

.1 The vent shall be of the double wall, factory-built type, designed for use in conjunction with Category II, III, or IV condensing or non-condensing, positive pressure gas fired appliances or as specified by the heating equipment manufacturer.

.2 Maximum continuous flue gas temperature shall not exceed 550°F (288°C).

.3 Vent shall be listed for a maximum positive pressure rating of 150 mm (6") w.c. and shall have passed at 380 mm (15") w.c.

.4 The vent system shall be continuous from the appliance's flue outlet to the vent termination outside the building. All systems components shall be ULC listed and supplied by the same manufacturer.

.5 The vent shall be constructed with an inner and outer tube, where the annular air space between the tubes is The inner tube (flue gas conduit) shall be constructed from AL29-4C or UNS S44735 stainless steel, with a min. wall thickness of 0.04 cm (0.016") for 75 mm (3") through 175 mm (7") dia. vents, 0.048 cm (0.019") for 200 mm (8") through 300 mm (12") dia. vents and 0.06 cm (0.024") for 350 mm (14") and 400 mm (16") dia. vents. The outer tube (jacket) shall be constructed from 304 stainless steel, with a min. wall thickness of 0.04 cm (0.016") for 75 mm (3") through 150 mm (6") dia. vents and 0.06 cm (0.024") for 175 mm (7") through 400 mm (16") dia. vents.

.6 All systems components such as vent supports, roof or wall penetrations, terminations, appliance connectors and drain fittings required to install the vent system shall be ULC listed and provided by the vent manufacturer.

.7 All systems components shall include a factory installed gasket in their female-end to render the vent air and water tight when the male/female ends are pushed together as per manufacturers instructions. Vent systems requiring field installed sealants or compounds shall not be acceptable.

.8 All systems components shall include a factory installed, internal mechanical locking band for fastening and securing all vent components against each other.

.9 Vent layout shall be designed and installed in compliance with manufacturers installation instructions and all applicable local codes.

.10 Rain shield shall be fabricated of 10 gauge 302 stainless steel to dimensions as per drawing.

.11 Acceptable materials:

.1 Selkirk Heatfab Safe T Vent CI Plus Model.

.2 Protech Systems, Inc. Model FasnsealW2.

2.3 ACCESSORIES

.1 Cleanouts: bolted, gasketed type, full size of chimney, as indicated.

.2 Barometric dampers: single acting, 70% of full size of breeching area.

.3 Hangers and supports: in accordance with recommendations of Sheet Metal and Air Conditioning Contractors National Association Inc. (SMACNA).

.4 Rain cap.

.5 Expansion sleeves with heat resistant caulking, held in place as indicated.

PART 3 EXECUTION

3.1 INSTALLATION

.1 Follow manufacturer's and SMACNA installation recommendations for shop fabricated components.

.2 Support chimneys at bottom, roof and intermediate levels as indicated.

.3 Install thimbles where penetrating roof. Pack annular space with heat resistant caulking.

.4 Install flashings on chimneys penetrating roofs, as indicated.

.5 Install rain caps and cleanouts, as indicated.

.6 Install boot-tee at all changes in direction c/w cleanout & drain nippled.

.7 The vent system shall be routed to maintain minimum clearance to combustibles as specified by the manufacturer.

.8 Vent installation shall conform to the manufacturer's installation instructions, its ULC listing and local codes.

.9 The vent system and breechings shall be inspected and cleaned before the final connection to the appliances.

END OF SECTION

PACKAGED BOILERS (DUAL FUEL)

PART 1 GENERAL

1.1 RELATED SECTIONS

.1 This section shall be read in conjunction with:

.1 Specification Section 20 05 01 - Mechanical General Requirements;

.2 All mechanical sections in Divisions 20, 21, 22, 23, and 25.

1.2 REFERENCES

.1 American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE)

.1 ASHRAE 90.1-2019, Energy Standard for Buildings Except Low-Rise Residential Buildings.

.2 Canadian Standards Association (CSA).

.1 CSA B149.1-20, Natural Gas and Propane Installation Code.

.2 CSA ANSI Z21.13-2017/CSA 4.9-2017, Gas-fired Low Pressure Steam and Hot Water Boilers.

.3 Listing and Labelling: Provide electrically operated components specified in this Section that are listed and labelled.

.1 The Terms "Listed" and "Labelled": As defined in NFPA 70, Article 100.

.2 Listing and Labelling Agency Qualifications: A "Nationally Recognized Testing Laboratory" as defined in OSHA Regulation 1910.7.

.4 ASME Compliance: Boilers shall bear ASME "H" stamp and be National-Board listed.

.5 FM Compliance: Control devices and control sequences according to requirements of FM.

.6 Comply with NFPA (Fire) 70, National Electrical Code (NEC), 2020 Edition for electrical components and installation.

.7 IRI Compliance: Control devices and control sequences according to requirements of IRI (GE GAP).

.8 ASME CSD-1-2018, Controls and Safety Devices for Automatically Fired Boilers.

1.3 SHOP DRAWINGS

.1 Submit shop drawings in accordance with Section 20 05 01 - Mechanical General Requirements.

.2 Indicate the following:

.1 General arrangement showing terminal points, instrumentation test connections.

.2 Clearances for operation, maintenance, servicing, tube cleaning, tube replacement.

.3 Anchor bolt arrangements.

.4 Piping hook-ups.

.5 Equipment electrical drawings.

.6 Burners and controls.

.7 All miscellaneous equipment.

.8 Flame safety control system.

.9 Venting configuration.

.3 Engineering data to include:

.1 Boiler efficiency at 25%, 50%, 75%, 100% of design capacity.

.2 Radiant heat loss at 100% design capacity.

1.4 CLOSEOUT SUBMITTALS

.1 Submit operation and maintenance data for incorporation into manual specified in Section 20 05 01 -Mechanical General Requirements.

PART 2 PRODUCTS

2.1 GENERAL

.1 Furnish and install factory fabricated and tested stainless steel Fire-tube condensing boiler.

.2 Design: The boiler shall be gas floor standing condensing boiler with stainless steel heat exchanger with three flue gas passes and high water content. The boiler shall be ETL certified as a condensing boiler. The boiler shall operate with natural gas, propane or dual fuel and have an ETL certified input rating as noted on the drawings, and shall be listed with AHRI and shall have a minimum thermal efficiency rating of 94.0% at rated input. The boiler shall be designed for up to 5:1 turn down. The design shall provide quiet burner ignition and operation. The boiler shall have double return; low & medium temperature, to maximize condensation in all working conditions. The boiler shall have top water and gas connections for easy access to piping. The boiler shall have insulation on boiler body, casing and front door.

.3 Acceptable Material: Riello RTC-80-3000 & RS100 GG W. DG HEAD. Boiler shall be certified to operate on both natural gas and digester gas.

2.2 COMPONENTS

.1 Heat Exchanger

.1 The fire tube stainless steel heat exchanger shall be inspected and tested to ASME Section IV requirements and shall bear the ASME section IV seal of approval.

.2 The heat exchanger shall be a fully condensing cylindrical counter-flow fire tube design with SA-240 type 316Ti combustion chamber, inversion tube and tube sheets, SA-312 Type 316L tube bundle, SA-516 Gr.60 external shell and SA 105 and SA 53 Gr. B nozzle.

.3 The heat exchanger maximum working pressure shall be 80 psig.

.4 The heat exchanger maximum operating temperature shall be 195F.

.5 The boiler shall be capable of operating with zero flow conditions without overheating. This solution shall allow the boiler to operate without overheating with the burner turned on and circulators turned off.

.6 The boiler shall have a water content of 130.7 Gallons for RTC 1000, 146.6 Gallons for RTC1300, 196.2 Gallons for RTC 1700, 203.4 Gallons for RTC2300, 348.7 Gallons for RTC 3000, 368.5 Gallons for RTC3800, 482.1 Gallons for RTC4700 and 501.9 Gallons for RTC5500.

.7 The heat exchanger shall be accessible for visual inspection and cleaning of all internal fire side surfaces.

.8 The boiler shall be equipped with an ASME certified pressure relief valve, from 30 psi to 75 psi.

.2 Combustion Chamber

.1 The boiler shall have sealed combustion capability with an engineered gas/air chamber that ensures proper mixing for stable combustion at all firing rates.

.2 The boiler shall have the combustion chamber at the top and the smooth pipe tube bundle at the bottom to optimize heat transfer and energy efficiency and to maximize the condensing effect.

.3 The boiler shall have low pressure combustion chamber for a smoother burner action.

.4 The heat exchanger shall have temperature-resistant, stainless steel turbulators inside the tube bundle for maximum burner efficiency.

.5 All parts that come into contact with the combustion gases shall be made from Titanium stabilized Stainless Steel to ensure maximum resistance to the corrosive action of acid condensation.

.6 The heat exchanger design shall have counter-current water flow vs flue gas to maximize condensation.

.7 A window view port shall be provided for visual inspection of the boiler combustion during firing.

.3 Gas Train

.1 The main gas train shall consist a low gas pressure switch (manual reset) and a high gas pressure switch (manual reset) as required by code.

.2 The gas train shall consist of Siemens VGG or VGD valves bodies with SKP15 and SKP25 actuators.

.3 The pilot train shall consist of an ASCO solenoid, Maxitrol regulator, and manual shut off valve.

.4 Each boiler shall have a manual gas shutoff valve and a test fire valve.

.5 The gas train can be selected for Natural gas or Propane.

.6 The boiler shall be capable of operating at high altitude with the right selection of a burner.

.4 Burner

.1 The burner shall be a Riello RS-100 with digester gas head.

.2 The burner shall be capable of operation on natural gas and digester gas.

.3 The burner shall operate with a 5:1 turn down on Natural Gas.

.4 The burner shall not produce more than 0.04% of Carbon monoxide (CO) at all firing rates.

.5 The burner shall not produce more than 30 ppm of NOx when operating on natural gas.

.6 The burner shall feature fully independent air and fuel actuators for regulation (linkage less).

.7 The flame safeguard shall be a Siemens LMV 3 or 5 system with a QRA flame detector.

.8 The burner shall be a packaged design including the combustion air fan and motor.

.9 Burner shall have auto fuel switchover to natural gas on loss of digester gas pressure.

.10 The burner shall include an on board RWF55 water temperature control.

.11 The burner fan housing and manifold shall be constructed from aluminum alloy.

.12 Burner to operate on the following pressures:

.1	Natural gas	9-14” w.c.
.2	Digester gas	11-14” w.c.

.5 Controls

.1 The boiler control kit shall be furnished with High Limit, High Limit Well Assembly, Operating Control, Operating Control Well Assembly, Low water Cut-Off, Low Water Cut-Off Probe, Blocked Flue Switch, Pressure/Temperature Gauge and Junction Box.

.2 The boiler shall be equipped with a side panel for mounting these components.

.6 Venting

.1 The boiler shall be designed for vertical or horizontal category IV venting.

.2 Air may be taken from the room or ducted directly to the boiler. Air may be drawn from the outdoors via a duct connected directly to the burner intake.

.3 The AISI 316L - AL29-4C vent materials shall be utilized for all system applications.

.7 Casings and Panels

.1 The boiler body shall be thoroughly insulated with a layer of high density glass wool.

.2 The boiler casing shall be made from painted steel sheet.

.3 The boiler's front door and flue gas chamber shall be opened completely to facilitate inspection, maintenance, cleaning of internal parts and to speed up servicing in general.

.4 The boiler front door shall be opened in either direction and without removing the burner. The door shall come fitted with hinges on the right, but these shall be reversed if necessary to suit individual installations.

2.3 MANUFACTURER'S FIELD SERVICES

.1 General: The boiler supplier's factory authorized service organization shall be responsible for performance of inspections, start up and testing of the package boiler, and accessory equipment and materials furnished under this Section. A detailed written record of the start up performance, including burner setting data over the entire load range shall be furnished to the engineer before final acceptance. All labour, equipment shall be furnished by the authorized service organization. All equipment defects discovered by the tests shall be rectified either by the service organization or boiler manufacturer.

.2 Equipment inspection: Boiler representative to provide 4 hours of jobsite assistance to inspect boilers and other equipment upon arrival, verifying completeness of equipment supplied and potential damages. All shipped loose components, such as casing, to be mounted on boiler by boiler provider after contractor has set boiler in building.

.3 Pre start-up walk through: Boiler representative shall spend 2 hours at jobsite reviewing installation with mechanical contractor to be conducted approximately 1 week prior to startup.

.4 Start-up shall be conducted by experienced and factory authorized technician in the regular employment of the authorized service organization, and shall include:

.5 Demonstrate that boiler, burner, controls, and accessories comply with requirements of this Section as proposed by the boiler and accessories supplier. Pre-test all items prior to scheduling the final testing that will be witnessed by the test engineer.

.6 Readings at different firing rates (20, 50, 75 and 100%) of load for the modulating burner shall be taken with a written report of the tests submitted to the engineer. The reports shall include readings for each firing rate tested and include stack temperatures, O2, CO, NOx, and overall boiler efficiency.

.7 Auxiliary Equipment and Accessories: Observe and check all valves, draft fans, electric motors and other accessories and appurtenant equipment during the operational and capacity tests for leakage, malfunctioning, defects, and non compliance with referenced standards or overloading as applicable.

.8 Commissioning Requirements:

.1 Fireside inspection
.2 Set up fuel train and combustion air system
.3 Set up operating set points
.4 Check all safeties, including Flame safeguard, LWCO, Airflow, Fuel pressures, High limits.
.5 Set up and verify efficiencies at 20%, 50%, 75%, and 100%
.6 Set up and verify burner turndown.

.9 Training to include all safety procedures, maintenance procedures, control operations, and diagnostic procedures. Training to be provided in a single 2 hour continuous session to accommodate operator's availability on site.

2.4 OPERATING & MAINTENANCE MANUALS

.1 Provide two (2) Operating and Maintenance manuals including cut-away views of boiler and burner, schematics including fuel trains, general instructions for maintenance and inspections, complete spare parts lists and trouble shooting procedures.

.2 A wiring diagram corresponding to the boiler shall be affixed to the boiler near the electrical panel.

2.5 WARRANTY DATA

.1 The pressure vessel (heat exchanger) shall be guaranteed against flue gas corrosion and materials/workmanship for a period of 10 years.

.2 All parts not covered by the above warranties shall carry a 1 year warranty from startup, or 18 months from shipment, whichever occurs first. This shall include all electrical components and burner components.

2.6 AUXILIARIES

.1 Provide for each boiler and to meet ASME requirements.

.2 Condensate neutralization tank and limestone fill, pipe to drain. Provide one (1) spare neutralization unit for each boiler.

2.7 ANCHOR

.1 Anchor bolts to be sized to Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping & Equipment.

PART 3 EXECUTION

3.1 INSTALLATION

.1 Installation shall be performed by the contractor in accordance with the requirements of the applicable codes and manufacturer's instructions. Contractor shall review the boiler and installation for compliance with requirements and/or issues that may affect boiler performance. Installation should not proceed until unsatisfactory conditions have been corrected.

.2 Equipment Mounting:

.1 Install boilers level on concrete base. Concrete base is specified in Division 23 Section "Common Work Results for HVAC", and concrete materials and installation requirements are specified in Division 03.

.2 The boiler must be installed on a level housekeeping pad at least 3" above the floor for proper condensate drainage and boiler operation.

.3 Comply with requirements of vibration isolation devices. Vibration isolation devices and installation requirements are specified in Division 23 Section "Vibration and Seismic Control for HVAC Piping and Equipment".

.4 Install gas-fired boilers according to NFPA 54 and ANSI Z223.1

.3 Assemble and install boiler trim. Burners will be factory assembled, but contractor to mount burners to boilers on site. Contractor shall support gas train from housekeeping pad and supply transition piping between gas train an burner intake based on exact placement on site.

.4 Install electrical devices furnished with boiler but not specified to be factory mounted.

.5 Install control wiring to field-mounted electrical devices.

3.2 CONNECTIONS

.1 Piping

.1 Each boiler shall be provided with all necessary inlet and outlet connections. Refer to specific Boiler's specification sheet for connection sizes. Piping installation requirements are specified in other Divisions 20, 21, 22, 23, & 25 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

.2 Check manufacturer's installation manual for clearance dimensions and install piping adjacent to boiler to allow service and maintenance.

.3 Install piping from equipment drain connection to nearest floor drain. Piping shall be at least full size of connection and adhere to proper codes for neutralization. Provide an isolation valve if required.

.4 Connect piping to boilers, except safety relief valve connections, with flexible connectors of material suitable for service. Flexible connectors

and their installation are specified in Division 20 05 01 Section “Common Work results for HVAC”.

.2 Venting

.1 Install air intake and exhaust venting system per manufacturer’s recommendations and state/provincial codes.

.2 Components shall comply with requirements in Section 23 51 00 “Breechings, Chimneys and Stacks”.

3.3 DEMONSTRATION

.1 Engage a factory authorized service representative to train Owner’s maintenance personnel as specified below:

.1 Operate boiler, including accessories and controls, to demonstrate compliance with requirements.

.2 Train Owner’s maintenance personnel on procedures and schedules related to startup and shutdown, troubleshooting, servicing, and preventive maintenance.

.3 Review data in the maintenance manuals. Refer to Division 1 Section “Contract Closeout” AND “Operation and Maintenance Data”.

.4 Schedule training with Owner with at least 7 days advance notice.

3.4 COMMISSIONING

.1 Manufacturer to:

.1 Certify installation.

.2 Start up and commission installation.

.3 Carry out on-site performance verification tests.

.4 Demonstrate operation and maintenance.

.2 Provide Engineer at least 48 h notice prior to inspections, tests, and demonstrations. Submit written report of inspections and test results.

.3 Include for Manufacturer Boiler System startup and commissioning and Owner education. Allow for at least 2 seasonal site visits during the first year of operation in addition to initial Boiler System Startup to trouble shoot/verify Heating System operation.

END OF SECTION

PACKAGED ROOFTOP HVAC UNITS

PART 1 GENERAL

1.1 RELATED SECTIONS

.1 This section shall be read in conjunction with:

.1 Specification Section 20 05 01 - Mechanical General Requirements;

.2 All mechanical sections in Divisions 20, 21, 22, 23, and 25.

1.2 REFERENCES

.1 Air-Conditioning, Heating, and Refrigeration Institute (formerly ARI)

.1 ARI 210/240-2008, Performance Rating of Unitary Air-Conditioning and Air-Source Heat Pump Equipment.

.2 American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)

.1 ASHRAE 90.1-2016, Energy Standard for Buildings Except Low-Rise Residential Buildings.

.3 American Society for Testing and Materials International (ASTM)

.1 ASTM B117-18, Standard Practice for Operating Salt Spray (Fog) Apparatus

.4 Canadian Standards Association (CSA).

.5 UL BOCA National Building Code, Air Conditioners, Central Cooling.

1.3 SHOP DRAWINGS

.1 Submit shop drawings in accordance with Section 20 05 01 - Mechanical General Requirements.

.2 Indicate:

.1 Equipment, piping, and connections, together with valves, strainers, control assemblies, thermostatic controls, auxiliaries and hardware, and recommended ancillaries which are mounted, wired and piped ready for final connection to building system, its size and recommended bypass connections.

.2 Piping, valves, fitting shipped loose showing final location in assembly.

.3 Control equipment shipped loose, showing final location in assembly.

.4 Complete internal wiring and any external panel wiring, both as schematics and as actually assembled.

.5 Dimensions, internal and external construction details, recommended method of installation with proposed structural steel support, mounting

curb details, sizes and location of mounting bolt holes; include mass distribution drawings showing point loads.

.6 Detailed composite wiring diagrams for control systems showing factory installed wiring and equipment on packaged equipment or required for controlling devices or ancillaries, accessories, controllers.

.7 Fan performance curves.

.8 Details of vibration isolation.

.9 Estimate of sound levels to be expected across each individual octave band in dB referred to A rating.

.10 Type of refrigerant used.

1.4 MAINTENANCE DATA

.1 Provide maintenance data for incorporation into manual specified in Section 20 05 01 - Mechanical General Requirements.

.2 Indicate:

.1 Brief description of unit, indexed, with details of function, operation, control, and service for each component.

.3 Manufacturer's installation instructions shall govern and unless otherwise noted, operation, maintenance and service of items. Include names and addresses of spare part suppliers.

.4 Include following:

.1 Provide for each unit, manufacturer's name, type, year, number of units, and capacity.

PART 2 PRODUCTS

2.1 AIR HANDLING UNIT (AHU-1):

.1 General:

.1 Roof mounted, hydronic heat air handling unit with remote condensing unit bearing labels of CSA, CGA, FM, UL and ULC.

.2 Unit to be certified to Class I Division II, Group C and D, T3 area.

.3 Unit shall comply with ASHRAE 90.1.

.4 Coordinate unit controls with Section 13832 - Controls.

.5 Performance as per schedule on drawings.

.2 Summary:

.1 The contractor shall furnish and install package rooftop units as shown and scheduled on the contract documents. The units shall be installed in accordance with this specification and perform at the specified conditions as scheduled.

.2 Acceptable materials:

.1 Southampton Industrial & Aaon

.2 Haakon

.3 General Unit Description:

.1 Units furnished and installed shall be combination gas heating/electric cooling packaged rooftops as scheduled on contract documents and these specifications. Units shall consist of insulated weather tight casing with compressors, air cooled condenser coil, condenser fans, evaporator coil, return air filters, supply motors and drives, gas-fired heating section, 100% modulating economizer and unit controls.

.2 Unit(s) shall be 100% factory run tested and fully charged with R-410a.

.3 Unit(s) shall have labels, decals, and/or tags to aid in the service of the unit and indicate caution areas.

.4 Capacity: Reference schedule on drawing.

.4 Unit Casing:

.1 Cabinet: Galvanized steel, phosphatized, and finished with an air-dry paint coating with removable access panels, 16 ga satin coat construction with 2" x 3 lb/ft3 density mineral wool insulation and 22 ga galvanized solid liner.

.2 Structural: 6-inch structural C-channel with 4" x 3 lb/ft3 density mineral wool insulation, 22 ga galvanized liner and removable lifting lugs. 14 ga hot rolled steel floor with epoxy coating. Structural members shall be 16 gauge with access doors.

.3 Unit's cabinet surface shall be tested 500 hours in salt spray test in compliance with ASTM B117.

.4 Cabinet construction shall allow for all service/maintenance from one side of the unit.

.5 Cabinet top cover shall be one piece construction or where seams exits, it shall be double hemmed and gasket sealed.

.6 Access Panels: Water and air tight panels with handles shall provide access to filters, heating section, return air section, supply air fan section, evaporator coil section, and unit control section.

.7 Insulation: Provide ½ inch thick coated fiberglass insulation on all exterior panels in contact with the return and conditioned air stream.

.5 Air Filters:

.1 Air Filters: Factory installed filters shall mount integral within the unit and shall be accessible thru access panels. One inch is standard. Two inch thick glass fibre disposable media filters shall be provided. 2-inch MERV 8 pre filter section with galvanized filter track.

.6 Fans and Motors:

.1 Plenum mounted supply and return fans, direct drive, with IEEE841 TEFC motors.

.2 Fans to be isolated with 1" spring isolators.

.3 Provide a unit mounted disconnect.

.7 Heating Section:

.1 0.0075" thick aluminum fin, 5/8" OD, 0.020" copper tube, suited for use with 50% propylene glycol heating, 16 ga galvanized steel casing.

.8 Electrical and Controls:

.1 575/3/60 power supply for main power supply. Unit to have single power supply.

.2 NEMA 3R, non-fused disconnect on main power supply (5 kA SCCR)

.3 Power wiring run in rigid aluminum conduit with XP fittings

.4 Control wiring run in rigid aluminum conduit with XP fittings

.5 Local Allen Bradley controller with IP/Ethernet capabilities

.6 Unit on/off switch

.7 Stepdown transformer for controls

.8 The following end devices are supplied and installed at the factory and wired to terminal strip:

.1 Outdoor air damper modulating actuator

.2 Return air damper modulating actuator

.3 Outdoor air temperature sensor

.4 Return air temperature sensor

.5 Mixed air temperature sensor

.6 Discharge air temperature sensor

.7 Filter monitoring - Differential pressure gauge on pre-filter section

.8 Filter monitoring - Differential pressure switch on pre-filter section

2.2 CONDENSING UNIT:

.1 General:

.1 Unit to be supplied with reversing valve, allowing for operation in heat pump mode.

.2 Housed service compartment for unit compressors and controls.

.3 Factory supplied and labeled split system copper stub outs with shut off valves.

.4 Refrigerant circuits contain automatic low pressure and manual reset high pressure safety cutouts, suction and liquid line Schrader valves, and a factory holding charge of refrigerant.

.5 Scroll compressor technology: two, four, five, or six cooling stages for enhanced energy efficiency and precise temperature control.

.6 Cabinet is constructed of heavy gauge galvanized steel with corrosion resistant paint that surpasses a 2,500 hour salt spray test.

.7 Rigid base design with forklift slots (2-25 and 30 tons) and lifting lugs (9-60 tons) provides easy handling at the job site.

.8 Unit specific color-coded point-to-point wiring diagrams are provided and are laminated and permanently affixed inside the control compartment.

.9 24V control circuit transformer to prevent exceeding the capacity of the air handling unit's control circuit transformer.

.10 Performance as per schedule on drawings.

.2 Accessible Cabinet Doors:

.1 Access doors with full length stainless steel piano hinges and quarter-turn, lockable handles provide improved reliability and easier serviceability over single point hinges.

.3 Condensing Coils:

.1 Microchannel condenser coils are durable, more efficient, lighter, and use less refrigerant than traditional fin and tube condenser coils.

.4 Compressors and Controls

.1 Compressors and controls are isolated from the condenser airflow and are included in the control compartment for easy service and maintenance.

.5 Service Equipment

.1 Factory wired convenience outlet permits the use of the outlet while power to the unit is shut off for easy servicing.

2.3 PACKAGED AIR HANDLING UNITS

.1 General Description

.1 Packaged rooftop unit shall include compressors, evaporator coils, filters, supply fans, dampers, air-cooled condenser coils, condenser fans, reheat coil, gas heaters, exhaust fans, energy recovery wheels, and unit controls.

.2 Unit shall be factory assembled and tested including leak testing of the DX coils, pressure testing of the refrigeration circuit, and run testing of the completed unit. Run test report shall be supplied with the unit in the service compartment's literature pocket.

.3 Unit shall have decals and tags to indicate lifting and rigging, service areas and caution areas for safety and to assist service personnel.

.4 Unit components shall be labeled, including refrigeration system components, and electrical and controls components.

.5 Estimated sound power levels (dB) shall be shown on the unit ratings sheet.

.6 Installation, Operation, and Maintenance manual shall be supplied within the unit.

.7 Laminated color-coded wiring diagram shall match factory installed wiring and shall be affixed to the interior of the control compartment's hinged access door.

.8 Unit nameplate shall be provided in two locations on the unit, affixed to the exterior of the unit and affixed to the interior of the control compartment's hinged access door.

.2 Construction

.1 All cabinet walls, access doors, and roof shall be fabricated of double wall, impact resistant, rigid polyurethane foam panels.

.2 Unit insulation shall have a minimum thermal resistance R-value of 13. Foam insulation shall have a minimum density of 2 pounds/cubic foot and shall be tested in accordance with ASTM D1929-11 for a minimum flash ignition temperature of 610°F.

.3 Unit construction shall be double wall with G90 galvanized steel on both sides and a thermal break. Double wall construction with a thermal break prevents moisture accumulation on the insulation, provides a cleanable interior, reduces heat transfer through the panel, and prevents exterior condensation on the panel.

.4 Unit shall be designed to reduce air leakage and infiltration through the cabinet. Cabinet leakage shall not exceed 1% of total airflow when tested at 3 times the minimum external static pressure provided in AHRI Standard 210/240. Panel deflection shall not exceed L/240 ratio at 125% of design static pressure, at a maximum 8 inches of positive or negative static pressure, to reduce air leakage. Deflection shall be measured at the midpoint of the panel height and width. Continuous sealing shall be included between panels and between access doors and openings to reduce air leakage. Piping and electrical conduit through cabinet panels shall include sealing to reduce air leakage.

.5 Roof of the air tunnel shall be sloped to provide complete drainage. Cabinet shall have rain break overhangs above access doors.

.6 Access to filters, dampers, cooling coils, reheat coil, heaters, energy recovery wheels, compressors, and electrical and controls components shall be through hinged access doors with quarter turn, zinc cast, lockable handles. Full length stainless steel piano hinges shall be included on the doors.

.7 Exterior paint finish shall be capable of withstanding at least 2,500 hours, with no visible corrosive effects, when tested in a salt spray and fog atmosphere in accordance with ASTM B 117-95 test procedure.

.8 Units with cooling coils shall include double sloped 304 stainless steel drain pans.

.9 Unit shall be provided with base discharge and return air openings. All openings through the base pan of the unit shall have upturned flanges of at least 1/2 inch in height around the opening.

.10 Unit shall include factory installed, painted galvanized steel condenser coil guards on the face of the condenser coil.

.3 Electrical

.1 Unit shall be provided with standard power block for connecting power to the unit.

.2 Unit shall have a 5kAIC SCCR.

.3 Unit shall be provided with a factory installed and field wired 115V, 20 amp GFI outlet in the unit control panel.

.4 Unit shall be provided with phase and brown out protection which shuts down all motors in the unit if the electrical phases are more than 10% out of balance on voltage, the voltage is more than 10% under design voltage or on phase reversal.

.4 Supply Fans

.1 Unit shall include direct drive, unhoused, backward curved, plenum supply fans.

.2 Blowers and motors shall be dynamically balance and mounted on rubber isolators.

.3 Motors shall include shaft grounding.

.5 Exhaust Fans

.1 Exhaust dampers shall be sized for 100% relief.

.2 Fans and motors shall be dynamically balanced.

.3 Unit shall include barometric relief dampers.

.4 Motors shall be premium efficiency ODP with ball bearings rated for 200,000 hours service with external lubrication points.

.5 Access to exhaust fans shall be through double wall, hinged access doors with quarter turn lockable handles.

.6 Unit shall include belt driven, unhoused, backward curved, plenum exhaust fans.

.7 Variable frequency drives shall be factory wired and mounted in the unit. Fan motors shall be premium efficiency.

.8 Motor shall include shaft grounding.

.9 Motor shall include shaft grounding.

.6 Cooling Coils

.1 Evaporator Coils

.1 Coils shall be designed for use with R-410A refrigerant and constructed of copper tubes with aluminum fins mechanically bonded to the tubes and galvanized steel end casings. Fin design shall be sine wave rippled.

.2 Coil shall be standard capacity.

.3 Coils shall be hydrogen or helium leak tested.

.4 Coils shall be furnished with factory installed expansion valves.

.7 Refrigeration System

.1 Unit shall be factory charged with R-410A refrigerant.

.2 Compressors shall be scroll type with thermal overload protection and carry a 5 year non-prorated warranty, from the date of original equipment shipment from the factory.

.3 Compressors shall be mounted in an isolated service compartment which can be accessed without affecting unit operation. Lockable hinged compressor access doors shall be fabricated of double wall, rigid polyurethane foam injected panels to prevent the transmission of noise outside the cabinet.

.4 Compressors shall be isolated from the base pan with the compressor manufacturer's recommended rubber vibration isolators, to reduce any transmission of noise from the compressors into the building area.

.5 Each refrigeration circuit shall be equipped with expansion valve type refrigerant flow control.

.6 Each refrigeration circuit shall be equipped with automatic reset low pressure and manual reset high pressure refrigerant safety controls, Schrader type service fittings on both the high pressure and low pressure sides and a factory installed liquid line filter driers.

.7 Unit shall include a variable capacity scroll compressor on the refrigeration circuit which shall be capable of modulation from 10-100% of its capacity.

.8 Refrigeration circuit shall be provided with hot gas reheat coil, modulating valves, electronic controller, supply air temperature sensor and a control signal terminal which allow the unit to have a dehumidification mode of operation, which includes supply air temperature control to prevent supply air temperature swings and overcooling of the space.

.9 Unit shall be configured as an air-source heat pump. Refrigeration circuit shall be equipped with a factory installed liquid line filter drier with check valve, reversing valve, accumulator, and expansion valves on both the indoor and outdoor coils. Reversing valve shall energize during the heat pump cooling mode of operation.

.10 Refrigeration circuit shall be equipped with a liquid line sight glass.

.11 Refrigeration circuit shall be equipped with suction and discharge compressor isolation valves.

.12 The factory installed controls shall include a 3 minute off delay timer to prevent compressor short cycling. The controls shall also include an adjustable, 20 second delay timer for each additional

capacity stage to prevent multiple capacity stages from starting simultaneously and adjustable compressor lock out.

.8 Condensers

.1 Air-Cooled Condenser

.1 Condenser fans shall be a vertical discharge, axial flow, direct drive fans.

.2 Heat pump outdoor coil shall be constructed of copper tubes with aluminum fins mechanically bonded to the tubes and aluminum end casings. Fin design shall be sine wave rippled.

.3 Coils shall be designed for a minimum of 10°F of refrigerant sub-cooling.

.4 Coils shall be hydrogen or helium leak tested.

.5 Condenser fans shall be high efficiency electrically commutated motor driven with factory installed head pressure control module. Condenser airflow shall continuously modulate based on head pressure and cooling operation shall be allowed down to 35°F with adjustable compressor lockout.

.9 Hydronic Heating

.1 Aluminum fin, copper tube heating coils, designed for a discharge temperature of 95°F.

.10 Filters

.1 Unit shall include 4 inch thick, pleated panel filters with an ASHRAE MERV rating of 13, upstream of the cooling coil. Unit shall also include 2 inch thick, pleated panel pre filters with an ASHRAE MERV rating of 8, upstream of the 4 inch standard filters.

.2 Unit shall include 1 inch aluminum mesh pre filters upstream of the outside air opening.

.11 Outside Air/Economizer

.1 Unit shall include 0-100% economizer consisting of a motor operated outside air damper and return air damper assembly constructed of extruded aluminum, hollow core, airfoil blades with rubber edge seals and aluminum end seals. Damper blades shall be gear driven and designed to have no more than 20 cfm of leakage per sq ft. at 4 in. w.g. air pressure differential across the damper. Low leakage dampers shall be Class 2 AMCA certified, in accordance with AMCA Standard 511. Damper assembly shall be controlled by spring return enthalpy activated fully modulating actuator. Unit shall include outside air opening bird screen, outside air hood, and relief dampers.

.12 Energy Recovery

.1 Unit shall contain a factory mounted and tested energy recovery wheel. The energy recovery wheel shall be mounted in a rigid

frame containing the wheel drive motor, drive belt, wheel seals and bearings. Frame shall slide out for service and removal from the cabinet.

.2 The energy recovery component shall incorporate a rotary wheel in an insulated cassette frame complete with seals, drive motor and drive belt.

.3 The energy recovery cassette shall be an Underwriters Laboratories Recognized Component for electrical and fire safety. The wheel drive motor shall be an Underwriters Laboratory Recognized Component and shall be mounted in the cassette frame and supplied with a service connector or junction box. Thermal performance shall be certified by the manufacturer in accordance with ASHRAE Standard 84, Method of Testing Air-to-Air Heat Exchangers and AHRI Standard 1060, Rating Air-to-Air Energy Recovery Ventilation Equipment. Cassettes shall be listed in the AHRI Certified Products.

.4 Hinged service access doors shall allow access to the wheel.

.1 Polymer Energy Recovery Wheels

.1 Shall be provided with removable energy transfer matrix. Wheel frame construction shall be a welded hub, spoke and rim assembly of stainless, plated and/or coated steel and shall be self-supporting without matrix segments in place. Segments shall be removable without the use of tools to facilitate maintenance and cleaning. Wheel bearings shall be selected to provide an L-10 life in excess of 400,000 hours. Rim shall be continuous rolled stainless steel and the wheel shall be connected to the shaft by means of taper locks.

.2 All diameter and perimeter seals shall be provided as part of the cassette assembly and shall be factory set. Drive belts of stretch urethane shall be provided for wheel rim drive.

.3 Polymer Energy recovery wheel cassette shall carry a 5 year non-prorated warranty, from the date of original equipment shipment from the factory. The first 12 months from the date of equipment startup, or 18 months from the date of original equipment shipment from the factory, whichever is less, shall be covered under the standard AAON limited parts warranty. The remaining period of the warranty shall be covered by Airxchange. The 5-year warranty applies to all parts and components of the cassette, with the exception of the motor, which shall carry an 18 month warranty. Warranty shall cover material and workmanship that prove defective, within the specified warranty period,

provided the Airxchange written instructions for installation, operation and maintenance have been followed. Warranty excludes parts associated with routine maintenance, such as belts. Refer to the Airxchange Energy Recovery Cassette Limited Warranty Certificate.

.4 Total energy recovery wheels shall be coated with silica gel desiccant permanently bonded by a process without the use of binders or adhesives, which may degrade desiccant performance. The substrate shall be lightweight polymer and shall not degrade nor require additional coatings for application in marine or coastal environments. Coated segments shall be washable with detergent or alkaline coil cleaner and water. Desiccant shall not dissolve nor deliquesce in the presence of water or high humidity.

.13 Controls

.1 Factory Installed and Factory Provided Controller

.1 Unit controller shall be capable of controlling all features and options of the unit. Controller shall be factory installed in the unit controls compartment and factory tested. Controller shall be capable of standalone operation with unit configuration, setpoint adjustment, sensor status viewing, unit alarm viewing, and occupancy scheduling available without dependence on a building management system.

.2 Controller shall have an onboard clock and calendar functions that allow for occupancy scheduling.

.3 Controller shall include non-volatile memory to retain all programmed values without the use of a battery, in the event of a power failure.

.4 Variable Air Volume Controller

.1 Unit shall utilize a variable capacity compressor system and a variable speed supply fan system to modulate cooling and airflow as required to meet space temperature cooling loads and to save operating energy. Supply fan speed shall modulate based on supply air duct static pressure. Cooling capacity shall modulate based on supply air temperature.

.2 With modulating hot gas reheat, unit shall modulate cooling and hot gas reheat as efficiently as possible, to meet space humidity loads and prevent supply air temperature swings and overcooling of the space.

.5 Unit configuration, setpoint adjustment, sensor status viewing, unit alarm viewing, and occupancy scheduling shall be accomplished with connection to interface module with LCD screen and input keypad, interface module with touch screen, or with connection to PC with free configuration software. Controller shall be capable of connection with other factory installed and factory provided unit controllers with individual unit configuration, setpoint adjustment, sensor status viewing, and occupancy scheduling available from a single unit. Connection between unit controllers shall be with a modular cable. Controller shall be capable of communicating and integrating with a LonWorks or BACnet network.

2.4 ROOF CURBS

.1 Rooftop equipment seismic curb 600 mm high.

.2 The frame must provide continuous support for the equipment and must resist wind and seismic forces.

.3 All hardware must be plated with a rust resistant finish.

.4 Curb waterproofing shall consist of a continuous galvanized counter flashing nailed over the curbs waterproofing.

.5 Curbs shall have provision for 50 mm of insulation.

.6 The rooftop unit must be solidly fastened to the curb, and the curb anchored to the roof structure.

.7 Roof curb construction to conform to requirements of National Roofing Contractors Association (NRCA).

.8 Provide seismic restraint calculations from P.Eng. For all equipment connections to the structure.

2.5 ACCESSORIES

.1 Powered convenience outlet.

.2 Clogged filter switch.

.3 Fan failure switch.

.4 Hot gas reheat.

PART 3 EXECUTION

3.1 INSTALLATION

.1 Install as per manufacturers' instructions on roof curbs provided by manufacturer.

.2 Manufacturer to certify installation, supervise start-up and commission unit.

END OF SECTION

VARIABLE REFRIGERANT FLOW (VRF) SYSTEM – AIR COOLED

PART 1 GENERAL

1.1 RELATED SECTIONS

.1 This section shall be read in conjunction with:

.1 Specification Section 20 05 01 - Mechanical General Requirements;

.2 All mechanical sections in Divisions 20, 21, 22, 23, and 25.

1.2 REFERENCES

.1 Canadian Standards Association (CSA)

.1 CSA B52-18, Mechanical Refrigeration Code.

1.3 SYSTEM DESCRIPTION

.1 Heat Pump/cooling only:

.1 The VRF (Variable Refrigerant Flow) system shall be a heat pump. The heat pump VRF system shall consist of an outdoor unit, indoor units and controls by the equipment manufacturer.

.2 The VRF (Variable Refrigerant Flow) system shall be a cooling only unit. The heat pump VRF system shall consist of an outdoor unit with low ambient kit & baffles, indoor units, and controls by the equipment manufacturer.

PART 2 PRODUCTS

2.1 INDOOR UNITS

.1 General:

.1 The indoor unit shall be factory assembled, wired and run tested.

.2 The indoor unit shall be factory wired and piped with its own electronic expansion device, control circuit board, fan and motor.

.3 The indoor unit shall have

.1 self-diagnostic function

.2 auto restart function

.4 Indoor unit refrigerant circuit shall be filled with a dry nitrogen gas charge from the factory.

.5 Return air shall be filtered with a factory supplied removable, washable filter.

.6 The indoor unit coil shall be nonferrous with louvred fins on copper tubing for maximum efficiency.

.7 The tubing shall have inner grooves for high efficiency heat exchange.

.8 The coils shall be pressure tested at the factory.

.9 A condensate drain pan shall be factory installed below the coil.

.10 All refrigerant lines to the indoor units shall be field insulated.

.11 The indoor unit electrical power shall be 208/230V, 1-phase, 60 Hz.

.12 The indoor unit shall be capable of operation within voltage limits of ±10% rated voltage.

.13 Unit shall use controls provided by the manufacturer to perform all functions necessary to operate the system effectively and efficiently and communicate with the outdoor unit.

.2 Programmable Remote Controller

.1 Wired 7-day programmable remote controller, supplied by the VRF system manufacturer:

.1 Controls one or more indoor units

.2 The 7-Day programmable controller allows control of indoor unit operation mode, fan speed and temperature setpoint. Programmable schedule allows for automatic energizing and shutdown of the indoor unit up to twice a day with set point control.

.3 Features:

.1 LED indicator for operating status

.2 Backlit

.3 Unit Operation - On/Off

.4 Temperature control (°F or °C)

.5 Instantaneous room temperature display

.6 Heating range (60-86 °F)

.7 Mode selection - Fan/Heat/Cool/Auto

.8 Fan speed- Low/Med/High/Power/Auto

.9 Clock

.10 Timer (Simple, Sleep,On/Off, Weekly, Holiday)

.11 7-day programmable schedule with setpoint control

.12 Discharge vanes- Auto Swing/Fixed

.13 Child lock Installation: as per manufacturer's instructions

.14 Error code displaying during unit or system malfunction

.15 Power failure compensation (3 hours maximum)

.16 Function setting for auxiliary heat

.3 Wall-mounted Indoor Unit:

.1 General:

.1 Wall-mounted indoor units shall protrude from the wall no more than 175 mm (7 inches).

.2 Unit Cabinet:

.1 The unit casing shall have a pearl white finish.

.2 Multi directional refrigerant piping up to four (4) directions shall be standard.

.3 Multi directional drain piping up to two (2) directions shall be standard.

.4 The indoor unit shall attach to a separate back plate that secures the unit to the wall.

.5 Indoor unit casing shall have integral sensor to read wireless handheld remote controller as standard from the factory.

.3 Fan:

.1 The indoor fan shall be an assembly with one cross flow fan direct driven by a single motor.

.2 The indoor fan shall be statically and dynamically balanced.

.3 Motor shall have permanently lubricated bearings.

.4 In cooling mode, the indoor fan shall have the following settings; Low, Med, High, Power Cool, and Auto.

.5 In heating mode, the indoor fan shall have the following settings; Low, Med, High, and Auto.

.6 The fan shall have a selectable Auto fan setting that will adjust the fan speed based on the difference between controller set-point and space temperature.

.7 A manually adjustable guide vane shall be factory installed allowing the ability to control the direction of airflow from side to side for units 15 MBh and below.

.8 A motorized sweeping guide vane shall be factory installed allowing the ability to control the direction of airflow from side to side for units 18 MBh and above.

.9 A motorized air sweep louvre shall provide an automatic change in airflow by directing the air up and down to provide uniform air distribution.

2.2 OUTDOOR UNIT

.1 .1 General:

.1 The outdoor unit shall be used with VRF components by the same manufacturer consisting of the outdoor unit, heat pump, indoor units; factory designed and supplied Y-branches, and controls.

.2 System components shall be of the same manufacturer or as recommended by the manufacturer of the VRF equipment.

.3 Unit control boards shall perform all functions required to effectively and efficiently operate the VRF system and communicate in a daisy chain configuration from outdoor unit to heat recovery and indoor units via RS485.

.4 The outdoor unit shall be completely factory assembled, piped and wired. Dual and triple frame outdoor units will be field piped with factory designed and supplied Y-branch kits to manifold them together into a single refrigerant circuit.

.5 Each outdoor unit shall be run tested at the factory.

.6 The sum of connected nominal capacity of all indoor air handlers shall range from 50% to 130% of outdoor unit nominal capacity to ensure the VRF system will have sufficient capacity to handle the building space loads at peak design.

.7 Outdoor unit shall have a tested sound rating no higher than 58 dB (A) per outdoor unit frame tested per ISO1996.

.8 All refrigerant lines from the outdoor unit to the heat recovery unit and from the heat recovery unit to the indoor units shall be field insulated.

.9 The outdoor unit shall have an accumulator. The outdoor unit shall have a high pressure safety switch.

.10 The outdoor unit shall have over-current protection.

.11 The outdoor unit shall use a double spiral tube subcooling heat exchanger.

.12 The outdoor unit shall have the ability to operate with an elevation difference of up to 110 m (360 ft.) above or below the indoor units.

.13 The outdoor unit shall allow up to a total equivalent refrigerant piping length of 1000 m (3280 ft.).

.14 The maximum piping length from outdoor unit to indoor unit shall be up to 200 m (656 ft.) or 225 equivalent metres (738 equivalent feet) without traps.

.15 The outdoor unit shall be capable of operating in heating only mode down to -20°C (-4°F) and up to 15°C (60°F) ambient wet bulb without additional low ambient controls.

.16 The outdoor unit shall be capable of operating in cooling only mode down to -5°C (23°F) and up to 46°C (115°F) ambient dry bulb.

.17 During heating based simultaneous mode the system shall be capable of operating at outdoor ambient temperatures down to -10°C (14°F) (WB).

.18 During cooling based simultaneous mode the system shall be capable of operating with the ambient temperatures down to -10°C (14°F)(DB).

.19 The outdoor unit shall have a centrifugal oil separator for each compressor and controls to ensure sufficient oil supply is maintained for the compressor.

.20 Shall use R410A refrigerant.

.2 Frame:

.1 Shall be constructed with galvanized steel, bonderized and be finished with powder coat baked enamel paint.

.3 Compressor:

.1 All 3 phase outdoor unit frames smaller than 23 kW (80 MBh) shall be equipped with one hermetic digitally controlled inverter driven scroll compressor.

.2 All 3 phase outdoor unit frames greater than 23 kW (80 MBh nominal capacity shall be equipped with one hermetic digitally controlled inverter driven scroll compressor and one hermetic constant speed scroll compressor.

.3 A 60 Watt crankcase heater shall be factory mounted on all compressors.

.4 The outdoor unit compressor shall have an inverter to modulate capacity. The frequency of the inverter compressor shall be variable from 20 to 120 Hz and modulate in 1 Hz increments.

.5 The compressor shall be equipped with an internal thermal overload.

.6 The compressor shall be mounted to avoid the transmission of vibration.

.4 Fan:

.1 All outdoor unit frames smaller than 23 kW (80 MBh) shall be furnished with one direct drive, variable speed propeller type fan.

.2 All outdoor unit frames greater than 23 kW (80 MBh) shall be furnished with two direct drives, variable speed propeller type fans.

.3 All fan motors shall have inherent protection, have permanently lubricated bearings, and be variable speed with a maximum speed up to 1050 rpm.

.4 All fans shall be provided with a raised guard to limit contact with moving parts.

.5 The outdoor unit shall have vertical discharge airflow.

.6 Outdoor unit shall have a static pressure capability up to 80 Pa (0.32 inches wg) with DIP switch to accommodate additional external static pressure.

.5 Coil:

.1 The outdoor coil shall be of nonferrous construction with louvred fins on copper tubing.

.2 The coil fins shall have a factory applied corrosion resistant material with hydrophilic coating.

.3 The coil shall be protected with an integral metal guard.

.4 Refrigerant flow from the outdoor unit shall be controlled by means of a digitally controlled inverter driven scroll compressor.

.6 Electrical:

.1 The outdoor unit electrical power shall be 208 V, 60 Hz, 3 phase.

.2 The outdoor unit shall be capable of operation within voltage limits of ±10% rated voltage.

.3 The outdoor unit shall be controlled by integral microprocessors.

.4 The control circuit between the indoor units, heat recovery box and the outdoor unit shall be 24VDC completed using a 2-conductor, stranded, and shielded cable for the RS485 daisy chain communication.

2.3 SYSTEM CONTROLLER

.1 Controller supplied by the VRF system manufacturer.

.2 Controls up to 64 indoor units and expandable to 128 indoor units.

.3 Features:

.1 Mode control, temperature control etc. and monitoring of up to 64 unit (A/C & Ventilation) by Zone/Group/Unit.

.2 Monitoring the operating status by Icon or List View.

.3 Individual indoor Function control locking; administrator only can change the functions: Temperature, Mode, Fan Speed.

.4 Temperature Setting Range restriction on individual controller.

.5 In schedule setup administrator can schedule the indoor Operating as well as the function locking.

.6 Operating and error history is saved in controller.

.7 Automatic control function, Auto-changeover and temperature limit,

.8 Selection of the controller displays language (English, French)

.9 Emergency Stop Interlocking function.

.10 Monitoring: report of each indoor's operation time & operation ratio.

.11 Temperature Limit control

.12 Web Access Function. Web Access level is distinguished to 2 Level: Administrator and User.

.13 E-mail function: error occurs for some fixed time resulting in automatic e-mail will to be sent to registered e-mail addresses.

.4 Functions:

.1 Individual and integrated operation & monitoring.

.2 Operating condition of the air conditioner.

.3 Operating mode.

.4 Fan level.

.5 Throw direction.

.6 Lock.

.7 Set temperature.

.8 175 mm (7 in.) touchscreen LCD.

.9 Stylus pen with storage slot.

.10 Binary system shut down input contacts.

.11 Operation -On/Off Display- On/Off.

.12 Display backlight - On/Off.

.13 Customize names- zone/group/unit.
.14 Mode select- Auto/Cool/Dehumidification/Heat/Fan Only.
.15 Setpoint control- All/Group/Unit/Device.
.16 Local controller lock function -All/Mode/Temp/Fan.
.17 Grouped local unit controllers- Lock/Unlock.
.18 Adjustable temperature range restriction.
.19 Fan speed- Auto/Low/Med/High/Power1

2.4 POWER DISTRIBUTION INDICATOR

.1 Power Distribution Indicator supplied by the VRF system manufacturer: able to indicate each indoor unit's accumulated total power consumption: indoor unit's power consumption plus the afferent outdoor's unit logic proportional power consumption.

.1 Power supply: DC 9V power adapter.
.2 Connectible units: 1 outdoor unit per electric power distribution.
.3 Operation range -55°C to 60°C (-68°F to 140°F).
.4 Features:
  .1 One monitor per outdoor unit.
  .2 Up to 48 indoor units per monitor.
  .3 Energy consumption displayed in watt-hours.
  .4 Power consumption display modes (kWh).
  .5 Current power usage.
  .6 Standby (unit off) usage
  .7 Custom period usage.
.5 Installation: as per manufacturer's instructions.
.6 Functions:
  .1 Accumulation of total power consumption.
  .2 Indication of current power in use.
  .3 Indication of accumulated power for period.
  .4 Indication of standby power (option setting).

2.5 ACCEPTABLE MANUFACTUERES

.1 LG, Mitsubishi, or approved alternates.

PART 3 EXECUTION

3.1 GENERAL

.1 Install as indicated, to manufacturers' installation instructions.

.2 Install as per CSA B52.

.3 Submit pressure test to Engineer.

.4 Manufacturer to certify installation and submit certification to Engineer for record.

.5 Mount programmable controls and extend 24V wiring to condensing/fan coil coil unit. Div. 16 to provide conduit & pull string.

3.2 EQUIPMENT PREPARATION

.1 Provide services of manufacturer's field engineer to set and adjust equipment for operation as specified.

END OF SECTION

DIVISION 25 INDEX

CONTROL PANELS

PART 1 GENERAL

1.1 SUMMARY

.1 This Section includes:

.1 Supply of Control Panels by Division 25.

.2 Installation of Control Panels by Division 26, including provision of all hardware, wiring and interconnection as indicated on drawings and described in the specifications.

1.2 RELATED REQUIREMENTS

.1 Section 25 05 02 – SCADA Configuration

.2 Section 25 05 05 – Control Panel Configuration

.3 Section 26 05 00 – Common Work Requirements, Electrical

.4 Section 26 05 21 – Wires and Cables, 0-1000V

.5 Section 26 29 03 – Control Devices

.6 Section 26 29 20 – Variable Frequency Drives

.7 Section 26 90 00 – Wiring of Equipment Supplied by Others

1.3 REFERENCE STANDARDS

.1 Canadian Standards Association (CSA International)

.1 CSA C22.2 No. 38-14, Thermoset-insulated Wires and Cables

.2 CSA C22.2 No. 127-15, Equipment and Lead Wires

.3 CSA C22.2 No. 214-17, Communications Cables

.4 CSA C22.2 No. 239-17, Control and Instrumentation Cables

1.4 SUBMITTALS

.1 Make submittals in accordance with Section 01 33 00 – Submittals and 01 78 00 – Closeout Submittals.

.2 Submit for review:

.1 Equipment list and systems manufacturers within ten (10) working days after award of contract.

.3 Quality Control:

.1

.1 All new equipment and assemblies of equipment shall be fabricated in a CSA approved panel shop. Permanent CSA labels shall be attached to each assembly and all equipment supplied.

.2 All field modifications to existing equipment shall be completed by a CSA approved panel shop. Field Permanent CSA labels shall be attached to each assembly and all equipment supplied.

.3 Provide equipment and material from manufacturer's regular production, CSA certified, manufactured to standard quoted plus additional specified requirements.

.4 Where CSA certified equipment is not available, submit such equipment to inspection authorities for special inspection and approval before delivery to site.

.5 Submit proof of compliance to specified standards with shop drawings and product data in accordance. Label or listing of specified organization is acceptable evidence.

.6 In lieu of such evidence, submit certificate from testing organization, approved by third party Engineer registered in Canada, certifying that item was tested in accordance with their test methods and that item conforms to their standard/code.

.7 For materials, whose compliance with organizational standards/codes/ specifications is not regulated by an organization using its own listing or label as proof of compliance, furnish certificate stating that material complies with applicable referenced standard or specification.

.8 Permits and fees: in accordance with general conditions of contract.

1.5 MAINTENANCE DATA

.1 Provide CAD as-built panel drawings and wiring schematics for each panel.

1.6 SCOPE OF WORK

.1 Provision of shop assembled control panels in accordance with Contract Drawings. Panels shall be complete with all devices for a complete and operational system, including but not limited to the devices and features described in Part 2 – Products.

.2 Provision of PLC programming – see Specification 25 05 05 – Control Panel Configuration.

.3 Provision of SCADA configuration - see Specification 25 05 02 – SCADA Configuration.

.4 Provision of network administration services for WPCP “SCADA” and “INTERNET” networks until plant is fully commissioned.

PART 2 PRODUCTS

2.1 ENCLOSURES

.1 Enclosures shall be NEMA 12 with the following features:

.1 Grey finish with white removable backplane.

.2 Suitable for floor mounting c/w feet and wall fasteners at top.

.3 Provide 120% of panel space required for all devices.

2.2 PROGRAMMABLE LOGIC CONTROLLERS

.1 ControlLogix 5580, 1756-L82E 5MB Ethernet processor in accordance with Contract Drawings, for CP-300. I/O and components consisting of:

.1 Provide 2GB SD compact flash card for backup memory for each 5580 processors.

.2 Provide 20% spare I/O for each I/O type.

.3 Digital I/O to be 120VAC unless indicated otherwise.

.4 Prosoft Modbus COMM Module – MV156E-MCM required in CP-300 for interfacing to ION 7650 Power meter & Generator controller.

.5 Provide an extended depth terminal block housing (1756-TBE) for each ControlLogix I/O card with 36-pin terminal blocks.

.6 PLC power protection shall include CSA approved surge suppression and a UPS sufficient for panel load requirements for 20 minutes. UPS shall be located inside the PLC panel enclosure.

.7 All analog instrumentation connected to PLC shall be powered from a 24VDC power supply mounted in the PLC panel.

.1 Power supply to be connected to positive and negative terminal blocks for instrumentation power.

.2 The power supply shall have a minimum of 50% spare capacity.

.2 Allen Bradley CompactLogix 5370, 1769-L33ER 2MB dual Ethernet processor in accordance with Contract Drawings, for CP-100 and CP-400. I/O and components consisting of:

.1 Provide 1GB SD compact flash card for backup memory for each 5370 processor.

.2 Provide 20% spare I/O for each I/O type.

.3 Digital I/O to be 120VAC unless indicated otherwise.

.4 PLC power protection shall include CSA approved surge suppression and a UPS sufficient for panel load requirements for 20 minutes. UPS shall be located inside the PLC panel enclosure.

.5 All analog instrumentation connected to PLC shall be powered from a 24VDC power supply mounted in the PLC panel.

.1 Power supply to be connected to positive and negative terminal blocks for instrumentation power.

.2 The power supply shall have a minimum of 50% spare capacity.

2.3 TOUCHSCREEN OPERATOR INTERFACE TERMINAL (OIT)

.1 Door-mounted, 15", color, touch-screen, Ethernet-connected, 24VDC-powered HMI.

.2 HMI to be programmed for all I/O and control functions directly controlled by each panel PLC.

.3 Center height of HMI shall be 1525mm above finished grade when panel is installed.

.4 Standard of acceptance: Allen-Bradley Panel View Plus 7 Performance, model number 2711P-T15C22D9P, or approved equivalent.

2.4 ETHERNET SWITCHES

.1 Industrial-type Managed Ethernet Switches for physically separate "SCADA" and "INTERNET" networks:

.1 EtherNet/IP, DIN-rail mounted, 24 VDC power supply, operating temperature between 0- and 45-degrees C.

.2 Ethernet switches shall have 20% spare RJ45 ports, minimum 2.

.3 If required, fiber ports shall be SC type. Number of fiber ports as shown in Network Topology Drawing plus minimum 1 spare pair.

.4 Acceptable manufacturers: Phoenix Contact, Hirschmann, Cisco Stratix or approved equivalent.

2.5 WIRELESS ACCESS POINTS

.1 Industrial-type WLAN access point / client for USA & Canada, with two internal antennas for single-hole mounting, IP54 rating, WLAN 802.11 a/b/g/n, frequency: 2.4 GHz & 5 GHz.

.2 Connections:

.1 Power supply: 18-32 VDC

.2 RJ45: for LAN, web, http/https, Command Line Interface

.3 Operating modes: access point, client adapter, repeater

.4 Configuration: Web-based management, command line interface

.5 Security: 802.11i, WPA PSK (preshared key), WPA2, AES, TKIP, MAC filter, supports 802.1X/RADIUS

.6 Standard of acceptance: Phoenix Contact FL WLAN 1101, or approved equivalent.

2.6 FIBER-OPTIC PATCH PANEL

.1 Modular Industrial Patch Panel:

.1 DIN-rail mounted.

.2 6 x SC duplex adapter modules. One module for each incoming 6-pair fiber cable into the control panel.

.3 Strain relief cable glands on all incoming fiber bundle cables.

.2 Standard of acceptance: Hirschmann MIPP Fiber Splice Box, or approved equivalent.

2.7 TERMINAL BLOCKS

.1 Terminal blocks shall be DIN-rail mounted Phoenix Contact UK Series or approved equivalent.

.2 3-level terminal blocks with fuses for all analog I/O channels.

.3 2-level terminal blocks for all digital input channels.

.4 All terminal blocks shall be labelled.

.5 All wires terminated to terminal blocks shall have crimped ferrule lugs.

2.8 INTERPOSING RELAYS

.1 Provide interposing relays for all digital outputs, DIN mounted, with the following features:

.1 Indicating light.

.2 24VDC or 120VAC coil, as required by the PLC digital output voltage.

.3 2A, 120VAC contact, minimum.

2.9 WIRING

.1 All wiring to have tin-plated stranded copper conductors, minimum 19 strands.

.2 All wiring shall have 600V, thermosetting type insulation of one of the following CSA types:

.1 REW

.2 CL1251

.3 CL1503

.4 Or approved equivalent.

.3 Type TEW wire is not acceptable.

.4 Provide shielded-twisted-pair instrument cable from all analog channels to terminal blocks, including spare channels. Analog channels shall be fused at terminal block with fuse status indication.

.5 All common supply digital output channels shall be fused at the channel output block.

.6 All wires terminated to terminal blocks shall have crimped ferrule lugs.

.7 Ethernet cables patch cables shall be pre-manufactured CAT5e.

.8 Fiber optic cable patch cables shall be pre-manufactured OM2 50/125um duplex multimode cable, with SC type connectors.

2.10 WIRING LABELS

.1 Label all wires with the corresponding I/O designation (e.g. “I:2/07”). Label commons with corresponding uniquely named labels.

.2 Analog cables shall be labelled with their channel designation (e.g. I:1/02) on their jacket with the “+” or “-” wires individually labelled.

.3 All wiring labels shall be mechanically printed and shall be permanent wiring adhesive strips.

2.11 WIRING DUCT

.1 Wiring duct shall be:

.1 Manufactured of high impact self-extinguishing warp resistant PVC, grey in colour.

.2 Minimum size 50mm width X 75mm height.

.3 Provided with continuous covers and finger slots every 20mm on both sides along the entire length of the duct.

2.12 TRANSIENT VOLTAGE SURGE SUPPRESSOR

.1 Provide a CSA approved, DIN mounted, transient voltage surge suppressor. Surge suppressor shall include an auxiliary contact for fault indication connection to PLC input.

.2 Standard of acceptance: Phoenix Contact Type 2 Surge Arrester or approved equivalent.

2.13 UPS FAIL CONTACTOR

.1 Provide contactor with 4 power poles – 2 N.O., 2 N.C. screw terminals, and 1 N.C. aux. contact for alarm to PLC.

.2 Standard of acceptance: Allen Bradley Bulletin 100-C, or approved equivalent.

2.14 UNINTERRUPTIBLE POWER SUPPLY

.1 Provide one (1) Uninterruptible Power Supply for each of the shop manufactured PLC panel, with sufficient capacity to maintain operation of each panel for twenty (20) minutes minimum.

.2 UPS to be modular type with separate power pass module, transfer utility, lightning and surge protection, overload indicators, replace battery indicator, and user-replaceable hot-swap sealed batteries. UPS shall also have two (2) dry contact status contacts to be wired to each PLC in panel (Fault Status and On Battery Status).

.3 Standard of acceptance: Eaton 9PX series, or approved equivalent.

.4 CP-300 UPS load to include the following devices:

.1 Power metering unit in Main Switchboard

.2 Ground fault detection system in Main Switchboard

2.15 GROUND BUS

.1 Provide two (2) 10mm X 50mm X 150mm stand-off mounted ground bus with 32 drilled and tapped holes. One isolated ground busbar for 24VDC analog instrumentation and one power ground busbar for 120VAC devices.

.2 Separate #6 AWG insulated bond wire from instrumentation ground bus to electrical room ground bus to be provided by Div. 26.

2.16 UTILITY ITEMS

.1 LED working light wired to door switch.

.2 Door mounted (outside) laptop shelf. Shelf height shall be 1050mm above finished floor when panel is installed.

.3 Duplex convenience receptacle on enclosure backplane.

.4 Door mounted (outside) network port and laptop receptacle.

.5 Door mounted (inside) drawing pocket.

2.17 INTRINSIC SAFETY BARRIERS

.1 Provide isolated, DIN rail mounted, Intrinsically Safe Barriers for devices to be wired from each PLC panel to classified areas.

2.18 CIRCUIT BREAKERS

.1 Provide circuit breakers for each device being powered from control panel, sized as recommended by device manufacturer. Provide 20% spare circuit breakers.

PART 3 EXECUTION

3.1 INSTALLATION

.1 Install shop manufactured Control Panels as indicated by Division 26 and Contract Drawings.

.2 Terminate field wiring on terminal blocks as indicated and provide wiring labels to correspond with wire label to which the field wire is to be connected. All ends of the field wiring shall be labelled (i.e. at the field device, junction box and control panel). Typically, the wire label would consist of the input or output designation, e.g. I:12/07.

.3 Field wiring terminated to panel terminal blocks shall have crimped ferrule lugs.

.4 No wiring shall enter the control panel from the top of the enclosure.

.5 Electrical inspection of panel shall be carried out and completed prior to installation. Proof of all necessary certification will be provided by the Contractor to the Engineer at time of installation.

.6 Configuration of PLC application software by Section 25 05 05 Integrator.

3.2 IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 00 – Common Work Results – Electrical.

.2 Install size 5 nameplate indicating tag name, and circuit fed from.

3.3 COMMISSIONING

.1 Ensure noiseless ground-bus is mounted in PLC Panels and connected to building ground bus using separate #6AWG wire.

.2 Ensure cable shields and network grounds are connected to noiseless ground.

.3 Verify proper function of devices which receive power from control panels.

.4 Check motor rotations and configure variable frequency drive parameters.

.5 Stroke valves and verify limit switches if applicable.

.6 Calibrate analog inputs and outputs.

.7 Document and confirm digital input and output designations. i.e. open/close, on/off, up/down, in/out using PLC program.

.8 Tune process control loops

.9 Verify that all alarms are correctly delayed, set, acknowledged, and reset and that both the General Process Alarm to the Alarm Notification responds correctly.

END OF SECTION

PART 1 GENERAL

1.1 CONFIGURATION OF SCADA

.1 Supply of SCADA by Division 25. Division 26 to supply, install and provide all wiring and interconnection as indicated on drawings.

.2 The Contractor shall solicit the services of the prequalified System Integrator listed below to provide the SCADA work as defined in this Section.

.1 A.R.C. Integration Inc.
P.O. Box 161 Foxboro, ON
Attn: Dale MacDonald macdonald.d@arcintegration.ca
Cell: (613) 813-7805

1.2 RELATED SECTIONS

.1 Section 25 05 01 – Control Panels

Section 25 05 05 – Control Panel Configuration

1.3 SUBMITTALS

.1 Make submittals in accordance with Section 01 33 00 – Submittals and 01 78 00 – Closeout Submittals.

1.4 MAINTENANCE DATA

.1 Provide operation and maintenance data for SCADA system for incorporation into manual.

1.5 SCOPE OF WORK

.1 Provision of SCADA programming, configuration, development, and connectivity to support the installation, commissioning, and acceptance of the Wastewater Treatment Plant.

.2 The SCADA system will act as the Human Machine Interface (HMI) for all devices interfaced to the PLC's and controls.

.3 SCADA will provide the monitoring, controlling, alarming, logging, and reporting features required for effective operations.

.4 Configuration and programming of the door mounted displays in each cabinet. These touch screen displays will act as the Operator Interface Terminal (OIT) for

all devices interfaced to each PLC. These displays are to mimic the main SCADA screens.

.1 Provision sample screens to be approved by the Contract Administrator before implementation. The screens shall include, but not be limited to:

.2 Process Overview

.3 Device Control pop-ups

.4 Reports

.5 Alarm display and Summary

.6 Historical Trends

.7 Setup

.8 Detailed Process illustrations

.9 Hardware check-out/maintenance screens

.5 SCADA Integrator to be available for support 24/7 for the 1-year warranty period. Maximum of 4-hour response time to be on site if required during warranty period.

.6 Provide Operation and Maintenance Data for SCADA system for incorporation into O&M manuals.

1.6 CODES & STANDARDS

.1 IEC 61000-4-2, 61000-4-3 & 61000-4-4: Electromagnetic Compatibility (EMC)

.2 IEC 61499-1 & 61499-2: Function Blocks for Industrial Process Measurement and Control Systems

.3 IEC 61158-2: Fieldbus Standard for Use in Industrial Control Systems – Physical Layer Specifications and Service Definition

.4 IEC 61131-3: Sequential Function Chart, Function Block, Ladder Diagram, Structured Test, and Instruction List editors

PART 2 PRODUCTS

2.1 USER PROGRAM

.1 Executable software, database or timed interval/event report written or assembled for the purpose of control, monitored, and reporting with respect to the operation of equipment provided under this contract. This includes but is not limited to PLC/RTU programs, spreadsheets and macros, scripts, databases, queries and searches, VB add-ons, transmitter configurations and microprocessor-based instrument calibrations.

.2 User programs shall not be proprietary.

.3 Programming, data table structure, and memory usage shall be documented. Most efficient methods and memory usage shall be employed.

.4 User programs shall be submitted in hardcopy and softcopy for archive at the completion of the project and/or at the request of the Engineer.

.5 Subsequent edits to user programs shall be submitted in hardcopy and softcopy for archive.

2.2 SCADA OPERATOR STATION PC (2 REQUIRED)

.1 Thin Client (HP pro t550 or equivalent)

- .1 Intel 4 core processor
- .2 8 Gb RAM
- .3 128 Gb NVMe
- .4 Windows 11 IoT Enterprise OS
- .5 Dual display port outputs
- .6 1Gb ethernet port
- .7 4 USB-A ports, 1 USB-C port

.2 Two Monitors – 27",1920 x 1080 resolution (HP E27 G5 or equivalent)

- .1 Adjustable height, tilt & swivel

2.3 SCADA DEVELOPMENT STATION/ENGINEERING WORKSTATION (1 REQUIRED)

.1 Identical PC as specified for the SCADA Operator Station in 2.2 above.

2.4 SCADA / HMI / HISTORIAN SERVERS AND RACK WITH COMPONENTS

.1 42U Server Rack

.2 Two vertical rackmount outlet strip (48"-6 outlets)

.3 Rackmount UPS (Eaton 9Px Lithium)

.4 1U KVM Switch/Console kit (Netcommander)

.5 Three – HPE Proliant Servers (c/w 5yr support for hw and sw & NCI-StR-E for up to 7VMs)

- .1 16 core per server
- .2 320 Gb Memory DDR5
- .3 Dual port 10/25 Gbe SFP28 Nic
- .4 1Gbe adapter
- .5 Dual power supplies

.6 Storage: 6TB (min). SSD or NVMe
.7 OS Boot Drive: dual hot plug NVMe 480Gb M.2 SSD
.8 Must support esxi or AHV. Hypervisor software included.
.9 Windows server standard OS license included for each server
.10 SQL Server Standard

.6 Level 3 Switches / components

.1 Two - HP Aruba CX6300 24-port SFP+ and 4-port SFP56
.1 Dual power supplies
.2 SFP56 to SFP56 0.65m DAC cables (2)
.3 SFP+ to SFP+ 10Gbe 3M DAC cables (6)
.4 HPE Aruba Networking CX 6200M 24G 4SFP+ Switch (1)
.5 HPE Aruba Networking X371 12VDC 250W 100-240VAC PS (1)
.6 HPE Aruba Networking 10G SFP+ to SFP+ 1m DAC cable (1)

.7 Firewall – Fortigate 90G, c/w 3 yr support, plus FortiCare Premium & FortiGuard Unified Threat Protection (UTP)

2.4 SOFTWARE LICENSES

.1 The AVEVA InTouch SCADA programming software shall be provided for the Work described in this Section.

.1 AVEVA InTouch HMI (qty. 2) -400 Flex Credits, 3 year subscription
.2 InTouch Unlimited Tag Server (qty. 2)
.3 InTouch desktop HMI Client (qty. 2)
.4 AVEVA Historian – 5000 Tag Server (qty. 2)
.5 AVEVA Historian Client (qty. 2)
.6 AVEVA Reports – 5000 Tags, 2 WEB clients
.7 AVEVA InTouch HMI Development Studio – Unlimited Tags
.8 AVEVA Standard Communication Drivers
.9 OPC UA Server
.10 Premium support for 3 years

.2 Alarm Dialer Software

.1 WIN-911 Pro and Premium Voice c/w XL Reporter

.3 If required, Contractor shall provide any additional software required for the Work described in this section.

PART 3 EXECUTION

3.1 GENERAL SCADA SOFTWARE REQUIREMENTS

.1 The SCADA software shall consist of a Human-Machine Interface (HMI) system with support for supervisory and process control, real-time data acquisition, alarm and event management, historical data collection, report generation, remote communications to PLC's.

.2 The SCADA system will act as the Human-Machine Interface (HMI) for all devices Interfaced to the plant PLC's and remote PLC's. It will provide the monitoring, controlling, alarming, logging, and reporting features required for effective operations.

.3 Navigation through the overview screens will allow the user of the system the ability to move forward or reverse on all systems by pressing on tabs as illustrated on the Process and Instrumentation Diagram. Process flow will be from left to right.

.4 The SCADA system operator shall be able to execute all monitoring and supervisory control functions from this HMI. Typical operator commands include modifying setpoints for control loops, alarm acknowledgment and setpoint adjustment, auto/manual switching and on/off control of field devices and taking points or devices on/off scan. The operator shall be able to access all SCADA tag name/hierarchical names or graphic displays from any workstation on the network without having to know which data historian or server the point or display resides on. The system software shall include an object-oriented colour graphics display generator with full animation capabilities to provide users with a realistic visualization of the system process. All graphical editing operations shall be point-and-click; selecting icons from a floating and docking tool bar, pull down menus or keyboard commands. It shall be possible to perform a functional test of any graphic display by switching to the runtime mode with a single mouse click. The graphics editor shall include a broad library of complex objects and process symbols such as meters, pushbuttons, sliders, gauges, pumps, motors, tanks, valves, trends, alarms, and controller faceplates. All complex objects shall be scalable to any size and may include animation links to provide dynamic response based on real-time data or user action.

.5 Display Navigation

.1 Operators shall interface to all process and SCADA activities through easily recognized icons, pull down or full screen menus.

.2 The operator shall be able to access displays via a pointing device and/or soft key menus with a choice of function keys, cursor control keys, or any single key on the keyboard. Display navigation shall not normally require the use of typing text commands into an alphanumeric keyboard. Supported pointing devices shall include a mouse or touch screen.

.3 The operator shall be able to easily identify which objects are selectable from any display by simply dragging the pointing device over the object.

Displaying a halo around the object shall provide confirmation that an object can be selected. Typical objects include process device symbols (pumps, motors, etc.) controller faceplates, buttons or switches or sliders.

.6 Programming Conventions

.1 The status of a device shall be illustrated graphically (e.g. colour change), and in text form in the SCADA display. States include but are not limited to ON / OFF, UP / DOWN, OPEN / CLOSED, AUTO / MANUAL, REMOTE / LOCAL, NORMAL / ALARM. Status colours shall be as follows: GREEN for ON, RUN and OPEN. RED for OFF, STOP and CLOSED. BAR GRAPHS: Levels shown shall be shown in BLUE when in normal operating conditions and flashing RED when in alarm condition, (once alarm acknowledged – RED, not flashing).

.2 Trends shall be located on separate full-size screens or pop-up displays. Trend displays shall be historical available for all analog values. There shall be no greater than 4 pens per trend. X & Y axis magnitude and starting value shall be adjustable by sliders.

.3 Control loop displays shall contain Setpoint, Process Variable, Actuator Position, Ready/Suspend status, Auto/Manual status and switching, Remote/Local status and loop alarm information. Displays shall reflect field status at all times. Displays will include pop ups for any interlock status information. Display will include help windows with complete text descriptions explaining controls. Targets to access hardware check-out / maintenance screens shall on the help screens or windows.

.4 Device tags and their descriptions shall be identical to the field processor they originate from, as indicated on the plant P&ID. Tag name naming conventions shall be consistent throughout the plant.

.5 The following shall be provided for all devices on the network of PLC's at a minimum:

.1 Pumps (and Blowers): The SCADA will provide the following information on each of the Pumps in the system, VFDs included if applicable. This includes the historical logging and trending of the following data:

.1 Pump Run status

.2 Pump Ready status

.3 Pump Fail status (Overload, Overtemp, Seal Fail, VFD Fail, etc)

.4 Selector switch position (Local, Off, Remote)

.5 Maintenance Count in hours

.6 Elapsed Runtime Hours

.7 Hours since last maintenance (Operator Configurable via SCADA)

.8 Hours until next maintenance (Operator Configurable via SCADA)

.9 VFD Command Speed

.10 VFD Actual Speed

.11 Motor Voltage

.12 Motor Amps

.2 Valves: The SCADA will provide the following information on each of the Valves in the system. This includes the historical logging and trending of the following data:

.1 Valve Open

.2 Valve Closed

.3 Selector switch position. (Local, Off, Remote)

.4 Valve Fail status (Fail to Open/Close, etc)

.5 Valve Actuated Position

.6 Valve Actuated Command Position

.3 Transmitters (Flow, Pressure, Level, Analytical, etc): The SCADA will provide Historical logging and Trending of each of these devices as well as High and Low alarm setpoints that are operator adjustable.

.1 Discrete Instruments (Pressure Switches, Level Switches, Motion Switches, etc):

.2 The SCADA will provide historical logging and trending of each of these devices.

.4 Fixed Speed Motors: The SCADA will provide the following information on each of the Motors in the system. This includes the Historical logging and Trending of the following data:

.1 Motor Run status

.2 Motor Ready status

.3 Motor Command state

.4 Motor Fail status (Overload, Overtemp, Seal Fail, VFD Fail, etc)

.5 Selector switch position. (Local, Off, Remote)

.6 Maintenance Count in hours.

.7 Elapsed Runtime Hours.

.8 Hours since last maintenance (Operator Configurable via SCADA)

.9 Hours until next maintenance (Operator Configurable via SCADA)

.10 Motor Amps

.6 Configure PLC application software to perform process functions as described in approved Sequence of Operation and as illustrated in Contract Drawings.

.7 Configure communication settings to establish required communications with other devices on the network.

.8 Configure PLC so that all PLC alarms are configurable for dial-out as determined with operations staff and contract administrator.

3.2 INSTALLATION

.1 Configure communication with plant and remote PLC's.

.2 Co-ordinate with Sections 25 05 01, and 25 05 05 to establish connectivity of SCADA computers.

.3 Install and configure all applications on the SCADA PC's and ensure correct operation.

.4 Demonstrate that the SCADA project starts & runs without operator intervention on power-up and restarts normally on a power-fail recovery.

.5 Demonstrate the proper operation of SCADA project and supporting applications.

.6 Provide a written report to Engineer upon completion of SCADA system installation.

.7 Address any deficiencies listed by the Engineer at no extra expense to the Owner.

3.3 FIELD QUALITY CONTROL

.1 Provide 20 hours of training for operators and maintenance personnel, to consist of five, four-hour sessions. Dates are to be approved by the Owner. Training shall include:

.1 Automatic Startup (Normal) and shutdown of system and application.
.2 Manual Startup and shutdown of the application.
.3 Overview of site networks.
.4 Alarm management.
.5 Printer maintenance.
.6 Reports.
.7 Detailed operator's manual.
.8 Detailed maintenance/design manual.

END OF SECTION

CONTROL PANEL CONFIGURATION

PART 1 GENERAL

1.1 CONFIGURATION OF CP'S

.1 Programming and configuration of the Control Panels and Modification to existing Panels supplied by this Division.

.1 The Contractor shall solicit the services of the prequalified System Integrator listed below to provide the Control Panel Configuration as defined in this Section.

.1 A.R.C. Integration Inc.
P.O. Box 161 Foxboro, ON
Attn: Dale MacDonald macdonald.d@arcintegration.ca
Cell: (613) 813-7805

1.2 RELATED SECTIONS

.2 Section 25 05 01 – Control Panels

.3 Section 25 05 02 – SCADA

1.3 SUBMITTALS

.1 Make submittals in accordance with Section 01 33 00 – Submittals and 01 78 00 – Closeout Submittals.

.2 Submit a PLC Sequence of Operation Control Narrative for each PLC for review and approval.

.1 Prepare narratives in Microsoft Word file format. When indicated, provide documents in editable file format for incorporation into plant manual. Otherwise provide Adobe Reader files (PDF type with commenting allowed).

.3 Provide Operation and Maintenance Data for SCADA system for incorporation into O&M manuals.

1.4 MAINTENANCE DATA

.1 Provide as-built updated control narrative in SCADA/PLC manual. Include detail comments and complete PLC/operator interface configuration and programming printouts in manuals.

1.5 SCOPE OF WORK

.1 Provide programming and configuration to meet requirements of processes including but not limited to:

.1 All coding for each PLC.

.2 Configuration and programming of touchscreen Operator Interface Terminal (OIT) displays in each panel.

.2 Provision of PLC programming as approved in the PLC Sequence of Operation, to support the installation, commissioning, and acceptance of the systems.

.1 After the programs have been fully written documented, commented, and tested, a formal presentation/review shall be made with the engineer. The SCADA integrator shall review and describe the entire program, rung by rung.

.3 Provision of configuration of all networking devices to ensure full participation of each device on the Ethernet network.

.4 Co-ordination with Section 25 05 02 - SCADA to:

.1 Make all process data available for the SCADA integration.

.2 Provide PLC software to minimize calculations and logic performed by the SCADA system.

.3 Provide HMI display screens that are similar as possible to the SCADA displays.

.4 Refer to Section 25 05 02 for HMI display conventions.

.5 Co-ordination with Section 25 05 02 so that all PLC alarms are configurable for dial-out and remote inquiry as described in approved Sequence of Operation.

.6 Watchdog hand shaking logic shall be implemented in CP-300 to monitor healthy run status of PLC and healthy communication between SCADA and each PLC. Failure of SCADA-to-PLC watchdog pulse will cause the PLC to activate the General Alarm which will result major alarm via the dial-out modem. If the PLC program stops running, its normally closed general alarm relay will be de-energized. Failure of the PLC will cause an alarm to be displayed by the SCADA application.

1.6 USER PROGRAM

.1 User program shall not be proprietary.

.2 PLC programming shall be written in a clear organized fashion in ladder logic.

.3 Programming, data table structure and memory usage shall fully be documented. Both short and long comments initialized. Ladder rung descriptors shall be written for each rung. Each register used in the program shall have a descriptor. Most efficient methods and memory usage shall be employed.

.4 User programs shall be submitted in hardcopy and softcopy for archive at the completion of the project.

.5 Subsequent edits to user programs shall be submitted in hardcopy and soft copy for archive to the Engineer at the completion of the project, or at the Engineer's request.

.6 Documentation to support the understanding of program content shall include tag-names, descriptions and comments and shall reflect Contract Drawings, P&ID, and approved Sequence of Operation.

.7 User program shall support the safe and correct operation of all devices physically connected to each PLC in which the user program resides.

.8 User program functionality shall reflect Contract Drawings, P&ID, and approved Sequence of Operation, and shall be subject to approval by the Engineer.

.9 Electronic copy of control narrative to be kept current and up to date as program is edited/changed. This document to be readily available to the operator via the SCADA displays – coordinate with 25 05 02.

PART 2 PRODUCTS

2.1 SOFTWARE

.1 The System Integrator's PLC and HMI programming software shall be used for the Work described in this section.

.2 If required, Contractor to provide any additional software required for the Work described in this section.

PART 3 EXECUTION

3.1 INSTALLATION

.1 Configure PLC application software to perform process functions as described in approved Sequence of Operation, Control Narrative, and as illustrated in Contract Drawings.

.2 Configure communication settings and co-ordinate with Section 25 05 02 (SCADA configuration) to establish required communications with other devices on the network.

.3 Co-ordinate with Section 25 05 02 (SCADA) to:

.1 Make all process data available to the SCADA integrator.

.2 Provide PLC software to minimize calculations and logic performed by the SCADA system.

.3 Provide HMI display screens that mimic the corresponding main SCADA iFIX screens.

.4 Configure PLC so that all PLC alarms are configurable for dial-out as described in approved Sequence of Operation.

3.2 COMMISSIONING

.1 Verify proper function of devices which receive power from control panel.

.2 Check motor rotations and configure variable frequency drive parameters.

.3 Stroke valves and verify limit switches if applicable.

.4 Calibrate analogue inputs and outputs.

.5 Document and confirm digital input and output designations (Open/Close, On/Off, Up/Down, In/Out, etc.) using PLC program.

.6 Tune process control loops.

.7 Verify that all alarms are correctly delayed, set, acknowledged, and reset, and that both the General Process Alarm to the Alarm Notification responds correctly.

END OF SECTION

LEVEL ELEMENTS

PART 1 GENERAL

1.1 SHOP DRAWINGS AND PRODUCT DATA

.1 This section specifies the supply, installation, field testing, and placing into operation of various level elements and transmitters as specified below, and as identified in but not limited to the attached Instrumentation Data Sheets and the Contract Drawings.

.2 The attached data sheets only indicate instruments to be supplied by Div. 25. Refer to contract drawings and shop drawings for instruments supplied by preselected equipment suppliers.

.3 Responsibility shall include supply and installation of all component and Vendor subsystems as to provide a fully functioning system, including supervision, calibration, checkout, start-up operating adjustment and documentation, tagging and compliance with data sheets.

.4 Submit shop drawings and product data in accordance with Section 01 33 00 – Submittals.

.5 The measuring elements of instrumentation designated for hazardous locations must be in full compliance with the OESC.

1.2 DELIVERY, STORAGE AND HANDLING

.1 Ship assembled to the degree which is possible. Inform installer of site assembly requirements.

1.3 RELATED SECTIONS

.1 Section 01 33 00 - Submittals

.2 Section 01 91 13 - Commissioning Requirements

.3 Section 01 91 33 - Commissioning Forms

.4 Section 01 91 41 - Commissioning Training

.5 Section 44 00 10 - Process General Requirements

.6 Section 26 00 10 - Electrical General Requirements

1.4 REFERENCES

.1 ISA RP12.06.01-2003, Recommended Practice for Wiring Methods for Hazardous (Classified) Locations Instrumentation, Part 1: Intrinsic Safety.

.2 CSA C22.2 No. 0.3-01 (R2005), Test Methods for Electrical Wires and Cables

1.5 COMMISSIONING AND TRAINING

.1 Commissioning, training, and closeout documents are to be carried out in accordance with Section 01 91 13, Section 01 91 33, and Section 01 91 41.

.2 Also submit the following:

.1 Manufacturer's calibration certificates.

.2 Instrument field calibration sheets.

.3 Instrument field loop check sheets.

PART 2 PRODUCTS

2.1 MATERIAL

.1 All instrumentation, control, and electrical devices provided under this Section shall be CSA approved and shall bear the CSA approvals seal as detailed in these specifications.

.2 Each device shall be a pre-assembled packaged unit. Upon delivery to the Work Site, each level measuring system shall be ready for installation with only minor piping and electrical connections required by the Contractor.

.3 Power supply to the transmitters shall be 120V AC, 60 Hz, single phase unless otherwise indicated. Primary elements shall derive any required power from the transmitter.

.4 The systems shall be installed to measure the specified process at the ranges and conditions indicated in these specifications and on the Contract Drawings. The devices will be installed at the locations indicated on the Drawings.

.5 Environmental, temperature and pressure requirements for the instruments shall be as specified.

.6 Each instrument shall be complete with mounting flanges and/or brackets as supplied by the instrument manufacturer.

.7 Sensing units shall be mounted so that interference to the sensing function is not caused by surrounding structures. The sensor shall be mounted on its own support, purposely built by the instrument manufacturer based on the manufacturer's recommendations, to facilitate maintenance and/or adjustment.

.8 Where amplifier/transmitter electronics are installed in a classified environment the housings shall be suitable for the application. i.e. Class 1, Div. 1 and suited to a wet and corrosive environment.

.9 The system design shall be based on the process ranges and service requirements listed in these specifications and on the Contract Drawings.

2.2 ULTRASONIC LEVEL TRANSMITTER

.1 Equipment will include the level element (transducer), a remote mounted transmitter enclosure, and interconnecting cable between the transducer and transmitter enclosure. The Contractor shall install the transducers and transmitter enclosures at the approximate locations indicated on the Drawings.

.2 Mounting and installation hardware shall be 316L stainless steel. If necessary, the Contractor shall provide and install a pipe section for installation of the transducer. A junction box shall be provided for each transducer for termination of the manufacturer supplied cable. Multiple transducers in a common area can be provided with a single junction box. A multi-pole receptacle shall be provided and installed for connection of each transducer as detailed in Installation Standards.

.3 The Contractor shall install and terminate the interconnecting cable between the element and transmitter. Power and control cable connections between the transmitter and remote devices shall be provided as specified elsewhere in the Contract Documents.

.4 The transmitters may or may not be factory calibrated by the supplier and shall need to be field verified by the Contractor. The Contractor shall make adjustments to setup, zero and span settings or other adjustments as required to calibrate the instruments.

.5 The Contractor shall be responsible for start-up and testing of the devices and shall perform loop or continuity testing to verify that all electrical connections are correct. Testing shall be in accordance with the testing standards, specified elsewhere in the Contract Documents.

.6 Typical transducer range 1-10 m with 6° beam angle, minimum of 20 m cable, 1” NPT mounting thread.

.7 Tools and spare parts shall be furnished and packaged as recommended by the manufacturer. As a minimum, the following spare parts shall be furnished:

.1 One spare transducer assembly.

.2 Handheld calibration tool as required.

.8 Additional equipment: Provide vendor supplied mounting equipment to permit easy installation and removal.

.9 Acceptable manufacturers:

.1 Siemens

.2 Rosemount

.3 ABB

2.3 RADAR LEVEL MEASUREMENT

.1 Equipment will include the level element (transducer), a remote mounted transmitter enclosure, and interconnecting cable between the transducer and

transmitter enclosure. The Contractor shall install the transducers and transmitter enclosures at the approximate locations indicated on the Drawings.

.2 Mounting and installation hardware shall be 316L stainless steel. If necessary, the Contractor shall provide and install a pipe section for installation of the transducer. A junction box shall be provided for each transducer for termination of the manufacturer supplied cable. Multiple transducers in a common area can be provided with a single junction box. A multi-pole receptacle shall be provided and installed for connection of each transducer as detailed in Installation Standards.

.3 The Contractor shall install and terminate the interconnecting cable between the element and transmitter. Power and control cable connections between the transmitter and remote devices shall be provided as specified elsewhere in the Contract Documents.

.4 The transmitters may or may not be factory calibrated by the supplier and shall need to be field verified by the Contractor. The Contractor shall make adjustments to setup, zero and span settings or other adjustments as required to calibrate the instruments.

.5 The Contractor shall be responsible for start-up and testing of the devices and shall perform loop or continuity testing to verify that all electrical connections are correct. Testing shall be in accordance with the testing standards, specified elsewhere in the Contract Documents.

.6 Typical transducer range 1-10 m with 20° beam angle, minimum of 20 m cable, Flange mounting.

.7 Tools and spare parts shall be furnished and packaged as recommended by the manufacturer. As a minimum, the following spare parts shall be furnished:

.1 One spare transducer assembly.
.2 Handheld calibration tool as required.

.8 Additional equipment: Provide vendor supplied mounting equipment to permit easy installation and removal.

.9 Acceptable manufacturers:

.1 Siemens
.2 Rosemount
.3 ABB

2.4 HYDROSTATIC PRESSURE LEVEL PROBE

.1 Equipment will include the level probe (transducer), a remote mounted indicator enclosure, and interconnecting cable between the transducer and indicator enclosure. The Contractor shall install the transducers and indicator enclosures at the approximate locations indicated on the Drawings.

.2 Mounting and installation hardware shall be 316L stainless steel. The Contractor shall provide and install a pipe section for installation of the transducer. The

Contract shall coordinate the pipe diameter with the transducer diameter dimensions.

.3 A junction box shall be provided for each transducer for termination of the manufacturer supplied cable. Multiple transducers in a common area can be provided with a single junction box. A multi-pole receptacle shall be provided and installed for connection of each transducer as detailed in Installation Standards.

.4 The Contractor shall install and terminate the interconnecting cable between the element and transmitter. Power and control cable connections between the transmitter and remote devices shall be provided as specified elsewhere in the Contract Documents.

.5 The transmitters may or may not be factory calibrated by the supplier and shall need to be field verified by the Contractor. The Contractor shall make adjustments to setup, zero and span settings or other adjustments as required to calibrate the instruments.

.6 The Contractor shall be responsible for start-up and testing of the devices and shall perform loop or continuity testing to verify that all electrical connections are correct. Testing shall be in accordance with the testing standards, specified elsewhere in the Contract Documents.

.7 Tools and spare parts shall be furnished and packaged as recommended by the manufacturer. As a minimum, the following spare parts shall be furnished:

.1 One spare transducer assembly.

.2 Handheld calibration tool as required.

.8 Additional equipment: Provide vendor supplied mounting equipment to permit easy installation and removal.

.9 Acceptable manufacturers:

.1 Endress+Hauser

.2 Siemens

.3 Rosemount

2.5 HYDROSTATIC PRESSURE LEVEL TRANSMITTER – ALUM TANKS

.1 Equipment will include the level indicating transmitter with integral sensing element (transducer) and interconnecting cable between the transmitter and PLC control panel. The Contractor shall install the transmitters at the approximate locations indicated on the Drawings.

.2 Mounting and installation hardware shall be 316L stainless steel. If necessary, the Contractor shall provide and install a pipe section for installation of the transducer. A junction box shall be provided for each transducer for termination of the manufacturer supplied cable. Multiple transducers in a common area can be provided with a single junction box. A multi-pole receptacle shall be provided and installed for connection of each transducer as detailed in Installation Standards.

.3 The Contractor shall install and terminate the interconnecting cable between the transducer and the control panel. Power and control cable connections between the control panel and transducer shall be provided as specified elsewhere in the Contract Documents.

.4 The transmitters may or may not be factory calibrated by the supplier and shall need to be field verified by the Contractor. The Contractor shall make adjustments to setup, zero and span settings or other adjustments as required to calibrate the instruments.

.5 The Contractor shall be responsible for start-up and testing of the devices and shall perform loop or continuity testing to verify that all electrical connections are correct. Testing shall be in accordance with the testing standards, specified elsewhere in the Contract Documents.

.6 Tools and spare parts shall be furnished and packaged as recommended by the manufacturer. As a minimum, the following spare parts shall be furnished:

.1 One spare transducer assembly.
.2 Handheld calibration tool as required.

.7 Additional equipment: Provide vendor supplied mounting equipment to permit easy installation and removal.

.8 Acceptable manufacturers:

.1 Siemens
.2 Rosemount
.3 Endress+Hauser

2.6 CONDUCTIVITY LEVEL PROBE (MULTITRODE)

.1 Equipment will include the multi-sensor probe element, a remote mounted transmitter and intrinsically safe barrier enclosure, and interconnecting cable between the transducer and transmitter enclosure. The Contractor shall install the transducers and transmitter enclosures at the approximate locations indicated on the Drawings.

.2 Mounting and installation hardware shall be 316L stainless steel. If necessary, the Contractor shall provide and install a pipe section for installation of the transducer. A junction box shall be provided for each transducer for termination of the manufacturer supplied cable. Multiple transducers in a common area can be provided with a single junction box. A multi-pole receptacle shall be provided and installed for connection of each transducer as detailed in Installation Standards.

.3 The Contractor shall install and terminate the interconnecting cable between the element and transmitter. Power and control cable connections between the transmitter and remote devices shall be provided as specified elsewhere in the Contract Documents.

.4 The transmitters may or may not be factory calibrated by the supplier and shall need to be field verified by the Contractor. The Contractor shall make adjustments

to setup, zero and span settings or other adjustments as required to calibrate the instruments.

.5 The Contractor shall be responsible for start-up and testing of the devices and shall perform loop or continuity testing to verify that all electrical connections are correct. Testing shall be in accordance with the testing standards, specified elsewhere in the Contract Documents.

.6 Additional equipment: Provide vendor supplied mounting equipment to permit easy installation and removal.

.7 Probe:

.1 Probe Length: as shown on Instrument Data Sheet
.2 Sensors: 10 sensors
.3 Sensor Material: Avesta 254 SMO High Grade Stainless Steel Alloy
.4 Probe Material: uPVC Premium Quality Extruded Tube
.5 Cable length: specified by contractor
.6 CSA approval - Class 1, Division 1, Group D.
.7 Temperature range of 0°C to 65°C

.8 Controller:

.1 To accept ten (10) sensor inputs.
.2 10 digital outputs.
.3 LED display complete with bar-graph for level indication and power on indication.
.4 120VAC power.
.5 CSA general purpose.
.6 Accepts a ten (10) sensor probe.

.9 Acceptable products:

.1 Xylem MultiTrode Probe complete with MTIC Indicator Controller and MTISB Intrinsically Safe Barrier.

PART 3 INSTALLATION

3.1 INSTRUMENTS

.1 All mounting plates, pedestals, bolts, shims, angle iron and other miscellaneous steel or hardware items required for the securing of equipment shall be supplied unless specifically noted otherwise.

.2 All instruments to be installed in accordance with the Manufacturer’s installation instructions.

.3 Each instrument sensing line shall be complete with an isolation valve. The isolation valves shall conform to Divisions 44 equipment requirements.

.4 Instruments or raceway will be installed so as not to obstruct access routes, equipment maintenance space or space for future equipment.

.5 Where the removal of filter cartridges and heater elements is necessary, attention will be paid to instrument locations and tubing runs.

.6 Instrument supports shall be located and installed to provide a fully supported, secure system with minimum vibration.

3.2 INDICATORS

.1 Select instruments so that normal operating point is just above midpoint of instrument range. (60 – 70%)

.2 All indications shall be displayed on a linear scale unless otherwise specified. Local indicators shall be in engineering units.

3.3 TESTING

.1 These devices will be field calibrated by the Contractor. The Contractor shall be responsible for start-up and testing of the devices and shall perform loop or continuity testing to verify that all electrical connections are correct. Testing shall be in accordance with the testing standards, specified elsewhere in the Contract Documents.

.2 During testing demonstrate proper calibration and correct operation to the Owners Representative.

.3 Upon completion of testing of each device, affix a tag to the instrument certifying that calibration and testing have been completed and specifying the calibration points. Include loop check sheet and instrument calibration sheets in instruction books.

END OF SECTION

INSTRUMENT DATA SHEET

LEVEL TRANSMITTERS

Project	Client	Town of Greater Napanee	Project No.	22001
	Location	New Napanee WPCP	Instrument Spec.	25 10 01
			Revision	1

General	Tag Number	LE/FT 1045	LT 1151	LT 1251
	Description of Instrument	Ultrasonic Level Transmitter	Radar Level Transmitter	Radar Level Transmitter
	Service	Parshall Flume	Wet Well	Wet Well
	P&ID No.	P0004	P0004	P0004
	Line Tag	Trench-in-conc 1050W x 1500D	RSP-T-1151	RSP-T-1251
	Line Size (mm)			
Process	Fluid	Raw Sewage	Raw Sewage	Raw Sewage
	Oper. Press Min/Max (kPa)			
	Viscosity @ Oper. Temp	14/23	14/23	14/23
	Ambient Temperature	5 - 30	5 - 30	5 - 30
	S.G. @ Oper. Temp	1.0	1.0	1.0
	Viscosity @ Oper. Temp	1.1	1.1	1.1
	Measurement Function	Flow	Level	Level
Transmitter	Tag No.	FIT 1045	LT 1151	LT 1251
	Transmitter Type	Remote	Integral	Integral
	Power Requirement	120V AC	24VDC, Loop powered	24VDC, Loop powered
	Electrical Connection	1/2" NPT	1" NPT - Factory installed cable	1" NPT - Factory installed cable
	Contact Type	2 SPST Form A/1 SPDT Form C	N/A	N/A
	Display Type	Digital LCD Integrak Display		
	Instrument Range	0.3 m to 8 m	0.3 m to 30 m	0.3 m to 30 m
	Operating Range	TBC	TBC	TBC
	Output Signal	4 - 20 mA	4 - 20 mA	4 - 20 mA
	Accuracy / Repeatability	±0.25% of Range or 6mm	2mm	2mm
	Enclosure Rating	IP67 / NEMA 4X	NEMA 6/7	NEMA 6/7
	Enclosure Material	Polycarbonate	PVDF	PVDF
	Mounting	Bridge Mount	Wall Mounted Bracket	Wall Mounted Bracket
Element	Tag No.	LE/FIT 1045		
	Sensor Type	Ultrasonic transducer	Radar transducer	Radar transducer
	Beam Angle	6 deg	4 deg	4 deg
	Frequency	44 kHz	80 GHz	80 GHz
	Measurement Range	TBC	0.3-8m	0.3-8m
	Facing Material	CSM Rubber		
	Mounting Thread	1" NPT	1" NPT	1" NPT
	Mounting Flange	N/A	N/A	N/A
	Submergence Shield Kit	No	Yes	Yes
	Enclosure Rating	NEMA 4X/6	NEMA 7/6	NEMA 7/6
	Enclosure Material	PVDF	PVDF	PVDF
	Cable Length	As required	As required	As required
Access	Name Plate	Yes	Yes	Yes
	Connection Plug	TBC	No	No
	Mounting Bracket	Yes	Wall Mount - 200mm offset	Wall Mount - 200mm offset
Approval / Enclosure		CSA / NEMA 7	CSA	CSA
Class / Division / Group		Class I / Div. 1 / Group A-G	Class I / Div. 1 / Group D	Class I / Div. 1 / Group D
Comments		With floor mounted bridge channel		
		bracket.		
Manufacturer		Siemens	Siemens	Siemens
Model Number		Echomax XRS-5C c/w LUT 400	Sitrans LR120	Sitrans LR120
Alternates				

Notes:

1. Vendor to supply Stainless Steel Tag with Instrument Tag Number clearly stamped on it.
2. Vendor is to fill in missing data in this specification sheet relevant to the device (i.e. model #)
3. Contractor is to supply mounting hardwate appropriate for the application.

No.	Date	By	Chkd	Appd	Revision
1	2025-01-22	M.M.			Issued for Tender

INSTRUMENT DATA SHEET

LEVEL TRANSMITTERS

Project	Client	Town of Greater Napanee	Project No.	22001
	Location	New Napanee WPCP	Instrument Spec.	25 10 01
			Revision	1

General	Tag Number	LE/LIT 4123	LE/LIT 3110	LE/LIT 3210
	Description of Instrument	Ultrasonic Level Transmitter	Radar Level Transmitter	Radar Level Transmitter
	Service	UV Disinfection Channel	Alum Tank 1	Alum Tank 2
	P&ID No.	P0009	P0016	P0016
	Line Tag	DIS-UV-4121	ALU-T-3110	ALU-T-3210
	Line Size (mm)			
Process	Fluid	Tertiary effluent	Alum	Alum
	Oper. Press Min/Max (kPa)			
	Viscosity @ Oper. Temp	14/23		
	Ambient Temperature	5 - 30		
	S.G. @ Oper. Temp	1.0		
	Viscosity @ Oper. Temp	1.1		
	Measurement Function	Level	Level	Level
Transmitter	Tag No.	LT 4123	LIT 3110	LIT 3210
	Transmitter Type	Remote	Integral	Integral
	Power Requirement	120V AC	24VDC, Loop powered	24VDC, Loop powered
	Electrical Connection	1/2" NPT	1" NPT - Factory installed cable	1" NPT - Factory installed cable
	Contact Type	2 SPST Form A/1 SPDT Form C	N/A	N/A
	Display Type	LCD	LCD	LCD
	Instrument Range	0.3 m to 15 m	0m to 8m	0m to 8m
	Operating Range	TBC	TBC	TBC
	Output Signal	4 - 20 mA	4 - 20 mA	4 - 20 mA
	Accuracy / Repeatability	±0.25% of Range or 6mm	5mm	5mm
	Enclosure Rating	IP67 / NEMA 4X	IP67 / NEMA 4X	IP67 / NEMA 4X
	Enclosure Material	Polycarbonate	PVDC	PVDC
	Mounting	Wall Mount	Flange mount	Flange mount
Element	Tag No.	LE 4123	N/A	N/A
	Sensor Type	Ultrasonic transducer	Radar	Radar
	Beam Angle	6 deg	20 deg	20 deg
	Frequency	44 kHz	80 GHz	80 GHz
	Measurement Range	TBC	TBC	TBC
	Facing Material	CSM Rubber		
	Mounting Thread	1" NPT	1-1/2" NPT	1-1/2" NPT
	Mounting Flange	N/A	Polypropylene adapter flange	Polypropylene adapter flange
	Submergence Shield Kit	No	No	No
	Enclosure Rating	NEMA 4X/6	N/A	N/A
	Enclosure Material	PVDF	N/A	N/A
	Cable Length	As required	8m	8m
Access	Name Plate	Yes	Yes	Yes
	Connection Plug	TBC	TBC	TBC
	Mounting Bracket	Wall Mount - Channel Bracket	No	No
Approval / Enclosure		CSA / NEMA 4X/6	CSA / NEMA 4X	CSA / NEMA 4X
Class / Division / Group		Unclassified	Unclassified	Unclassified
Comments			Mounting Flange Size TBD	Mounting Flange Size TBD
Manufacturer		Siemens	Siemens	Siemens
Model Number		Echomax XRS-5 c/w LUT 400	Sitrans LR100	Sitrans LR100
Alternates				

Notes:

1. Vendor to supply Stainless Steel Tag with Instrument Tag Number clearly stamped on it.
2. Vendor is to fill in missing data in this specification sheet relevant to the device (i.e. model #)
3. Contractor is to supply mounting hardwate appropriate for the application.

No.	Date	By	Chkd	Appd	Revision
1	2022-12-23	M.M.	B.M	B.M.	Issued for Tender

INSTRUMENT DATA SHEET

LEVEL TRANSMITTERS

Project	Client	Town of Greater Napanee	Project No.	22001
	Location	New Napanee WPCP	Instrument Spec.	25 10 01
			Revision	1

General	Tag Number	LE/LIT 6105
	Description of Instrument	Ultrasonic Level Transmitter
	Service	On-Site Pumping Station - Wet Well
	P&ID No.	P0014
	Line Tag	RSP-T-6100
	Line Size (mm)	
Process	Fluid	Raw Sewage
	Oper. Press Min/Max (kPa)	
	Viscosity @ Oper. Temp	14/23
	Ambient Temperature	5 - 30
	S.G. @ Oper. Temp	1.00
	Viscosity @ Oper. Temp	1.10
	Measurement Function	Level
Transmitter	Tag No.	LT 6105
	Transmitter Type	Remote
	Power Requirement	120V AC
	Electrical Connection	1" NPT - Factory installed cable
	Contact Type	2 SPST Form A/1 SPDT Form C
	Display Type	LCD
	Instrument Range	0.3 m to 15 m
	Operating Range	TBC
	Output Signal	4 - 20 mA
	Accuracy / Repeatability	±0.25% of Range or 6mm
	Enclosure Rating	IP67 / NEMA 4X
	Enclosure Material	Polycarbonate
	Mounting	Wall Mount
Element	Tag No.	LE 6105
	Sensor Type	Ultrasonic transducer
	Beam Angle	6 deg
	Frequency	44 kHz
	Measurement Range	TBC
	Facing Material	CSM Rubber
	Mounting Thread	1" NPT
	Mounting Flange	N/A
	Submergence Shield Kit	No
	Enclosure Rating	NEMA 4X/6
	Enclosure Material	PVDF
	Cable Length	As required
Access	Name Plate	Yes
	Connection Plug	TBC
	Mounting Bracket	Wall Mount - Channel Bracket

Approval / Enclosure	CSA	NEMA 4X/6
Class / Division / Group	Class I / Div. 1 / Group D	
Comments		
Manufacturer	Siemens	
Model Number	Echomax XPS-15 c/w LUT 400	
Alternates		

Notes:

1. Vendor to supply Stainless Steel Tag with Instrument Tag Number clearly stamped on it.
2. Vendor is to fill in missing data in this specification sheet relevant to the device (i.e. model #)
3. Contractor is to supply mounting hardwate appropriate for the application.

No.	Date	By	Chkd	Appd	Revision
1	2022-12-23	M.M.	B.M	B.M.	Issued for Tender

PRESSURE ELEMENTS

PART 1 GENERAL

1.1 SHOP DRAWINGS AND PRODUCT DATA

.1 This section specifies the supply, installation, field testing, and placing into operation of all flow meters, flow transducers and transmitters as identified in but not limited to the attached Instrumentation Data Sheets (PE/PIT/PI Pressure Transmitter and Pressure Indicators).

.2 The attached data sheets only indicate instruments to be supplied by Div. 25. Refer to contract drawings and shop drawings for instruments supplied by preselected equipment suppliers.

.3 Responsibility shall include supply and installation of all component and Vendor subsystems as to provide a fully functioning system, including supervision, calibration, checkout, start-up operating adjustment and documentation, tagging and compliance with data sheets.

.4 Submit shop drawings and product data in accordance with Section 01 33 00 – Submittals.

.5 The measuring elements of instrumentation designated for hazardous locations must be in full compliance with the OESC.

1.2 DELIVERY, STORAGE AND HANDLING

.1 Ship assembled to the degree which is possible. Inform installer of site assembly requirements.

1.3 RELATED SECTIONS

.1 Section 01 33 00 - Submittals

.2 Section 01 91 13 - Commissioning Requirements

.3 Section 01 91 33 - Commissioning Forms

.4 Section 01 91 41 - Commissioning Training

.5 Section 44 00 10 - Process General Requirements

.6 Section 26 00 10 - Electrical General Requirements

1.4 REFERENCES

.1 ISA RP12.06.01-2003, Recommended Practice for Wiring Methods for Hazardous (Classified) Locations Instrumentation, Part 1: Intrinsic Safety.

.2 CSA C22.2 No. 0.3-01 (R2005), Test Methods for Electrical Wires and Cables

1.5 COMMISSIONING AND TRAINING

.1 Commissioning, training, and closeout documents are to be carried out in accordance with Section 01 91 13, Section 01 91 33, and Section 01 91 41.

.2 Also submit the following:

.1 Manufacturer's calibration certificates.

.2 Instrument field calibration sheets.

.3 Instrument field loop check sheets.

PART 2 PRODUCTS

2.1 GENERAL

.1 All instrumentation, control, and electrical devices provided under this Section shall be CSA approved and shall bear the CSA approvals seal as detailed in Section 44 00 10 - Process General Requirements.

.2 Provide each instrument with mechanisms and enclosures that are corrosion resistant.

.3 Provide each instrument with mechanisms enclosed in a dust-proof and a moisture-proof case.

.4 Provide all indicator and gauge dials finished in permanent white with black graduations and figures.

.5 Each instrument sensing line shall be complete with an isolation valve. The isolation valves shall conform to Division 44 Specification 44 10 71.

.6 Sensing units shall be mounted so that interference to the sensing function is not caused by surrounding structures. The sensor shall preferably be mounted on its own support, purpose built to manufactures recommendations, to facilitate maintenance and/or adjustment.

.7 Where amplifier/transmitter electronics is installed in a classified environment the housings shall be suitable for the application. i.e. Class 1, Division 1 and suited to a wet and corrosive environment. Each of the Pressure Elements and Transmitters supplied for this project must meet this requirement.

2.2 DIAPHRAGM SEALS

.1 Where indicated on the Instrument Data Sheet, a diaphragm seal shall be provided for the respective instrument, switch or pressure indicator. Diaphragm seals shall be thread-attached type with removable Viton diaphragm, SS16 L plated upper housing, and stainless steel lower housing. The upper housing shall be contoured to fit and provide a seat and seal for the diaphragm and shall be designed to permit removal of the pressure sensing element with the system under pressure. The lower housing shall be provided with a tapped and plugged 6mm NPT flushing connection. Each diaphragm seal and the pressure sensing element served shall

be factory assembled, filled with a suitable fluid, and calibrated as a unit. The diaphragm seal and seal diameter shall be selected to suit the design pressure ranges indicated in the attached data sheets.

2.3 PRESSURE GAUGES

.1 Service

.1 Tag Number: See instrument list.
.2 Service: See instrument list.
.3 Fluid: See instrument list.
.4 Operating Pressure: As noted, application requirement.
.5 Installation Drawing: See instrument list.

.2 Performance:

.1 Accuracy: ±0.5% of span.

.3 Gauge:

.1 Type: Bourdon tube, ANSI Grade 2A.
.2 Range: See instrument list.
.3 Wetted Parts: 316 stainless steel.
.4 Gear Mechanism: 316 stainless steel.
.5 Case Material: Black polypropylene.
.6 Blowout: Back blowout.
.7 Window: Shatter-proof.
.8 Filling: Liquid filled, liquid shall be selected based on the instrument location. Outdoor gauges shall operate within a temperature range of +40°C to -50°C.
.9 Dial: 115 mm white plastic laminated metal dial with black markings. Indicator rests approximately in the 50% range, under normal operating conditions.
.10 Calibration: Slotted calibration screw.
.11 Mounting: Stem mounting.
.12 Process Connection: 13 mm (0.5”) Threaded-female NPT, bottom connection.

2.4 PRESSURE ELEMENTS/TRANSMITTERS

.1 Transmitters shall be capable of providing a 4-20mA signal and shall be of the two-wire type. Process fluid shall be isolated from the sensing elements by AISI Type 316 stainless steel, Hastelloy-C, or cobalt-chromium-nickel alloy diaphragms, and a silicon oil fluid fill. Diaphragm material shall be selected based on the indicated measured process medium for proper operation in the process.

.2 Where a two channel transmitter is indicated, PIT 305, receiving signals from two pressure elements PE-305A and PE-305B, should the transmitter not be capable

to transmitting two input channels then the supplier shall provide to transmitters, one for each pressure element.

.3 Transmitters shall have self-diagnostics and electronically adjustable span, zero, and damping. Transmitters shall have over-range protection greater than the maximum line pressure. Transmitters shall not be damaged by reverse polarity. Transmitters shall be capable of having an elevated or suppressed zero, as required by the application. Transmitters shall be provided with a 3-1/2 digit LCD display, calibrated in engineering units.

.4 Mounting and installation hardware shall be 316L stainless steel. Mounting hardware shall be provided to allow pipe-stand for the pressure element and wall mounting of the transmitter. Include NPT process connection, diaphragm seal and flushing connections for all units, coordinate with Div. 44 to provide pipe reducers and bushings to connect to the specified process connection.

.5 Each pressure transmitter system shall be provided with a shut-off valve and mounting hardware. The shut-off valve shall be mounted to the transmitter prior to shipment. The manifold shall have test ports on the instrument side of the valve. The valve shall be as specified in Section 44 10 71.

.6 Transmitters shall be configurable as either square root or linear. The effect of static pressure changes on accuracy shall be negligible. The transmitter shall have minimum 15:1 field rangeability.

.7 For systems which require a dedicated programming device for calibration, maintenance, or troubleshooting, one such programming device shall be provided for each location. The programming device shall include appropriate operation manuals and shall be included in the training requirements. For systems which allow the programming device functions to be implemented in software, running on a laptop computer, the software shall be provided instead of the programming device.

.8 Tools and spare parts shall be furnished and packaged in accordance with Section 40 00 10 – Instrumentation; Spare Parts. As a minimum, the following spare parts shall be furnished for each level system:

.9 .1 Two spare fuses of each type required.

.10 Acceptable manufacturers:

.1 Siemens
.2 Rosemount
.3 Endress+Hauser

2.5 PRESSURE SWITCHES

.1 Pressure switches shall be diaphragm actuated type switches. Switches shall be field adjustable type, with trip point repeatability better than 1% of actual pressure. Switches shall be housed in EEMAC Type 4 enclosures. Switches shall be differential type where indicated on the Instrument Data Sheet. Switch wetted parts

shall be in accordance with the Material Class Sheets. Where not covered by the Material Class Sheets, the switch shall be provided with a teflon coated diaphragm, viton seals, and a stainless steel connection port.

.2 Panel mounted and surface mounted switches shall be provided with 6 mm NPT connections. All stem mounted switches shall be provided with 12 mm NPT connections.

.3 All pressure switches shall ranged as indicated in the data sheets. Unless otherwise indicated, switches shall have a fixed deadband and shall be auto-reset type. As a minimum switches shall be SPDT, rated 10 amperes at 120 volts AC.

.4 Each switch shall be provided with a threaded end, ball-type shutoff valve, as per Shutoff valve materials shall be in accordance with the Specification 44 10 71, bushings required to . Where not covered by the Material Class Sheets, valves shall have 316SS wetted parts and teflon seals. Multi-port valves shall have all unused ports plugged.

.5 Each switch shall be powered with a multi-pole receptacle on the switch enclosure for connection of external wiring. The receptacle shall be a male connector with integral leads for each pole. Number of poles shall be equal to the number of switch terminal connections for external wiring (to a maximum of 10 poles per connector). The connector shall be installed in a knockout or hub, with leads connected to the switch terminals. Receptacles shall be as indicated in Installation Standards.

.6 Each switch shall be provided with all required mounting hardware to securely mount the unit according to the mounting requirements indicated in the Instrument Data Sheet. Mounting and installation hardware shall be 316L stainless steel.

.7 Tools and spare parts shall be furnished and packaged in accordance with Section 14 00 10.

PART 3 EXECUTION

3.1 MANUFACTURER'S QUALITY CONTROL & FACTORY TESTING

.1 Provide manufacturer's quality control program and factory testing in accordance with Division 01.

.2 Provide calibration of all instruments. The Calibration Certificates shall be shipped with the instruments; the original documents shall be submitted to the Contract Administrator and copies shall be included in the Operations and Maintenance Manual.

3.2 PLANNING AND COORDINATION OF SERVICES OR INSTALLATIONS

.1 Plan and coordinate services and installation in accordance with Division 26.

.2 Install anchors, bolts, pipe sleeves, hanger inserts, etc. required in ample time to prevent delays to other division's installation work.

3.3 DELIVERY, STORAGE AND HANDLING

.1 Provide and securely attach the tag number and instructions for proper field handling and installation to each instrument prior to packaging.

.2 Package instrumentation to provide protection against shipping damage, dust, moisture and atmospheric contaminants.

.3 Transport, unload, store and handle instrumentation at the site. Inspect instrumentation for damage in shipment and return damaged instrumentation to the manufacturer. Store instruments indoors, in dry, clean and temperature controlled storage facilities.

3.4 FIELD INSTALLATION

.1 Provide field instruments as indicated in accordance with this section.

.2 Do not install primary elements or other sensitive equipment until construction is sufficiently completed to provide an "operating condition" environment. Notify the Contract Administrator prior to installing any equipment of this type.

.3 The instrument locations are to be coordinated with the installation of adjacent equipment under other Divisions, but locations must be approved by the Contract Administrator prior to installation.

.4 Equipment, supplied under other Divisions/Sections, but interconnected with the work of this Section will be either mounted by these other Divisions/Sections or, handed over for installation by this Section as indicated.

.5 Provide process connections, mounting hardware, floor stands, wall brackets and/or instrument racks as required for complete and operational system to the satisfaction of the Contract Administrator.

.6 Ensure that covers where required are properly installed on all equipment. Provide all covers, padding, guards, etc. as required to guard any equipment against damage to finish, proper operation or life expectancy.

.7 Obtain and use instrument mounting details from the manufacturer or supplier for installation purposes. Where the instrument installation details furnished with the Specification and Drawings conflict with the manufacturer’s installation detail, mount the instrument in accordance with manufacturer’s specifications and instructions. Prior to installation, obtain the ruling and approval from the Contract Administrator.

.8 Unless shown otherwise, do not mount direct reading or electrical transmitters on process piping; mount on instrument racks or stands or in enclosures near the sensor at a level that permits viewing from floor elevation.

.9 Install the instrumentation and auxiliary devices such that they are accessible for operation and maintenance. Provide space between instruments and other

equipment and piping for ease of removal and servicing. Generally, install instrumentation to be accessible from floor level or grade.

.1 Locate indicators such that indicator display is readily readable at eye level (1.5–1.6m) from floor elevation.

.2 Locate transmitter with adequate clearance and accessibility for service. For pipe/rack mounted instruments at least 1m distance/ clearance to the wall.

.3 Allow sufficient clearance for cover removal and adjustment of switches.

.4 Provide adequate clearance (100mm minimum) from piping and other obstructions for operation of valve handles.

.5 Provide safe access to the sensor.

.10 Provide field wiring c/w cables, raceway (wireways, conduit, wiring-duct, cable tray, etc.), terminations, etc.

.1 Where the instruments are installed in the hazardous areas, provide wiring, sensors/instruments enclosures and intrinsically safety circuitry to meet the CSA Code Class, Group or Division as specified.

.2 For remote transmitter units, installed manufacture supplied primary signal cables from primary element / transducer to the transmitter per manufacturer's instructions. Where cables are not supplied by the manufacturer, the Contractor is responsible to provide the required cable. The cables are to be installed without any splices. Where maximum standard cable length is inadequate for the field conditions, provide manufacturer's approved termination box, suitable for the environment.

.3 Instrumentation cables shall be as described by Division 25 and 26 of this specification. Single pair twisted shielded cable to be run in conduit. Multipairs shall be Teck run in cable tray.

.4 Control wiring shall be either multi-conductor Teck run in cable tray or single conductor wire run in conduit.

.5 Provide junction/terminal boxes as required and/or indicated on the drawings; terminate cables and conduits as required.

.6 Provide liquid-tight flexible metal or non-metallic conduit for up to a meter from the primary sensor or transmitter, or as appropriate to allow removal of it, for the following installations:

.1 Where primary sensor signal cables are required to be installed in the conduit.

.2 Where cables are required to be installed in the conduit for integral transmitter units.

.3 Where vibration of the process piping is excessive, beyond manufacturer's recommendations.

.7 Terminate primary sensor cables and conductors at the primary element / transducer (for non-sealed cables) and transmitter in accordance with manufacturer's recommendations, and Division 26 requirements.

.8 Provide and terminate control power, discrete indication and control, analog indication and control, and communication cables and conductors at transmitters and control panels as indicated on the drawings as directed

by the Contract Administrator, in accordance with manufacturer's recommendations, and Division 26 requirements.

.11 Select instruments so that normal operating point is just above midpoint of instrument range (60 – 70%).

.12 All indications shall be displayed on a linear scale unless otherwise specified. Local indicators shall be in engineering units.

.13 Verify all identification legends on equipment and cross-check wiring identification numbers with drawings and schedules.

.14 Return all damaged equipment to the factory for total corrective repairs. Replace damaged equipment with new product if deemed necessary by the Engineer. The Contractor to bear any costs due to construction delays resulting from the delay in delivery of acceptable equipment.

3.5 FIELD QUALITY CONTROL, START-UP AND COMMISSIONING

.1 Provide field quality control, start-up and commissioning in accordance with Division 01 requirements.

.2 After the instrument is fully installed, (including mounting, process connections, signal connections and power connections) and after the process is put into test mode or actual operation, perform preventative maintenance tasks, calibrate the instrument, and perform commissioning and start-up.

.3 Provide services of a competent Manufacturer's/Supplier's trained and certified technical representative to verify the installation, and provide calibration, adjustment, testing, and troubleshooting of all the instrumentation and control devices and systems until the operation of the systems are satisfactory to the Contract Administrator.

.1 The Contractor is responsible for coordination and scheduling of such a work. Notify the Engineer in writing 5 working days prior to scheduling the visits.

.2 Tests shall be carried out either separately or in conjunction with other equipment tests as determined by the Contract Administrator.

.3 Prepare instrumentation installation and calibration certification sheet for each primary element sensor and electronic indicator/analyzer/transmitter for each instrument uniquely specified. Utilize this sheet to calibrate, test and record each instrument.

.4 Calibrate measurements over the full instrument range, including zero, full range and 3 intermediate points. Repeat 2 times and document all results.

.5 Demonstrate alarms by varying process conditions. Repeat 3 times and document all results.

.6 Where equipped, calibrate instruments communication to insure that the device communicates all information to the communication network.

.7 Provide record of the calibration and testing to the Contact Administrator after the work is completed; a copy of the field notes before leaving the site

if practical, or faxed copy within 12h, and a copy of the final typed-written record report within 48h.

.8 In the Instrument Data Sheet document the results of calibration and note any setting or adjustment made.

3.6 MANUFACTURER'S CERTIFICATION AND TRAINING

.1 Provide manufacturer's certification and training in accordance with Division 01 and as modified herein.

.1 The Manufacturer's Qualified Technical Representative shall provide a training session for up to six (6) Owner's representatives for minimum of half (1/2) normal workday per each type of instrument at the job site location determined by the Contract Administrator.

.2 Include training on calibration, testing, maintenance and operation.

.3 The Contractor is responsible for coordination and scheduling of such a work.

END OF SECTION

INSTRUMENT DATA SHEET

PRESSURE TRANSMITTERS

Project	Client	Town of Greater Napanee	Project No.	22001
	Location	New Napanee WPCP	Instrument Spec.	25 10 02
			Revision	1

General	Tag Number	PE/PIT 2121	PE/PIT 2221	PE/PIT 3123
	Description of Instrument	Pressure Element/Transmitter	Pressure Element/Transmitter	Pressure Element/Transmitter
	Service	Sludge/supernatant transfer pump 1 pressure	Sludge/supernatant transfer pump 2 pressure	THK-T-3123
	P&ID No.	P0006	P0006	P0007
	Line Tag	150-WAS/SN-SS1	150-WAS/SN-SS1	80-TWAS-SS1
	Line Size (mm)	150	150	80
Process / Fluid Data	Fluid	Waste activated sludge/supernatant	Waste activated sludge/supernatant	Thickened Waste activated sludge
	Oper. Press Norm / Max (kPa)			
	Oper. Temp Norm / Max (°C)	14/23	14/23	14/23
	Ambient Temperature (°C)	5 - 30	5 - 30	5 - 30
	S.G. @ Oper. Temp	1.0	1.0	1.0
	Viscosity @ Oper. Temp	1.1	1.1	1.1
	Measurement Function	Pressure	Pressure	Pressure
Transmitter	Tag No.	PT-2121	PT-2221	PT-3123
	Transmitter Type	Loop Powered	Loop Powered	Loop Powered
	Power Requirement	24VDC	24VDC	24VDC
	Electrical Connection	1/2" NPT	1/2" NPT	1/2" NPT
	Contact Type			
	Display Type	Digital LCD Integral Display	Digital LCD Integral Display	Digital LCD Integral Display
	Instrument Range	0 - 400 kPa	0 - 400 kPa	0 - 400 kPa
	Operating Range	0 - 400 kPa	0 - 400 kPa	0 - 400 kPa
	Output Signal	4 - 20 mA	4 - 20 mA	4 - 20 mA
	Accuracy / Repeatability	±0.065%	±0.065%	±0.065%
	Enclosure Rating	NEMA 7	NEMA 7	NEMA 7
	Enclosure Material	Polyamide	Polyamide	Polyamide
	Mounting			
Element	Tag No.	PE-2121	PE-2221	PE-3123
	Sensor Type	Integral	Integral	Integral
	Measurement Range	0 - 400 kPa	0 - 400 kPa	0 - 400 kPa
	Element Material	Stainless Steel	Stainless Steel	Stainless Steel
	Line Size (mm)			
	Enclosure Rating	NEMA 7	NEMA 7	NEMA 7
	Enclosure Material	316L SS	316L SS	316L SS
	Process Connection	Red Valve Series 48	Red Valve Series 48	Red Valve Series 48
Access	Name Plate	Yes	Yes	Yes
	Connection Plug	Yes	Yes	Yes
	Mounting Bracket	Yes	Yes	Yes
	Isolation Valve and/or Manifold	Quick Disconnect	Quick Disconnect	Quick Disconnect
Approval / Enclosure		CSA	CSA	CSA
Class / Division / Group		Class I Division 1, 2	Class I Division 1, 2	Class I Division 1, 2
Comment				
Manufacturer		Siemens	Siemens	Siemens
Model Number		Sitrans P320	Sitrans P320	Sitrans P320
Alternates				

Notes:

1. Vendor to supply Stainless Steel Tag with Instrument Tag Number clearly stamped on it.
2. Vendor is to fill in missing data in this specification sheet relevant to the device (i.e. model #)
3. Contractor is to supply mounting hardwate appropriate for the application.
4. Dirty service transmitter to be factory installed and calibrated with Red Valve Series 48 Pressure Sensor.

No.	Date	By	Chkd	Appd	Revision
1	2025-01-22	M.M.	B.M.	B.M.	Issued for Tender

INSTRUMENT DATA SHEET

PRESSURE TRANSMITTERS

Project	Client	Town of Greater Napanee	Project No.	22001
	Location	New Napanee WPCP	Instrument Spec.	25 10 02
			Revision	1

General	Tag Number	PE/PT 3223
	Description of Instrument	Pressure Element/Transmitter
	Service	THK-T-3223
	P&ID No.	P0007
	Line Tag	80-TWAS-SS1
	Line Size (mm)	80
Process / Fluid Data	Fluid	Thickened Waste activated sludge
	Oper. Press Norm / Max (kPa)	
	Oper. Temp Norm / Max (°C)	14/23
	Ambient Temperature (°C)	5 - 30
	S.G. @ Oper. Temp	1.00
	Viscosity @ Oper. Temp	1.10
	Measurement Function	Pressure
Transmitter	Tag No.	PT-3223
	Transmitter Type	Loop Powered
	Power Requirement	24VDC
	Electrical Connection	1/2" NPT
	Contact Type	
	Display Type	Digital LCD Integral Display
	Instrument Range	0 - 400 kPa
	Operating Range	0 - 400 kPa
	Output Signal	4 - 20 mA
	Accuracy / Repeatability	±0.065%
	Enclosure Rating	NEMA 7
	Enclosure Material	Polyamide
	Mounting	
Element	Tag No.	PE-3223
	Sensor Type	Integral
	Measurement Range	0 - 400 kPa
	Element Material	Stainless Steel
	Line Size (mm)	
	Enclosure Rating	NEMA 7
	Enclosure Material	316L SS
	Process Connection	Red Valve Series 48
Access	Name Plate	Yes
	Connection Plug	Yes
	Mounting Bracket	Yes
	Isolation Valve and/or Manifold	Quick Disconnect

Approval / Enclosure	CSA	NEMA 4X
Class / Division / Group	Class I Division 1, 2	
Comment		
Manufacturer	Siemens	
Model Number	Sitrans P320	
Alternates		

Notes:

1. Vendor to supply Stainless Steel Tag with Instrument Tag Number clearly stamped on it.
2. Vendor is to fill in missing data in this specification sheet relevant to the device (i.e. model #)
3. Contractor is to supply mounting hardwate appropriate for the application.
4. Dirty service transmitter to be factory installed and calibrated with Red Valve Series 48 Pressure Sensor.

No.	Date	By	Chkd	Appd	Revision	
1	2025-01-22	M.M.	B.M.	B.M.	Issued for Tender	

ANALYTICAL ELEMENTS

PART 1 GENERAL

1.1 SHOP DRAWINGS AND PRODUCT DATA

.1 This section specifies the supply installation, field testing, and placing into operation of various analytical instruments as described below, and as provided in but not limited to the attached Instrumentation Data Sheets (AE/AIT).

.2 The attached data sheets only indicate instruments to be supplied by Div. 25. Refer to contract drawings and shop drawings for instruments supplied by preselected equipment suppliers.

.3 Responsibility shall include supply and installation of all component and Vendor subsystems as to provide a fully functioning system, including supervision, calibration, checkout, start-up operating adjustment and documentation, tagging and compliance with data sheets.

.4 Submit shop drawings and product data in accordance with Section 01 33 00 – Submittals.

.5 The measuring elements of instrumentation designated for hazardous locations must be in full compliance with the OESC.

1.2 DELIVERY, STORAGE AND HANDLING

.1 Ship assembled to the degree which is possible. Inform installer of site assembly requirements.

1.3 RELATED SECTIONS

.1 Section 01 33 00 - Submittals

.2 Section 01 91 13 - Commissioning Requirements

.3 Section 01 91 33 - Commissioning Forms

.4 Section 01 91 41 - Commissioning Training

.5 Section 44 00 10 - Process General Requirements

.6 Section 26 00 10 - Electrical General Requirements

1.4 REFERENCES

.1 ISA RP12.06.01-2003, Recommended Practice for Wiring Methods for Hazardous (Classified) Locations Instrumentation, Part 1: Intrinsic Safety.

.2 CSA C22.2 No. 0.3-01 (R2005), Test Methods for Electrical Wires and Cables

PART 2 PRODUCTS

2.1 MATERIAL

.1 All instrumentation, control, and electrical devices provided under this Section shall be CSA approved and shall bear the CSA approvals seal.

.2 Provide each instrument with mechanisms that are corrosion resistant.

.3 Provide each instrument with mechanisms enclosed in a dust-proof and a moisture-proof case (unless stated otherwise).

.4 Provide all indicator and gauge dials finished in permanent white with black graduations and figures.

.5 Each component and composite instrument shall be suitable for the location and installation position at the attitude designated on the drawings. (eg. horizontal, vertical or sloped position.)

.1 If sensing systems utilize probes then the probes shall be braced to the structure with a minimum of two 316 SS clamps to prevent sensor movement for any reason.

.2 Sensing units shall be mounted so that interference to the sensing function is not caused by surrounding structures. The sensor shall preferably be mounted on its own support, purpose built to manufactures recommendations, to facilitate maintenance and/or adjustment.

.6 Each instrument shall be complete with supplier manufactured mounting flanges and/or brackets. The flanges shall conform to Division 44.

.7 Where amplifier/transmitter electronics is installed in an explosive environment, the housings shall be suitable for the application. (i.e. Class 1, Div 2 and suited to a wet and corrosive environment.)

.8 Provide each instrument powered with 120 VAC with a circuit protector fuse / breaker.

.9 All control panel mounted instruments shall be suitable for flush mounting and shall be furnished with bezel.

2.2 COMBINATION PH/TEMP METERS

.1 PH Systems shall be suitable for the measurement of pH in the fluids of wastewater treatment plant and also suitable for measurement of pH of final treated and filtered water.

.2 Equipment will include the pH electrode assembly, a remote mounted transmitter enclosure, and interconnecting cable between the electrode assembly and transmitter enclosure. The Contractor shall install the electrode assembly and transmitter enclosures at the approximate locations indicated on the Drawings.

.3 Mounting and installation hardware shall be 316L stainless steel. If necessary, the Contractor shall provide and install a pipe section for installation of the transducer. A multi-pole receptacle shall be provided and installed for connection of each electrode assembly as detailed in Installation Standards.

.4 The Contractor shall install and terminate the interconnecting cable between the element and transmitter. Power and control cable connections between the transmitter and remote devices shall be provided as specified elsewhere in the Contract Documents.

.5 The transmitters shall need to be field calibrated by the Contractor. The Contractor shall make adjustments to setup, zero and span settings or other adjustments as required to calibrate the instruments.

.6 The Contractor shall be responsible for start-up and testing of the devices and shall perform loop or continuity testing to verify that all electrical connections are correct. Testing shall be in accordance with the testing standards, specified elsewhere in the Contract Documents.

.7 Electrode for combined pH and temperature measurement c/w measuring cables and immersion assembly. (Probe shall include guard against mechanical damage). Typical pH range of 2 - 12 pH with integral PT-100 temperature compensation. Temperature range: -15 - 80°C.

.8 Tools and spare parts shall be furnished and packaged in accordance with Section 44 00 10 – General Process Requirements; Spare Parts. As a minimum, the following spare parts shall be furnished:

.1 One (1) complete spare pH/temperature electrode assembly.

.9 If not already allowed for elsewhere, provide handheld calibration tool as may be required.

2.3 COMBINATION ORP/TEMP METERS

.1 Jamie to add specs.

2.4 SUSPENDED SOLIDS METERS

.1 Jamie to add specs.

2.5 UV ABSORBANCE TRANSMITTANCE

.1 UV Transmittance system shall be capable of continually measuring UV absorbance and transmittance in water.

.2 The method of measuring UV absorbance and percent transmittance will be by determining the Spectral Absorption Coefficient (SAC) at a wavelength of 254 mm using a 2-beam ultra-violet absorption technology with a 1, 2, 5 or 50 mm path length.

.3 Equipment will include an immersion style probe assembly, a remote mounted transmitter enclosure, and interconnecting cable between the probe assembly and transmitter enclosure. The Contractor shall install the probe assembly and transmitter enclosures at the approximate locations indicated on the Drawings.

.4 Mounting and installation hardware shall be 316L stainless steel. A multi-pole receptacle shall be provided and installed for connection of each probe assembly as detailed in Installation Standards.

.5 The Contractor shall install and terminate the interconnecting cable between the element and transmitter. Power and control cable connections between the transmitter and remote devices shall be provided as specified elsewhere in the Contract Documents.

.6 The transmitters shall need to be field calibrated by the Contractor. The Contractor shall make adjustments to setup, zero and span settings or other adjustments as required to calibrate the instruments.

.7 The Contractor shall be responsible for start-up and testing of the devices and shall perform loop or continuity testing to verify that all electrical connections are correct. Testing shall be in accordance with the testing standards, specified elsewhere in the Contract Documents.

.8 Insertion/Immersion Probe assemblies c/w measuring cables. Transmitter Output/Display value (%).

.9 Typical range of 0 – 60 m^{-1} at 50 mm.

.10 Tools and spare parts shall be furnished and packaged in accordance with Section 44 00 10 – General Process Requirements. As a minimum, the following spare parts shall be furnished:

.1 One calibration kit and one-year of spare swiper blades.

.11 If not already allowed for elsewhere, provide handheld calibration tool as may be required.

.12 Acceptable Manufacturers: HACH Solitax Units shall be suitable for both suspended immersion application and retractable insertion into pipe as indicated in the design drawings.

2.6 DISSOLVED OXYGEN METERS

.1 Jamie to add specs.

PART 3 EXECUTION

3.1 INSTALLATION

.1 Carry out installation, calibration and adjustment in accordance with manufacturer's installations instructions, recommended practices and as indicated on drawings and elsewhere in these specifications.

.2 All mounting plates, pedestals, bolts, shims, angle iron and other miscellaneous steel or hardware items required for the securing of equipment shall be supplied unless specifically noted otherwise.

.3 All instruments to be installed in accordance with the Manufacturer's installation instructions.

.4 Instruments or raceway will be installed so as not to obstruct access routes, equipment maintenance space or space for future equipment.

.5 Instrument supports shall be located and installed to provide a fully supported, secure system with minimum vibration.

3.2 INDICATORS

.1 Select instruments so that normal operating point is just above midpoint of instrument range. (60 – 70%)

.2 All indications shall be displayed on a linear scale unless otherwise specified. Local indicators shall be in engineering units.

3.3 START-UP

.1 The contractor shall have manufacturer's representative check and verify that instrumentation installation is in accordance with drawings and manufacturer's installation instructions.

.2 The contractor shall have manufacturer's representative instruct plant personnel on operation and maintenance of filters.

.3 The manufacturer shall include two (2) trips to the site, each 2 days: one (1) trip to start-up and calibration and one (1) trip to train the operators.

.4 Upon completion of testing of each device, affix a tag to the instrument certifying that calibration and testing have been completed and specifying the calibration points. Include loop check sheet and instrument calibration sheets in instruction books.

END OF SECTION

INSTRUMENT DATA SHEET

ANALYZING TRANSMITTERS

Project	Client	Town of Greater Napanee	Project No.	22001
	Location	New Napanee WPCP	Instrument Spec.	25 10 05
			Revision	1

General	Tag Number	AE/AIT-1003	AE/AIT 3027
	Description of Instrument	pH and Temperature	TWAS
	Service	Headworks Inlet Channel	TWAS to digester
	P&ID No.	P0003	P0007
	Line Tag	TRENCH-IN-CONC 750W x 1500D	100-TWAS-SS1
	Line Size (mm)	750W x 1500D	100
Process / Fluid Data	Fluid	Raw sewage	Thickened Waste Activated Sludge
	Oper. Press Norm / Max (kPa)	14/23	14/23
	Oper. Temp Norm / Max (°C)	5 - 30	5 - 30
	Ambient Temperature (°C)	1	1
	S.G. @ Oper. Temp	1.1	1.1
	Viscosity @ Oper. Temp		
	Measurement Function	pH, Temperature	Turbidity, Suspended Solids
Transmitter	Tag No.	AIT-1003	AIT 3027
	Transmitter Type	Single Channel Remote	Single Channel Remote
	Power Requirement	120V	120V
	Electrical Connection	1/2" NPT	1/2" NPT
	Contact Type		
	Display Type	Digital LCD Integral Display	Digital LCD Integral Display
	Instrument Range		
	Operating Range		
	Output Signal	Dual 4 - 20 mA (pH, Temp)	4 - 20 mA
	Accuracy	<1%	
	Enclosure Rating	NEMA 4X	NEMA 4X
	Enclosure Material	Metal w/ Corrosion Resistant Finish	Metal w/ Corrosion Resistant Finish
	Mounting	Wall Mount	Wall Mount
Element	Tag No.	AE/TE-1003	AE 3027
	Sensor Type	pH, Temp	TSS
	Measurement Range	-2 to 14 pH / 0 to 50 deg C	Turb.: 0.001 to 4000 NTUSus. Solids: 0.001 mg/L to 500 g/L
	Element Material	Glass, General Purpose	
	Enclosure Rating	NEMA 4X	NEMA 4X
	Enclosure Material	Stainless Steel	Stainless Steel
	Process Connection	Immersion Probe	Immersion Probe
Access	Name Plate	Yes	Yes
	Connection Plug	Quick Disconnect	Quick Disconnect
	Sensor Mounting Assembly	Immersion Type	Immersion Type
	Mounting Straps	Standard Hardware	Standard Hardware
Approval / Enclosure		CSA, NEMA 4X	CSA, NEMA 4X
Class / Division / Group		Class 1, Div. 1, Group D	Unclassified
Comment			
Manufacturer		HACH	HACH
Model Number		DPS1 c/w SC200 Controller	Solitax sc c/w SC200 Controller
Alternates			

Notes:

1. Vendor to supply Stainless Steel Tag with Instrument Tag Number clearly stamped on it.
2. Vendor is to fill in missing data in this specification sheet relevant to the device (i.e. model #)
3. Contractor is to supply mounting hardwate appropriate for the application.

No.	Date	By	Chkd	Appd	Revision	
1	2025-01-22	M.M.	B.M.	B.M.	Issued for Tender	

INSTRUMENT DATA SHEET

ANALYZING TRANSMITTERS

Project	Client	Town of Greater Napanee	Project No.	22001
	Location	New Napanee WPCP	Instrument Spec.	25 10 05
			Revision	1

General	Tag Number	AE/AIT 4120	
	Description of Instrument	ORP, pH and Temperature	
	Service	UV Influent Channel	
	P&ID No.	P0009	
	Line Tag		
	Line Size (mm)		
Process / Fluid Data	Fluid	Tertiary Effluent	
	Oper. Press Norm / Max (kPa)	14/23	
	Oper. Temp Norm / Max (°C)	5 - 30	
	Ambient Temperature (°C)	1.00	
	S.G. @ Oper. Temp	1.10	
	Viscosity @ Oper. Temp		
	Measurement Function	ORP, pH and Temperature	
Transmitter	Tag No.	AIT 4120	
	Transmitter Type	Dual Channel Remote	
	Power Requirement	120V	
	Electrical Connection	1/2" NPT	
	Contact Type		
	Display Type	Digital LCD Integral Display	
	Instrument Range		
	Operating Range		
	Output Signal	Dual 4 - 20 mA (ORP, pH, Temp)	
	Accuracy	<1%	
	Enclosure Rating	NEMA 4X	
	Enclosure Material	Metal w/ Corrosion Resistant Finish	
	Mounting	Wall Mount	
Element	Tag No.	AE/TE 4120A	AE 4120B
	Sensor Type	pH, Temp	ORP
	Measurement Range	-2 to 14 pH / 0 to 50 deg C	-1500 to 1500 mV
	Element Material	Glass, General Purpose	Platinum
	Enclosure Rating		
	Enclosure Material	NEMA 4X	NEMA 4X
	Process Connection	Stainless Steel	Stainless Steel
Access	Name Plate	Immersion Probe	Immersion Probe
	Connection Plug	Yes	Yes
	Sensor Mounting Assembly	Quick Disconnect	Quick Disconnect
	Mounting Straps	Immersion Type	Immersion Type
Approval / Enclosure		Standard Hardware	Standard Hardware
Class / Division / Group		CSA, NEMA 4X	CSA, NEMA 4X
Comment		Unclassified	Unclassified
		2 sensors connected to single SC1000 controller	2 sensors connected to single SC1000 controller
Manufacturer		HACH	HACH
Model Number		DRS5 c/w SC1000 Controller	DRS5 c/w SC1000 Controller
Alternates			

Notes:

1. Vendor to supply Stainless Steel Tag with Instrument Tag Number clearly stamped on it.
2. Vendor is to fill in missing data in this specification sheet relevant to the device (i.e. model #)
3. Contractor is to supply mounting hardwate appropriate for the application.

No.	Date	By	Chkd	Appd	Revision	
1	2025-01-22	M.M.	B.M.	B.M.	Issued for Tender	

FLOW METERS

PART 1 GENERAL

1.1 SHOP DRAWINGS AND PRODUCT DATA

.1 This section specifies the supply (for those instruments not included within the supply of a pre-selected equipment package), installation, field testing, and placing into operation of all flow meters (including those supplied as part of a pre-selected equipment package), various level elements and flow transducers/transmitters as specified below, and as identified in but not limited to the attached Instrumentation Data Sheets and on the Contract Drawings.

.2 The attached data sheets only indicate instruments to be supplied by Div. 25. Refer to contract drawings and shop drawings for instruments supplied by preselected equipment suppliers.

.3 Responsibility shall include supply and installation of all component and Vendor subsystems as to provide a fully functioning system, including supervision, calibration, checkout, start-up operating adjustment and documentation, tagging and compliance with data sheets.

.4 Submit shop drawings and product data in accordance with Section 01 33 00 – Submittals.

.5 The measuring elements of instrumentation designated for hazardous locations must be in full compliance with the OESC.

1.2 DELIVERY, STORAGE AND HANDLING

.1 Ship assembled to the degree which is possible. Inform installer of site assembly requirements.

1.3 RELATED SECTIONS

.1 Section 01 33 00 - Submittals

.2 Section 01 91 13 - Commissioning Requirements

.3 Section 01 91 33 - Commissioning Forms

.4 Section 01 91 41 - Commissioning Training

.5 Section 44 00 10 - Process General Requirements

.6 Section 26 00 10 - Electrical General Requirements

1.4 REFERENCES

.1 ISA RP12.06.01-2003, Recommended Practice for Wiring Methods for Hazardous (Classified) Locations Instrumentation, Part 1: Intrinsic Safety.

.2 CSA C22.2 No. 0.3-01 (R2005), Test Methods for Electrical Wires and Cables

1.5 COMMISSIONING AND TRAINING

.1 Commissioning, training, and closeout documents are to be carried out in accordance with Section 01 91 13, Section 01 91 33, and Section 01 91 41.

.2 Also submit the following:

.1 Manufacturer's calibration certificates.
.2 Instrument field calibration sheets.
.3 Instrument field loop check sheets.

PART 2 PRODUCTS

2.1 GENERAL

.1 All instrumentation, control, and electrical devices provided under this Section shall be CSA approved and shall bear the CSA approvals seal as detailed in Section 44 00 10 - Process General Requirements.

.2 Provide each instrument with mechanisms and enclosures that are corrosion resistant.

.3 Provide each instrument with mechanisms enclosed in a dust-proof and a moisture-proof case.

.4 Provide all indicator and gauge dials finished in permanent white with black graduations and figures.

.5 Each component shall be carefully selected and designed for a long lifetime with ample margin to withstand transient and other surge voltages which may occur in the circuits from any source in the power supply.

.6 Each component and composite instrument shall be suitable for the location and installation position at the attitude designated on the drawings, eg., horizontal, vertical or sloped position.

.1 If sensing systems utilize probes then the probes shall be braced to the structure with a minimum of two 316 SS clamps to prevent sensor movement for any reason.
.2 Where probes are suspended into vessels or chambers, stilling tubes shall be used to prevent excessive movement.
.3 Sensing units shall be mounted so that interference to the sensing function is not caused by surrounding structures. The sensor shall preferably be mounted on its own support, purpose built to manufactures recommendations, to facilitate maintenance and/or adjustment.

.7 Where amplifier/transmitter electronics is installed in an explosive environment, the housings shall be suitable for the application. i.e. Class 1, Div 1 and suited to

a wet and corrosive environment. Each of the Flow meter instruments supplied for this project must meet this requirement.

2.2 MAGNETIC FLOWMETERS

.1 Magnetic flowmeters shall be completely obstruction less, in-line meters with no constrictions in the flow of fluid through the meter. The meter shall consist of a metallic tube with flanged ends and with grounding rings. Flange diameter and bolt drilling pattern shall comply with ANSI/ASME B16.5, Class 150. Flangeless wafer insert style meters may be used for pipe sizes up to 150 mm, where compatible with adjacent piping flanges. Meters shall be suitable for the maximum range of working pressures of the adjacent piping. Electrode and liner material shall be fully compatible with the process fluid. Each meter shall be factory calibrated, at a facility which is traceable to NIST or other standard acceptable to the Engineer. A copy of the calibration report shall be submitted.

.2 The meter shall be capable of standing empty for extended periods of time without damage to any components. The meter housing shall withstand submergence in 10 m of water for 48 hours without damage.

.3 Magnetic flowmeter systems shall provide zero flow stability by means of automatic zero adjustment of a DC excited metering circuit. Converters shall be capable of bi-directional flow measurement. Signal converters shall be of the same manufacturer as the flow element.

.4 Signal cable from the meter to signal converter shall be provided by the meter manufacturer. A minimum of three meters of interconnecting cable shall be provided. The signal converter shall be housed in a corrosion-resistant, weatherproof, EEMAC 4 enclosure, suitable for wall or pipe strut mounting. The signal converter shall be suitable for operation over an ambient temperature range of -34 to 60°C, and a relative humidity of 10-100%.

.5 Each magnetic flowmeter shall be provided with an optional remote mounted or integral, microprocessor-based signal converter (transmitter). The signal converter shall include output damping, self-testing, built-in calibration capability, and an “empty pipe zero” contact input. The overall accuracy of the magnetic flowmeter signal converter shall be ±0.5% of actual flowrate for full-scale flow settings of 1-10 m per second. Converter output shall be linear with flowrate. The signal converter shall be provided with an integral four digit LCD indicator, scaled in engineering units.

.6 The signal converter shall be housed in a corrosion-resistant, weatherproof, EEMAC 4 enclosure, suitable for wall or pipe strut mounting. The signal converter shall be suitable for operation over an ambient temperature range of -34 to 60°C, and a relative humidity of 10-100%.

.7 Each transmitter shall be powered from 120 volts AC, 60 Hz, single phase. A multi-pole receptacle shall be provided on the transmitter enclosure for connection of AC power via a cordset in accordance with Installation Standards.

.8 Magnetic flowmeters shall be factory calibrated by the Contractor to the flow ranges indicated in the Instrument Data Sheets. Copies of the factory calibration data sheets shall be submitted in accordance with the applicable sections of the Contract Documents.

.9 Each magnetic flowmeter system shall be provided with all required mounting hardware to mount both the element and transmitter according to the mounting requirements indicated in the Instrument Data Sheet. Mounting and installation hardware shall be 316L stainless steel or other material approved by the flowmeter manufacturer for use in the specified conditions.

.10 For systems where the primary element and transmitter are physically separated, interconnecting cable from the element to the transmitter shall be provided. The cable shall be the type approved by the flowmeter manufacturer for the intended purpose of interfacing the element to the transmitter. Length of cable shall be a minimum of three meters or as indicated in the Instrument Data Sheet.

.11 For systems which require a dedicated programming device for calibration, maintenance, or troubleshooting, one such programming device shall be provided for each location. The programming device shall include appropriate operation manuals and shall be included in the training requirements. For systems which allow the programming device functions to be implemented in software, running on a laptop computer, the software shall be provided instead of the programming device.

.12 Transmitters indicated as requiring a serial interface shall be provided with all accessories required to properly communicate over the serial link. As a minimum, an appropriate cable shall be provided to allow the transmitter serial interface to be connected to a personal computer. One licensed copy of the diagnostic/interface software shall be provided for each facility (two total). Software shall be capable of running under Microsoft's Windows XP operating system. If the software furnished performs the same functions as the programming device, specified elsewhere, then the programming device shall not be furnished.

.13 Tools and spare parts shall be furnished as recommended by the manufacturer. As a minimum, the following spare parts shall be furnished:

.1 Two spare fuses of each type required.

.14 Acceptable Manufacturers:

.1 Siemens
.2 ABB
.3 Endress+Hauser
.4 Yokogawa

2.3 THERMAL MASS FLOW METERS

.1 Flow Element - The flow element shall be a thermal dispersion type, explosion-proof, stainless steel sensing element, suitable for insertion into the specified process piping. For process piping 50 mm and greater, the element shall be

fabricated to allow insertion into the pipe, with the insertion length recommended by the manufacturer. For systems measuring flow in pipe sizes less than 50 mm, the sensor shall be integrally mounted to a pipe spool piece with flanged connections. Spool piece materials of construction shall match the process pipe in which the flow meter is to be installed. Each removable sensor shall be provided with an isolation valve and packing gland which allows insertion removal, and adjustment while the piping is under pressure.

.2 Transmitter - The transmitter shall be a microprocessor based unit housed in a remote mounted NEMA Type 4 enclosure. The transmitter electronics shall accept the signal input from the flow element and output an isolated 4-20mA DC signal linearly proportional to the measured flow rate. The transmitter shall be provided with an integral 3-1/2 digit LCD indicator, calibrated in liters per second and m^3 per day. The transmitter shall also be capable of displaying a totalized flow rate and the process temperature.

.3 Mounting Hardware - Each flow metering system shall be provided with all required mounting hardware to mount both the element and transmitter according to the mounting requirements of the flowmeter manufacturer. Mounting and installation hardware shall be 316L stainless steel or other material approved by the sensor manufacturer and suited for use in the specified process stream (as indicated in the Instrument Data Sheets). The supplier shall include the restraints, retractors, cable glands, conduit seals, cable, compression fittings, packing glands and ball valves (see Section 44 10 74 for valve specification).

.4 Interconnecting Cable - For systems where the primary element and transmitter are physically separated, interconnecting cable from the element to the transmitter shall be provided. The cable shall be the type approved by the flowmeter system manufacturer for the intended purpose of interfacing the element to the transmitter. Length of cable shall be three meters minimum, or as indicated in the Instrument Data Sheet.

.5 Programming Device - For systems which require a dedicated programming device for calibration, maintenance, or troubleshooting, one such programming device shall be provided. The programming device shall include appropriate operation manuals and shall be included in the training requirements.

.6 Tools and Spare Parts - Tools and spare parts shall be furnished and packaged in accordance with Section 44 00 10. As a minimum, the following spare parts shall be furnished for each flow metering system:

.1 2 spare fuses for each type required.

.2 2 spare flow elements.

.7 Standard of Acceptance: Kurz Series 454FTB-

PART 3 EXECUTION

3.1 INSTALLATION

.1 Install all instruments in strict accordance with the recommendation of the manufacturer.

.2 The in-line mechanical installation of items such as flow-meters, is specified in Division 44, Process Mechanical for all vendor packages.

.3 Carry out installation, calibration and adjustment in accordance with manufacturers installations instructions, recommended practices and as indicated on drawings and elsewhere in these specifications.

3.2 EQUIPMENT MOUNTING

.1 All mounting plates, pedestals, bolts, shims, angle iron and other miscellaneous steel or hardware items required for the securing of equipment shall be supplied unless specifically noted otherwise.

.2 All instruments to be installed in accordance with the Manufacturer's installation instructions.

.3 Each instrument sensing line shall be complete with an isolation valve. The isolation valves shall conform to Divisions 44 equipment requirements.

.4 Instruments or raceway will be installed so as not to obstruct access routes, equipment maintenance space or space for future equipment.

.5 Where the removal of filter cartridges and heater elements is necessary, attention will be paid to instrument locations and tubing runs.

.6 Instrument supports shall be located and installed to provide a fully supported, secure system with minimum vibration.

3.3 WIRE AND CABLE

.1 Instrumentation cables shall be as described by Division 25 and 26 of this specification. Single pair twisted shielded cable to be run in conduit. Multi-pairs shall be Teck run in cable tray.

.2 Control wiring shall be either multi-conductor Teck run in cable tray or single conductor wire run in conduit.

3.4 GAUGES AND INDICATORS

.1 Install primary sensors or indicators in uninterrupted straight pipe, minimum 3 pipe diameters downstream and 3 pipe diameters upstream, on supply lines downstream of pumps, or according to manufacturer's recommendations.

.2 Select instruments so that normal operating point is just above midpoint of instrument range. (60 – 70%)

.3 All indications shall be displayed on a linear scale unless otherwise specified. Local indicators shall be in engineering units.

3.5 TESTING

.1 These devices will be field calibrated by the Contractor. The Contractor shall be responsible for start-up and testing of the devices and shall perform loop or continuity testing to verify that all electrical connections are correct. Testing shall be in accordance with the testing standards, specified elsewhere in the Contract Documents.

.2 During testing demonstrate proper calibration and correct operation to the Owners Representative.

.3 Upon completion of testing of each device, affix a tag to the instrument certifying that calibration and testing have been completed and specifying the calibration points. Include loop check sheet and instrument calibration sheets in instruction books.

3.6 COMMISSIONING

.1 Notwithstanding the requirements of all other sections of this contract as they relate to commissioning, commissioning of the instrumentation and control system shall include, but not be limited to the following:

.1 Supervise installation of components, wiring connections and piping connections.

.2 Supervise wiring continuity and pipe leak tests.

.3 Verify instrument calibration and provide written report.

.4 Function check and adjust under operational conditions the instruments and control equipment.

.5 Coordinate instrument and control equipment supplier’s service personnel as required for complete system testing.

.6 Instruct plant personnel in correct method of operation of instruments and control equipment.

.7 Direct plant personnel at hand-over as to final adjustment to the system for correct operation of plant.

.8 Ensure that the instrumentation and control equipment suppliers cooperate to complete the work of this section.

.9 Verify signal levels and wiring connections to all instrumentation and control equipment.

END OF SECTION

INSTRUMENT DATA SHEET

FLOW TRANSMITTERS

Project	Client	Town of Greater Napanee	Project No.	22001
	Location	New Napanee WPCP	Instrument Spec.	25 10 05
			Revision	1

General	Tag Number	FE/FT 1004	FE/FT 1165	FE/FIT 2123
	Description of Instrument	Electromagnetic Flowmeter	Electromagnetic Flowmeter	Electromagnetic Flowmeter
	Service	Septage Receiving	Influent sewage to AGS reactors	Supernatant from sludge buffer tank to IPS
	P&ID No.	P0003	P0004	P0006
	Line Tag	150-SEP-SS1	600-IN-SS1	100-SN-DR1
	Line Size (mm)	150	600	100
Process / Fluid Data	Fluid	Raw Septage	Activated sludge	Supernatant
	Oper. Press Norm/Max (kPa)			
	Oper. Temp Norm/Max (°C)	14/23	14/23	14/23
	Ambient Temperature	5 - 30	5 - 30	5 - 30
	S.G. @ Oper. Temp	1.0	1.0	1.0
	Viscosity @ Oper. Temp	1.1	1.1	1.1
	Turbidity (NTU)/TDS (mg/L)			
	Measurement Function	Flow rate - Volume Totalizer	Flow rate	Flow rate
Transmitter	Tag No.	FT 1004	FT 1165	FIT 2123
	Transmitter Type	Remote	Remote	Remote
	Power Requirement	120VAC	120VAC	120VAC
	Electrical Connection	1/2" NPT	1/2" NPT	1/2" NPT
	Contact Type	n/a	n/a	n/a
	Display Type	Digital LCD Integral Display	Digital LCD Integral Display	Digital LCD Integral Display
	Instrument Range			
	Operating Range			
	Output Signal	4 - 20 mA and Pulsed	4 - 20 mA	4 - 20 mA
	Accuracy / Repeatability	±0.2% ± 1 mm/s	±0.2% ± 1 mm/s	±0.2% ± 1 mm/s
	Enclosure Rating	NEMA 4X	NEMA 4X	NEMA 4X
	Enclosure Material	Polyamide	Polyamide	Polyamide
	Mounting	Wall Mount	Wall Mount	Wall Mount
Element	Tag No.	FE 1004	FE 1165	FE 2123
	Sensor Type	DC MAG	DC MAG	DC MAG
	Measurement Range			
	Element Material	Hastelloy C276	Hastelloy C276	Hastelloy C276
	Tube Size	150	600	100
	Enclosure Rating	NEMA 7/6	NEMA 7/6	NEMA 7/6
	Enclosure Material	Carbon steel	Carbon steel	Carbon steel
	Process Connection	ANSI B16.5, class 150	ANSI B16.5, class 150	ANSI B16.5, class 150
Access	Name Plate	Yes	Yes	Yes
	Connection Plug	Yes	Yes	Yes
	Mounting Bracket	Yes	Yes	Yes
	Isolation Valve and/or Manifold			
Approval / Enclosure				
Class / Division / Group		Class I Division 1, 2	Class I Division 1, 2	Class I Division 1, 2
Comment				
Manufacturer		Siemens	Siemens	Siemens
Model Number		Sitrans FM MAG 5100W c/w MAG6000	Sitrans FM MAG 5100W c/w MAG6000	Sitrans FM MAG 5100W c/w MAG6000
Alternates				

Notes:

1. Vendor to supply Stainless Steel Tag with Instrument Tag Number clearly stamped on it.
2. Vendor is to fill in missing data in this specification sheet relevant to the device (i.e. model #)
3. Contractor is to supply mounting hardwate appropriate for the application.
4. Dirty service transmitter to be factory installed and calibrated with Red Valve Series 40 Pressure Sensor.

No.	Date	By	Chkd	Appd	Revision	
1	2025-01-22	M.M	B.M.	B.M.	Issued for Tender	

INSTRUMENT DATA SHEET

FLOW TRANSMITTERS

Project	Client	Town of Greater Napanee	Project No.	22001
	Location	New Napanee WPCP	Instrument Spec.	25 10 05
			Revision	1

General	Tag Number	FE/FIT 3027	FIT 3451	FE/FIT 4100
	Description of Instrument	Electromagnetic Flowmeter	Thermal Mass Flowmeter	Electromagnetic Flowmeter
	Service	TWAS from thickeners to digesters	Blower air to AGS Effluent Weir	Secondary effluent from AGS to tertiary treatment
	P&ID No.	P0007	P0010	P0008
	Line Tag	65-TWAS-SS1	100-AA-SS1-25PP	450-SE-SS1
	Line Size (mm)	65	100	450
Process / Fluid Data	Fluid	TWAS	Blower air	Secondary effluent
	Oper. Press Norm/Max (kPa)			
	Oper. Temp Norm/Max (°C)	14/23	14/23	14/23
	Ambient Temperature	5 - 30	5 - 30	5 - 30
	S.G. @ Oper. Temp	1.0	1.0	1.0
	Viscosity @ Oper. Temp	1.1	1.1	1.1
	Turbidity (NTU)/TDS (mg/L)			
	Measurement Function	Flow rate	Flow rate	Flow rate
Transmitter	Tag No.	FIT 3027	FIT 3451	FIT 4100
	Transmitter Type	Remote	Integral	Remote
	Power Requirement	120VAC	120VAC	120VAC
	Electrical Connection	1/2" NPT	1/2" NPT	1/2" NPT
	Contact Type	n/a	N/A	n/a
	Display Type	Digital LCD Integral Display	Digital LCD Integral Display	Digital LCD Integral Display
	Instrument Range		0 - 70000 SFPM	
	Operating Range			
	Output Signal	4 - 20 mA	4 - 20 mA (Dual) Flow and Temp	4 - 20 mA
	Accuracy / Repeatability	±0.2% ± 1 mm/s	Flow: ± 1% / Temp: ±0.5%	±0.2% ± 1 mm/s
	Enclosure Rating	NEMA 4X	NEMA 4	NEMA 4X
	Enclosure Material	Polyamide	Aluminum	Polyamide
	Mounting	Wall Mount	Process Piping	Wall Mount
Element	Tag No.	FE 3027	FE 3351	FE 4100
	Sensor Type	DC MAG	Equal Mass	DC MAG
	Measurement Range		0 - 70000 SFPM	
	Element Material	Hastelloy C276	C276 alloy	Hastelloy C276
	Tube Size	65	100	450
	Enclosure Rating	NEMA 4X/6	N/A	NEMA 4X/6
	Enclosure Material	Carbon steel	ess steel or aluminum or polycarbonate (re	Carbon steel
	Process Connection	ANSI B16.5, class 150	3/4" or 1" NPT	ANSI B16.5, class 150
Access	Name Plate	Yes	Yes	Yes
	Connection Plug	Yes	Yes	Yes
	Mounting Bracket	Yes		Yes
	Isolation Valve and/or Manifold			

Approval / Enclosure			CSA, NEMA 4X	NEMA 4x
Class / Division / Group	Class I Division 1, 2		Unclassified	
Comment				
Manufacturer	Siemens		Kurz	Siemens
Model Number	Sitrans FM MAG 5100W c/w MAG6000		Series 454 FTB	Sitrans FM MAG 5100W c/w MAG6000
Alternates				

Notes:

1. Vendor to supply Stainless Steel Tag with Instrument Tag Number clearly stamped on it.
2. Vendor is to fill in missing data in this specification sheet relevant to the device (i.e. model #)
3. Contractor is to supply mounting hardwate appropriate for the application.
4. Dirty service transmitter to be factory installed and calibrated with Red Valve Series 40 Pressure Sensor.

No.	Date	By	Chkd	Appd	Revision	
1	2025-01-22	M.M	B.M.	B.M.	Issued for Tender	

INSTRUMENT DATA SHEET

FLOW TRANSMITTERS

Project	Client	Town of Greater Napanee	Project No.	22001
	Location	New Napanee WPCP	Instrument Spec.	25 10 05
			Revision	1

General	Tag Number	FE/FIT 4200	FE/FIT 4300	FE/FT 6015
	Description of Instrument	Electromagnetic Flowmeter	Electromagnetic Flowmeter	Electromagnetic Flowmeter
	Service	Secondary effluent from AGS to tertiary treatment	Secondary effluent from AGS to tertiary treatment	On-site Pump Station Sanitary Sewer
	P&ID No.	P0008	P0008	P0014
	Line Tag	450-SE-SS1	450-SE-SS1	200-SAN-SS2
	Line Size (mm)	450	450	200
Process / Fluid Data	Fluid	Secondary effluent	Secondary effluent	Raw sewage
	Oper. Press Norm/Max (kPa)			
	Oper. Temp Norm/Max (°C)	14/23	14/23	14/23
	Ambient Temperature	5 - 30	5 - 30	5 - 30
	S.G. @ Oper. Temp	1.0	1.0	1.0
	Viscosity @ Oper. Temp	1.1	1.1	1.1
	Turbidity (NTU)/TDS (mg/L)			
	Measurement Function	Flow rate	Flow rate	Flow rate - Volume Totalizer
Transmitter	Tag No.	FIT 4200	FIT 4300	FE-6015
	Transmitter Type	Remote	Remote	Remote
	Power Requirement	120VAC	120VAC	120VAC
	Electrical Connection	1/2" NPT	1/2" NPT	1/2" NPT
	Contact Type	n/a	n/a	n/a
	Display Type	Digital LCD Integral Display	Digital LCD Integral Display	Digital LCD Integral Display
	Instrument Range			
	Operating Range			
	Output Signal	4 - 20 mA	4 - 20 mA	4 - 20 mA and Pulsed
	Accuracy / Repeatability	±0.2% ± 1 mm/s	±0.2% ± 1 mm/s	±0.2% ± 1 mm/s
	Enclosure Rating	NEMA 4X	NEMA 4X	NEMA 4X
	Enclosure Material	Polyamide	Polyamide	Polyamide
	Mounting	Wall Mount	Wall Mount	Wall Mount
Element	Tag No.	FE 4200	FE 4300	FE 6015
	Sensor Type	DC MAG	DC MAG	DC MAG
	Measurement Range			
	Element Material	Hastelloy C276	Hastelloy C276	Hastelloy C276
	Tube Size	450	450	200
	Enclosure Rating	NEMA 4X/6	NEMA 4X/6	NEMA 7/6
	Enclosure Material	Carbon steel	Carbon steel	Carbon steel
	Process Connection	ANSI B16.5, class 150	ANSI B16.5, class 150	ANSI B16.5, class 150
Access	Name Plate	Yes	Yes	Yes
	Connection Plug	Yes	Yes	Yes
	Mounting Bracket	Yes	Yes	Yes
	Isolation Valve and/or Manifold			

Approval / Enclosure	NEMA 4x		NEMA 4x	
Class / Division / Group				Class I Division 1, 2
Comment				
Manufacturer	Siemens		Siemens	Siemens
Model Number	Sitrans FM MAG 5100W c/w MAG6000		Sitrans FM MAG 5100W c/w MAG6000	Sitrans FM MAG 5100W c/w MAG6000
Alternates				

Notes:

1. Vendor to supply Stainless Steel Tag with Instrument Tag Number clearly stamped on it.
2. Vendor is to fill in missing data in this specification sheet relevant to the device (i.e. model #)
3. Contractor is to supply mounting hardwate appropriate for the application.
4. Dirty service transmitter to be factory installed and calibrated with Red Valve Series 40 Pressure Sensor.

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DIVISION 26 INDEX

PART 1 GENERAL

1.1 DESCRIPTION

.1 This Section covers items common to Sections of Division 26. This section also supplements requirements of Division 1, Division 23, Division 25, Division 28, Division 33 and Division 44.

1.2 REFERENCE STANDARDS

.1 Canadian Standards Association (CSA)

.1 CSA C22.1, Canadian Electrical Code, Part 1, Safety Standard for Electrical Installations, and Ontario Amendments to CSA C22.1 (Ontario Electrical Safety Code).

.2 CSA-22.3 No.1, Overhead Systems.

.3 CSA-22.3 No.7, Underground Systems.

.4 CAN3-C235, Preferred Voltage Levels for AC Systems, 0 to 50,000 V.

.5 CSA Z462, Workplace Electrical Safety

.6 CSA Z463, Maintenance of Electrical Systems

.7 CSA Z85-1983, Abbreviations for Scientific and Engineering Terms.

1.3 CARE, OPERATION AND START-UP

.1 Instruct Contract Administrator and operating personnel in the operation, care and maintenance of systems, system equipment and components.

.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 Arrange and pay for services of manufacturer's factory service engineer to supervise start-up of installation, check, adjust, balance, and calibrate components and instruct operating personnel.

.4 Provide these services for such period, and for as many visits as necessary to put equipment in operation and ensure that operating personnel are conversant with all aspects of its care and operation.

1.4 DESIGN REQUIREMENTS

.1 Perform complete installation in accordance with the latest edition of the Ontario Electrical Safety Code, including latest published Amendments and Bulletins.

.1 The design intent of the Contract Documents is for the completed Work to comply with the Electrical Code and not require a deviation or postponement by the Inspection Authority, as defined in Section 2 of the Electrical Code.

.2 Refer to Section 1.15 - ACCEPTANCE OF WORK.

.2 In addition to the codes and standards listed in Section **Error! Reference source not found.** - REFERENCE STANDARDS, do complete installation in accordance with the following:

.1 Ontario Building Code (OBC).

.2 Electrical Safety Authority (ESA) inspection permits.

.3 Local code of governing authorities.

.3 Operating voltages: to CAN3-C235

.1 Motors, electric heating, control and distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits established by above standard. Equipment to operate in extreme operating conditions established in above standard without damage to equipment.

1.5 SUBMITTALS

.1 Submit in accordance with Section 01 33 00 – Submittal Procedures.

.2 Product Data: submit manufacturer’s instructions, printed product literature and data sheets, including 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 wiring diagrams and installation details of equipment indicating proposed location, layout, and arrangement, proposed conduit routing, control panels, accessories, piping, ductwork, and other items that must be shown to ensure coordinated installation.

.3 Identify on wiring diagrams: circuit terminals, internal wiring for each item of equipment, and interconnection wiring between each item of equipment.

.4 Indicate on drawings: clearances for operation, maintenance, and replacement of operating equipment devices.

.5 Submit conduit sleeve plan for wall penetrations as described in Section **Error! Reference source not found.** - CONDUIT AND CABLE INSTALLATION.

.6 Submit routing plan for under-slab conduits as described in Section **Error! Reference source not found.** - CONDUIT AND CABLE INSTALLATION.

.4 Descriptive System Document

.1 For all device & wiring circuits to be installed in hazardous locations, submit a Descriptive System Document, as per OESC rule 18-066 and in accordance with OESC Appendix F.

.5 Equipment Tagging

.1 Submit list of lamicoid labels for approval.

.6 Quality Control: in accordance with Specification 01 45 00 - Quality Control.

.1 Provide CSA certified, or certified by recognized organizations as detailed in ESA Bulletin 2-7-*, equipment and material.

.2 Where CSA certified, or ESA recognized approval equipment and material is not available, submit such equipment and material to authority having jurisdiction for approval before delivery to site.

.3 Submit test results of installed electrical systems and instrumentation.

.4 Submit, upon completion of Work, load balance report as described in section 3.8.6 - Load Balance.

.5 Submit certificate of acceptance from authority having jurisdiction upon completion of Work to Contract Administrator.

.7 Manufacturer's Field Reports: submit to Contract Administrator within seven (7) working days of review, verifying compliance of Work, electrical system and instrumentation testing, as described in section 3.8 - FIELD QUALITY CONTROL.

.8 Single Line Electrical Diagrams

.1 Provide single line electrical diagrams in glazed frames as follows:

.1 Electrical distribution system: locate in main electrical room.

.2 Drawings: 600 x 600 mm minimum size.

.9 Arc-Flash Study

.1 Contractor shall supply an arc-flash study to the latest edition of CSA Z462, of the building’s entire distribution system. Study to be performed by the successful electrical equipment Supplier.

.2 Contractor shall furnish the Supplier with distances, wire lengths and transformer shop drawings as required.

.3 Contractor shall supply stick-on labels for all equipment, identifying the arc-flash hazard rating of each distribution board and panel board. Such labelling shall meet the latest edition of CSA Z462.

.4 Contractor shall supply one full set of Personal Protective Equipment required for each identified hazard rating in the arc-flash study.

.5 The arc-flash study shall be submitted with the electrical distribution equipment shop drawings. The electrical distribution equipment shop drawings will not be reviewed until the arc-flash study is received.

.10 Co-ordination Study

.1 Submit co-ordination study as described in section 3.8.6 - LOAD BALANCE.

1.6 DELIVERY, STORAGE AND HANDLING

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

.2 Waste Management and Disposal:

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

1.7 PERMITS, FEES, AND INSPECTION

.1 Submit to Electrical Inspection Division and Supply Authority necessary number of drawings and specifications for examination and approval prior to commencement of work.

.2 Pay associated fees associated with this Work.

.3 Notify Contract Administrator of changes required by Electrical Inspection Division prior to making changes.

.4 Furnish Certificates of Acceptance from Electrical Inspection Division or authorities having jurisdiction on completion of Work to Contract Administrator.

1.8 SEISMIC RESTRAINTS

.1 The contractor shall retain a specialty Engineer to develop seismic restraints and perform seismic calculations in accordance with Ontario Building Code. Calculations, restraint selections and installation details shall be done by a professional engineer experienced in seismic restraint design and installation and licensed in the Province of Ontario.

.2 The seismic restraint calculations, selections and installation details shall be submitted as a shop drawing submittal. This submittal shall be signed and sealed by a professional engineer as stated above.

.3 The Design Criteria in accordance with Ontario Building Code for a post disaster building. The seismic restraints design to cover all electrical equipment and cable tray/supports.

.4 At the completion of the installation, the seismic specialist shall visit the site and review the installation is done in accordance with their design. Once complete the

specialist shall provide written certification that the equipment and components have been correctly restrained. This report to forwarded to the Engineer.

.5 At the completion of the installation the seismic specialist shall visit the site and review the installation of the seismic restraints. The specialist shall provide written certification that the systems have been correctly restrained.

1.9 CO-ORDINATION

.1 Co-ordinate electrical work with work of other divisions to avoid conflict.

.2 Locate distribution systems, equipment, and materials to provide minimum interference and maximum usable space.

.3 Locate all existing underground services and make all parties aware of their existence and location.

.4 Where interference occurs, Contract Administrator must approve relocation of equipment and materials regardless of installation order.

.5 Notwithstanding the review of shop drawings, this division may be required to relocate electrical equipment which interferes with the equipment of other trades, due to lack of co-ordination by this Division. The cost of this relocation shall be the responsibility of this Division. The Contract Administrator shall decide the extent of relocation required.

1.10 CUTTING AND PATCHING

.1 Inform all other divisions in time, concerning required openings. Where this requirement is not met, bear the cost of all cutting. Openings of 200 mm or smaller shall be the responsibility of Division 26. Openings larger than 200 mm shall be the responsibility of Division 1. Obtain written approval of Structural engineer before drilling any beams or floors.

1.11 PROTECTION

.1 Protect exposed live equipment during construction for personnel safety.

.2 Shield and mark all live parts “LIVE 120 VOLTS”, or with appropriate voltage in English.

.3 Arrange for installation of temporary doors for rooms containing electrical distribution equipment. Keep these doors locked except when under direct supervision of electrician.

1.12 RECORD DRAWINGS

.1 Obtain and pay for three sets of white prints. As the job progresses, mark these prints to accurately indicate installed work. Have the white prints available for inspection at the site at all times and present for scrutiny at each job meeting.

.2 Show on the record drawings the installed inverts of all services entering and leaving the building and the property. Dimension underground services at key points of every run-in relation to the structure and building.

.3 Indicate exact location of all services for future work. Show and dimension all work embedded in the structure.

.4 Submit record drawings within 30 days prior to start of commissioning.

1.13 SCHEDULING OF WORK

.1 Work shall be scheduled in phases as per other divisions of the architectural specifications.

.2 Become familiar with the phasing requirements for the work and comply with these conditions.

.3 No additional monies will be paid for the Contractor's requirement to comply with work phasing conditions.

1.14 INSPECTION OF WORK

.1 The Contract Administrator will make periodic visits to the site during construction to ascertain reasonable conformity to plans and specifications but will not execute quality control. The Contractor shall be responsible for the execution of their work in conformity with the construction documents and with the requirements of the Inspection Authority.

1.15 ACCEPTANCE OF WORK

.1 The Work of this division shall be completed to the satisfaction of the Contract Administrator, including but not limited to compliance with the Electrical Code.

.2 Any Work requiring a deviation or postponement by the Inspection Authority, as defined in Section 2 of the Electrical Code, shall also require approval by the Contract Administrator.

.1 The Contractor shall notify the Contract Administrator of any Work of this nature within 48 hours of discovery, and shall submit detailed plans to the Contract Administrator for review and approval before completion of the Work.

.3 No additional monies will be paid for the Contractor's requirement to complete the work to the satisfaction of the Contract Administrator.

1.16 FIRE RATING OF PENETRATIONS

.1 Maintain fire ratings around conduits passing through floors, ceilings and fire rated walls.

.2 When cables or conduits penetrate or pass through fire rated assemblies such as walls, floor/ceiling, roof/ceiling or columns protection, do fire stopping and smoke sealing in accordance with an approved system specified in Section 07 84 00 to match the rating of the assembly being penetrated. Refer to architectural drawings to ascertain locations and degree of the fire rated assemblies. Refer to detail ULC System No. SP341 for fire-stopping cable tray floor and wall partitions.

PART 2 PRODUCTS

2.1 ELECTRIC MOTORS, EQUIPMENT AND CONTROLS

.1 Responsibility of supply and installation is indicated in Motor, Control and Equipment Schedule on electrical drawings, and related mechanical responsibility is indicated on Mechanical Equipment Schedule on mechanical drawings, where applicable.

.2 Control wiring and conduit is specified in Division 26 for all conduit, wiring and connections related to control systems specified in Division 25 and shown on Mechanical, Process and Civil drawings. Division 26 is responsible for all conduit, wiring, and connections of 120V and below, which are related to control systems in Division 25 and shall comply with the requirements of Division 26 for standard of quality.

2.2 MATERIALS AND EQUIPMENT

.1 Provide materials and equipment in accordance with Section 01 61 00 - Common Product Requirements.

.2 Equipment and material to be CSA certified or ESA recognized certifications, as detailed above. Where there is no alternative to supplying equipment which is not CSA certified, obtain special approval from CSA Electrical Inspection Division.

.3 Factory-assemble control panels and component assemblies.

2.3 FINISHES

.1 Shop-finish metal enclosure surfaces by application of rust resistant primer inside and outside, and at least two coats of finish enamel.

.1 Paint outdoor electrical equipment "equipment green" finish to EEMAC Y1-1.

.2 Paint indoor switchgear and distribution enclosures light grey to EEMAC 2Y-1.

2.4 WARNING SIGNS

.1 As specified and to meet requirements of Electrical Inspection Department and Contract Administrator.

.2 Porcelain enamel decal signs, minimum size 175 x 250 mm.

2.5 EQUIPMENT IDENTIFICATION

.1 Identify electrical equipment with nameplates and labels according to its Specifcation Section, and as follows.

.1 Allow for minimum of twenty-five (25) letters per nameplate and label.

.2 Nameplates:

.1 Lamicoid 3 mm thick plastic engraving sheet, white face, black core, mechanically attached with self-tapping screws.

.2 Sizes as follows:

NAMEPLATE SIZES

Size 1	10 x 50 mm	1 line	3 mm high letters
Size 2	12 x 70 mm	1 line	5 mm high letters
Size 3	12 x 70 mm	2 lines	3 mm high letters
Size 4	20 x 90 mm	1 line	8 mm high letters
Size 5	20 x 90 mm	2 lines	5 mm high letters
Size 6	25 x 100 mm	1 line	12 mm high letters
Size 7	25 x 100 mm	2 lines	6 mm high letters

.3 Wording on nameplates and labels to be approved by Contract Administrator prior to manufacture.

.4 Identification to be English (and French where applicable).

.5 Disconnects, starters and contactors: indicate equipment being controlled, voltage and circuit fed from.

.6 Instrumentation: label shall include tag name and circuit fed from.

.7 Terminal cabinets, junction boxes and pull boxes: indicate system name and voltage.

.8 Transformers: indicate capacity, primary and secondary voltages, circuit fed from, and equipment being fed.

.3 Labels:

.1 Embossed plastic labels with 6 mm high letters unless specified otherwise.

.2 Receptacles: indicate panel name and circuit number.

2.6 WIRING IDENTIFICATION

.1 Identify wiring with permanent indelible identifying markings, either numbered or coloured plastic tapes, on both ends of phase conductors of feeders and branch circuit wiring.

.2 Maintain phase sequence and colour coding throughout.

.3 Colour code: to CSA C22.1, Canadian Electrical Code.

.4 Use colour coded wires in communication cables, matched throughout system.

2.7 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.

Conduit System	Prime Color	Auxiliary Color
up to 250 V	Yellow	
up to 600 V	Yellow	Green
up to 5 kV	Yellow	Blue
up to 15 kV	Yellow	Red
Telephone	Green	
Other Communication Systems	Green	Blue
Fire Alarm	Red	
Emergency Voice	Red	Blue
Other Security Systems	Red	Yellow

PART 3 EXECUTION

3.1 NAMEPLATES AND LABELS

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

3.2 LOCATION OF OUTLETS

.1 Locate outlets in accordance with Section 26 27 26 – Wiring Devices.

.2 Do not install outlets back-to-back in wall; allow minimum 150 mm horizontal clearance between boxes.

.3 Change location of outlets at no extra cost or credit, providing distance does not exceed 3000 mm, and information is given before installation.

.4 Locate light switches on latch side of doors. Locate disconnect devices in mechanical and elevator machine rooms on latch side of door.

3.3 CONDUIT AND CABLE INSTALLATION

.1 Conduit and cable installation shall be considered:

.1 Subject to mechanical injury below 2.4m AFF in unfinished spaces except electrical and mechanical service rooms.
.2 Subject to corrosive environments in:
  .1 All areas exposed to exterior elements
  .2 Building 3000 – Screening Room
  .3 Building 4000 – Tertiary/UV Disinfection
  .4 Area 2000 – Alum Storage (Rm #)
.3 Subject wet/damp environments in:
  .1 All other areas except admin building interior (building 8000).
.4 Subject to dry environment in:
  .1 Building 8000 interior.

3.4 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 at following heights unless indicated otherwise.

  .1 Local switches: 1200 mm.
  .2 Wall receptacles:
    .1 General: 300 mm.
    .2 Above top of continuous baseboard heater: 200 mm.
    .3 Above top of counters or counter splash backs: 175 mm.
    .4 In mechanical rooms: 1400 mm.
  .3 Panelboards: as required by Code or as indicated.
  .4 Telephone and interphone outlets: 300 mm.
  .5 Wall mounted telephone and interphone outlets: 1400 mm.
  .6 Fire alarm stations: 1200 mm.
  .7 Fire alarm bells: 2400 mm.
  .8 Television outlets: 300 mm.
  .9 Wall mounted speakers: 2400 mm.
  .10 Clocks: 2400 mm.
  .11 Door bell pushbuttons: 1200 mm.
  .12 Exit lights: 2400 mm.
  .13 Emergency lighting heads: 2400 mm.

3.5 POWER SHUTDOWNS

.1 Power shutdowns shall be kept to a minimum. Schedule shutdowns well in advance with Contract Administrator stating time(s) and duration(s). Maintain all

electrical services to the occupied areas of the buildings. Power shutdowns will be allowed during normal working hours and must be approved by the Owner. Shutdowns to be 4 hours maximum.

.2 Provide temporary services, equipment and wiring as necessary to maintain continuity of services throughout, during construction of this project.

.3 Ensure all services, i.e. security, fire alarm, telephone, LAN, normal and essential power, etc. remain operational during construction.

.4 Refer to construction phasing Section 00 13 14 and perform work as required to meet the multiple phases of completion steps to ensure the plant services are maintained.

3.6 REMOVALS

.1 Remove existing electrical equipment, wiring, conduit and other devices.

.2 Where existing walls and partitions are to be removed, remove existing outlets, devices and wiring located therein and make safe. Remove existing equipment, devices and outlets as necessary. Relocate or reinstall these items as indicated and as required. Co-ordinate with applicable trades.

.3 Maintain continuity of power, lighting, fire alarm and communication circuits as required.

.4 Remove all existing redundant wiring associated with all devices. Co-ordinate and arrange for telephone company to remove redundant telephone cables.

.5 Any material the Contract Administrator does not want, shall be removed from the site by this contractor.

3.7 CO-ORDINATION OF PROTECTIVE DEVICES

.1 Immediately on award of Contract, prepare a co-ordination study and submit for approval.

.2 The co-ordination study data shall be presented in tables and on composite charts and shall include but not be limited to the following:

.1 Minimum and Maximum available short circuit current 600V, and 120/208V systems based on available MVA at the source. This shall be calculated for every bus down to the lighting panel level.

.2 Minimum and Maximum available ground fault current of 600V, and 120/208V systems.

.3 Power transformer thermal short circuit damage curve, 3 phase, phase to ground.

.4 Main and feeder circuit breakers.

.5 Distribution transformer and generator thermal short circuit damage curves.

.6 Largest distribution breaker characteristics in each panel.

.7 Largest branch breaker in each panel.

.8 Establish the required setting for all ground fault protective devices.

.9 General damage and decrement curves.

.10 Cable damage curves.

.11 Co-ordination charts shall be drawn in ink on log paper or printed if computer generated. Each chart shall include a single line diagram of the appropriate devices with description and numbering matching that shown on the contract documents. Transformers shall be shown complete with KVA rating, primary and secondary voltages, winding connections, grounding method and impedance.

.12 The study shall meet the requirements of IEEE 242.

.3 The co-ordination study shall include a list of recommendations to improve co-ordination or protection where possible and minimize arc fault energy levels.

.4 A copy of the single line diagram in AutoCAD (.dwg) format will be made available if requested.

3.8 FIELD QUALITY CONTROL

.1 All electrical work to be carried out by qualified, licensed electricians or apprentices. Employees registered in a provincial apprentice's program shall be permitted, under the direct supervision of a qualified licensed electrician, to perform specific tasks – the activities permitted shall be determined based on the level of training attained and the demonstration of ability to perform specific duties.

.2 The work of this division to be carried out by a contractor who holds a valid Master Electrical Contractor License as issued by the Province.

.3 In addition to the inspection and acceptance by the electrical authority having jurisdiction, the Work of this division shall meet the acceptance of the Contract Administrator. Refer to Section 1.15 - ACCEPTANCE OF WORK.

.4 Conduct and pay for following tests:

.1 Distribution system including phasing, voltage, grounding, and load balancing.

.2 Circuits originating from branch distribution panels.

.3 Lighting and its control.

.4 VFD configuration, testing, commissioning, and training by manufacturer's factory trained and certified technician.

.5 Motors, heaters, and associated control equipment including sequenced operation of systems where applicable.

.6 Systems: fire alarm system, security, and communications.

.5 Furnish manufacturer's certificate or letter confirming that entire installation as it pertains to each system has been installed to manufacturer's instructions.

.6 Load Balance

.1 Measure phase current to panelboards with normal loads (lighting) operating at time of acceptance; adjust branch circuit connections as required to obtain best balance of current between phases and record changes.

.2 Measure phase voltages at loads and adjust transformer taps to within 2% of rated voltage of equipment.

.3 Submit, at completion of work, report listing phase and neutral currents on panelboards, dry-core transformers, and motor control centres, operating under normal load. State hour and date on which each load was measured, and voltage at time of test.

.7 Insulation resistance testing.

.1 Megger and record circuits, feeders, and equipment up to 350V with a 500V instrument.

.2 Megger and record 350 – 600V circuits, feeders, and equipment with a 1000V instrument.

.3 Check resistance to ground before energizing and record value.

.8 Carry out tests in presence of Contract Administrator.

.9 Provide instruments, meters, equipment, and personnel required to conduct tests during and conclusion of project.

.10 Submit test results for Contract Administrator’s review and include in Commissioning Manuals specified in Section 01 91 13 – Commissioning (Cx) Requirements.

3.9 CLEANING

.1 Do cleaning in accordance with Section 01 74 11 - Cleaning.

.2 Progress Cleaning:

.1 Leave work area clean at end of each day.

.3 Final Cleaning:

.1 upon completion remove surplus materials, rubbish, tools and equipment.

.2 Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint.

.3 Clean and prime exposed non-galvanized hangers, racks, and fastenings to prevent rusting.

.4 Remove construction materials from wiring devices, cover plates, outlets, cabinets, enclosures, tubs, etc.

END OF SECTION

HV POWER CABLE AND CONDUCTORS

PART 1 GENERAL

1.1 RELATED SECTIONS

.1 Section 26 05 00 – Common Work Requirements Electrical.

.2 Section 26 05 43 – Installation of Cables in Trenches and in Ducts.

1.2 REFERENCE STANDARDS

.1 Canadian Standards Association (CSA International)

.1 CSA-C22.2 No. 131-[07], Type TECK 90 Cable.

.2 CAN/CSA-C61089-[2003], Round Wire Concentric Lay Overhead Electrical Stranded Conductors.

.3 CAN/CSA-C68.5, Primary Shielded and concentric neutral cable for distribution utilities.

1.3 SUBMITTALS

.1 Provide submittals in accordance with Section 26 05 00 – Common Work Requirements Electrical.

.2 Product Data:

.1 Provide manufacturer's printed product literature, specifications, data sheet and include product characteristics, performance criteria, physical size, finish and limitations.

PART 2 PRODUCTS

2.1 PRIMARY OVERHEAD CONDUCTORS

.1 Bare aluminum conductors steel reinforced: to CAN/CSA-C61089, size as indicated.

2.2 CONCENTRIC NEUTRAL POWER CABLE (5000 - 46000 V)

.1 Concentric Neutral Power Cable to CAN/CSA C68.5.

.2 Single aluminum stranded conductor, size as indicated.

.1 Class B compact round.

.2 Water blocked

.3 Semi-conducting strand shield.

.4 Insulation: tree retardant cross-linked polyethylene (TRXLPE), rated 90 degrees C and 15 kV for 100% voltage level.

.5 Semi-conducting insulation shielding layer.

.6 Copper neutral wires applied helically over insulation shield.

.1 33% rated neutral for three phase circuits.

.2 100% rated neutral for single phase circuits.

.7 Extruded Low-Density polyethylene (LLDPE) jacket rated minus 40 degrees C.

.8 Provide 3M Coldshrink silicone rubber termination kits.

PART 3 EXECUTION

3.1 INSTALLATION

.1 Install primary overhead conductors on pole lines as indicated.

.2 Install concentric neutral power cable in trenches, ductbanks, manholes as indicated and in accordance with manufacturers requirements.

.3 Provide supports and accessories for installation of high voltage power cable.

.4 Install stress cones, terminations and splices in accordance with manufacturer's instructions

.5 Install grounding in accordance with local inspection authority having jurisdiction.

.6 Provide cable identification tags and identify each phase conductor of power cable.

3.2 FIELD QUALITY CONTROL

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

.2 Installation, splicing, termination and testing of high voltage power cables shall be performed by persons who hold the following current registration with the ministry of labour, training and skills development (MLTSD). Submit contractor qualification certificates.

.1 Journeyman Powerline Technician.

.3 Engage an independent testing agent to test high voltage power cable. Submit test result and inspection certificate.

END OF SECTION

WIRING AND BOX CONNECTORS, 0-1000V

PART 1 GENERAL

1.1 SECTION INCLUDES

.1 Material and installation specifications for wire and box connectors for low voltage (LV) systems operating between 0-1000 Volts.

1.2 RELATED SECTIONS

.1 Section 26 05 00 – Common Work Requirements Electrical.

1.3 REFERENCE STANADARDS

.1 Canadian Standards Association (CSA International)

.1 CAN/CSA-C22.2 No.18, Outlet Boxes, Conduit Boxes and Fittings.

.2 CAN/CSA-C22.2 No.65, 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)

1.4 SUBMITTALS

.1 Provide submittals in accordance with Section 26 05 00 – Common Work Requirements Electrical.

.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.

1.5 CLOSEOUT SUBMITTALS

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

.2 Operation and Maintenance Data:

.1 Submit operation and maintenance data for wire and box connectors for incorporation into manual.

1.6 DELIVERY, STORAGE AND HANDLING

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

PART 2 PRODUCTS

2.1 MATERIALS

.1 Pressure type wire connectors to: CSA C22.2 No.65, with current carrying parts of copper sized to fit copper conductors as required.

.2 Fixture type splicing connectors to: CSA C22.2 No.65, with current carrying parts of copper sized to fit copper conductors 12 AWG or less unless noted otherwise.

.3 Compression lugs/splices required for all terminations 10 AWG and larger.

.4 Bushing stud connectors: to EEMAC 1Y-2 to consist of:

- .1 Connector body and stud clamp for stranded copper conductors.
- .2 Clamp for copper bar.
- .3 Stud clamp bolts.
- .4 Bolts for copper bar.
- .5 Sized for conductors and bars as indicated.

.5 Clamps or connectors for armoured cable, aluminum sheathed cable, mineral insulated cable, flexible conduit, non-metallic sheathed cable as required to: CAN/CSA-C22.2 No.18.

PART 3 EXECUTION

3.1 INSTALLATION

.1 Remove insulation carefully from ends of conductors and:

- .1 Install mechanical pressure type connectors and tighten screws with appropriate compression tool recommended by manufacturer. Installation shall meet secureness tests in accordance with CSA C22.2 No.65.
- .2 Install fixture type connectors and tighten. Replace insulating cap.
- .3 Install compression lugs with lug manufacturer’s compression tool and corresponding dies appropriate to wire size.
- .4 Install bushing stud connectors in accordance with EEMAC 1Y-2.

END OF SECTION

WIRING AND CABLES 0-1000V

PART 1 GENERAL

1.1 SECTION INCLUDES

.1 Material and installation requirements for wire and cables operating between 0-1000 Volts.

.2 This section does not include HV wiring in excess of 1000 Volts. Refer to 26 05 14 for hv wiring and cable requirements.

1.2 RELATED SECTIONS

.1 Section 01 33 00 – Submittals

.2 Section 01 78 00 – Closeout Submittals

.3 Section 01 91 13 – Commissioning Requirements

.4 Section 26 05 00 – Common Work Requirements Electrical

.5 Section 26 05 34 – Conduits, Fastenings and Fittings

1.3 REFERENCE STANDARDS

.1 Canadian Standards Association (CSA International)

.1 CSA C22.2 No. 0.3-09, Test Methods for Electrical Wires and Cables
.2 CSA C22.2 No. 38-14, Thermoset-insulated Wires and Cables
.3 CSA C22.2 No. 51-14, Armoured Cables
.4 CSA C22.2 No. 131-14, Type TECK 90 Cable
.5 CSA C22.2 No. 174, Cables and Cable Glands for Use in Hazardous Locations
.6 CSA C22.2 No. 214-17, Communications Cables
.7 CSA C22.2 No. 239-17, Control and Instrumentation Cables

1.4 SUBMITTALS

.1 Provide submittals in accordance with Section 26 05 00 – Common Work Requirements Electrical.

.1 Provide manufacturer's printed product literature, specifications, data sheet and include product characteristics, performance criteria, physical size, finish and limitations.

PART 2 PRODUCTS

2.1 BUILDING WIRES FOR 0 - 1000 V POWER WIRING IN CONDUIT

.1 Conductors: stranded copper, number and size as indicated. Minimum #12 AWG.

.2 Insulation: chemically cross-linked thermosetting polyethylene (XLPE) material.

.1 RWU90 in Wet or Damp Locations.

.2 RW90 in Dry Locations Only.

2.2 TECK 90 CABLE FOR 0 – 1000 V POWER WIRING

.1 TECK 90 cable to CAN/CSA-C22.2 No.131.

.2 Conductors:

.1 Grounding conductor: stranded copper.

.2 Circuit conductors: stranded copper, number and size as indicated. Minimum #12 AWG.

.3 Insulation:

.1 Chemically cross-linked thermosetting polyethylene rated type RW90, XLPE 1000 V.

.2 Hazardous location rating.

.4 Inner jacket: polyvinyl chloride material.

.5 Armour: interlocking aluminum.

.6 Overall covering: polyvinyl chloride material with LFS/LGE (low fire spread/low gas evolution) FT4 rating.

.7 Connectors:

.1 Explosion-proof approved for TECK cable in classified areas.

.2 Teck connectors c/w sealing ring in non-classified areas.

2.3 CONTROL & INSTRUMENTATION WIRING

.1 Analog 4-20mA signals (installed in conduit):

.1 CSA, 300V control and instrumentation cable (CIC) to CAN/CSA C22. No. 239

.2 Twisted shielded pair #16, stranded tinned copper cable assembly. Shield consisting of 100% aluminum/polyester foil with #18 AWG drain wire.

.3 100% overall foil shield and drain wire for multi-pair cables.

.4 Standard of Acceptance: Belden 22646 or multi-pair equivalent with individually shielded pairs and overall shield.

.2 Analog 4-20mA signals (installed in cable tray):

.1 CSA, 600V armored control and instrumentation cable (ACIC) to CAN/CSA C22. No. 239

.2 Twisted shielded pair #16, stranded tinned copper cable assembly (installed in conduit). Shield consisting of 100% aluminum/polyester foil with #18 AWG drain wire insulated with 600V rated chemically cross linked thermosetting polyethylene material rated RW90 XLPE c/w hazardous location rating, inner jacket of polyvinyl chloride material, armor of interlocking aluminum and over all covering of polyvinyl chloride material with LES/LGE (low fire spread, low gas evolution) rating.

.3 Standard of Acceptance: Belden 24500 or multi-pair equivalent with individually shielded pairs and overall shield.

.4 Connectors:

.1 Explosion-proof approved for TECK cable in classified areas.

.2 Teck connectors c/w sealing rings

.3 24V to 120V control wiring in conduit:

.1 Stranded copper #14 AWG, insulation rated 600V of chemically cross-linked thermosetting polyethylene material rated RW90 XLPE.

.4 24V to 120V multiconductor TECK control wiring:

.1 CSA TECK 90 cable to CAN/CSA-C22.2 No.131.

.2 Stranded copper #14 AWG insulated with 600V rated chemically cross-linked thermosetting polyethylene material rated RW90 XLPE c/w hazardous location rating, inner jacket of polyvinyl chloride material, armor of interlocking aluminum and over all covering of polyvinyl chloride material with LES/LGE (low fire spread, low gas evolution) rating.

.3 Standard of Acceptance: Belden C5500 or multi-conductor equivalent as indicated.

.4 Connectors:

.1 Explosion-proof approved for TECK cable in classified areas.

.2 Teck connectors c/w sealing rings.

.5 Modbus TSIPC.

.1 Low capacitance single pair, twisted shielded, #24 AWG - Belden 9841.

.6 RS485 cables:

.1 2 pair, 18 AWG stranded copper, separately twisted pairs, overall 100% aluminum-polyester shield, tinned copper stranded drain wire by Belden Wire and Cable.

PART 3 EXECUTION

3.1 INSTALLATION OF BUILDING WIRES

.1 Installed in conduit to Section 26 05 34 – Conduits, Fastenings and Fittings.

3.2 INSTALLATION OF TECK90 CABLE FOR 0-1000V POWER WIRING

.1 Install TECK90 cables within (or passing thru) all Class I, Div.I, and Div.II, Group 'D' locations.

.2 Installed in cable tray to Section 26 05 36 – Cable Trays for Electrical Systems.

.3 Prior to cable installation, indicate on a set of drawings proposed cable type, routing and grouping. Keep on same drawing indicating cable tray routing from Section 26 05 36 – Cable Trays for Electrical Systems. Review drawings with general contractor and other trades to eliminate interferences. Review drawings with engineer before proceeding with installation.

3.3 INSTALLATION OF CONTROL AND INSTRUMENTATION CABLES

.1 Type RW90 and CIC installed in conduit to Section 26 05 34 – Conduits, Fastenings and Fittings.

.2 Type TECK90 and ACIC installed in cable tray to Section 26 05 36 – Cable Trays for Electrical Systems.

.3 Ground control cable shield at controller end only.

.4 Field terminations and joints shall be made on labelled terminal blocks installed in terminal boxes suitable for the classification of location installed. Crimped connections are not acceptable.

.5 Termination of Data line cable by Division 26

END OF SECTION

GROUNDING – PRIMARY

PART 1 GENERAL

1.1 RELATED SECTIONS

.1 Section 26 05 00 – Common Work Requirements Electrical.

1.2 REFERENCE STANADARDS

.1 American National Standards Institute/Institute of Electrical and Electronics Engineers (ANSI/IEEE):

.1 ANSI/IEEE 837-02, Qualifying Permanent Connections Used in Substation Grounding.

1.3 SUBMITTALS

.1 Provide submittals in accordance with Section 26 05 00 – Common Work Requirements Electrical.

.2 Product Data:

.1 Provide manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish, and limitations.

1.4 CLOSEOUT SUBMITTALS

.1 Submit ground resistance test results.

.2 Submit touch and step potential calculations.

1.5 DELIVERY, STORAGE AND HANDLING

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

PART 2 PRODUCTS

2.1 MATERIALS

.1 Rod electrodes: copper clad steel, 19 mm diameter by 3 m long.

.2 Conductors: bare, stranded, tinned soft annealed copper wire, size No. 4/0 AWG and 2/0AWG for ground bus, electrode interconnections, metal structures, gradient control mats, transformers, switchgear, motors, ground connections.

.3 Conductors: RW90 insulated coloured green, stranded soft annealed copper wire, size No. 4 AWG for grounding cable sheaths, raceways, pipe work, screen guards, switchboards, potential transformers.

.4 Conductors: RW90 insulated coloured green, stranded soft annealed copper wire No. 10 AWG for grounding meter and relaycases.

.5 Conductors: No. 3/0 AWG extra flexible (425 strands) copper conductor for connection of switch mechanism operating rod to gradient control mat, fence gates, vault doors.

.6 Bolted removable test links.

.7 Accessories: non-corroding, necessary for complete grounding system, type, size material as indicated, including:

.1 Grounding and bonding bushings.
.2 Protective type clamps.
.3 Bolted type conductor connectors.
.4 Thermit welded type conductor connectors.
.5 Bonding jumpers, straps.
.6 Pressure wire connectors.

.8 Wire connectors and terminations: as indicated.

PART 3 EXECUTION

3.1 INSTALLATION – GENERAL

.1 Install continuous grounding system including, electrodes, conductors, connectors and accessories as indicated and to requirements of local authority having jurisdiction.
.2 Ground fences to grounding system independent of station ground.
.3 Install connectors and cadweld in accordance with manufacturer's instructions.
.4 Protect exposed grounding conductors during and after construction.
.5 Make buried connections, and connections to electrodes, structural steel work, using copper welding by thermit process permanent mechanical connectors to ANSI/IEEE 837.
.6 Use mechanical connectors for grounding connections to equipment provided with lugs.
.7 Use No. 4/0 AWG bare copper cable for main ground bus of substation and No. 2/0AWG mhd bare copper cable for taps on risers from main ground bus to equipment.
.8 Use tinned copper conductors for aluminum structures.

3.2 ELECTRODE INSTALLATION

.1 Install ground rod electrodes. Make grounding connections to station equipment.

.2 Install ground rod electrodes at transformer and switchgear locations.

.3 Make special provision for installing electrodes that will give acceptable resistance tog round value, where rock or sand terrain prevails.

3.3 EQUIPMENT GROUNDING

.1 Install grounding connections as indicated to typical station equipment including: metallic water main, line sky wire, neutral, gradient control mats. Non current carrying parts of: transformers, generators, motors, circuit breakers, reclosers, current transformers, frames of gang-operated switches and fuse cutout bases. Cable sheaths, raceways, pipe work, screen guards, switchboards, potential transformers. Meter and relay cases. Any exposed building metal, within or forming part of station enclosure. Sub-station fences, pothead bodies. Outdoor lighting.

.2 Ground hinged doors to main frame of electrical equipment enclosure with flexible jumper.

.3 Connect metallic piping (water, oil, air, etc.) inside station to main ground bus at several locations, including each service location within station.

3.4 NEUTRAL GROUNDING

.1 Connect transformer neutral and distribution neutral together.

.2 Interconnect transformer primary neutral to station grounding electrodes and primary neutral at each installation.

.3 Ground transformer tank with continuous conductor from tank ground lug through connector on ground bus to primary neutral.

3.5 CABLE SHEATH GROUNDING

.1 Bond single conductor, metallic sheathed cables together at one end only. Break sheath continuity by inserting insulating sleeves in cables using special isolating transformer.

.2 Use No. 6 AWG flexible copper wire soldered, not clamped, to cable sheath.

.3 Connect bonded cables to ground with No. 2/0 AWG copper conductor.

3.6 FIELD QUALITY CONTROL

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

.2 Engage an independent testing agent to inspect grounding and perform ground resistance test before backfill.

.3 Perform earth loop test and resistance tests using method appropriate to site conditions and to approval of Engineer and local authority having jurisdiction.

.4 Perform test before energizing electrical system.

.5 Provide step-and-touch potential calculations using measured station ground resistance measurements. Submit test result and inspection certificate before energizing electrical system.

END OF SECTION

GROUNDING – SECONDARY

PART 1 GENERAL

1.1 RELATED SECTIONS

.1 Section 26 05 00 – Common Work Requirements Electrical.

.2 Section 26 24 02 – Incoming Entrance Board

.3 Section 26 11 13 – Liquid Filled Padmount Transformer

.4 Section 26 32 13 – Diesel Fired Generator

1.2 REFERENCE STANADARDS

.1 Canadian Standards Association (CSA International)

.1 CSA C22.2 No.41-13 Grounding and Bonding Equipment

.2 American National Standards Institute (ANSI)/Institute of Electrical and Electronics Engineers (IEEE)

.1 ANSI/IEEE 837, Qualifying Permanent Connections Used in Substation Grounding.

1.3 SUBMITTALS

.1 Provide submittals in accordance with Section 26 05 00 – Common Work Requirements Electrical.

.2 Product Data:

.1 Provide manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish, and limitations.

PART 2 PRODUCTS

2.1 EQUIPMENT

.1 Clamps for grounding of conductor: size as indicated to electrically conductive underground water pipe.

.2 Copper conductor: minimum 6 m long for each concrete encased electrode, bare, stranded, tinned, soft annealed, size as indicated.

.3 Rod electrodes: copper clad steel 19 mm diameter by 3 m long.

.4 Grounding conductors: bare stranded copper, soft annealed, size as indicated.

.5 Insulated grounding conductors: green, type RW90, rated 1kV, stranded copper conductor.

.6 Ground bus: copper, 50mm x 6mm, complete with 25mm insulated supports, fastenings, connectors.

.7 Non-corroding accessories necessary for grounding system, type, size, material as indicated, including but not necessarily limited to:

.1 Grounding and bonding bushings.
.2 Protective type clamps.
.3 Thermit welded type conductor connectors, as indicated.
.4 Bonding jumpers, straps.
.5 Burndy Hyground compression connectors.

PART 3 EXECUTION

3.1 INSTALLATION - GENERAL

.1 Install complete permanent, continuous grounding system including, electrodes, conductors, connectors, accessories. Where EMT is used, run insulated copper ground wire in conduit and bond EMT at both ends.

.2 Install connectors in accordance with manufacturer's instructions. Use manufacturer’s crimping tool for compression connectors.

.3 Protect exposed grounding conductors from mechanical injury.

.4 Make buried connections, and connections to conductive water main, electrodes, using copper welding by thermit process.

.5 Use mechanical connectors for grounding connections to equipment provided with lugs.

.6 Soldered joints not permitted.

.7 Install bonding wire for flexible conduit, connected at both ends to grounding bushing, solderless lug, clamp or cup washer and screw. Neatly cleat bonding wire to exterior of flexible conduit.

.8 Install flexible ground straps for bus duct enclosure joints, where such bonding is not inherently provided with equipment.

.9 Install separate ground conductor to outdoor lighting standards.

.10 Connect building structural steel and metal siding to ground by welding copper to steel.

.11 Make grounding connections in radial configuration only, with connections terminating at single grounding point. Avoid loop connections.

.12 Bond single conductor, metallic armoured cables to cabinet at supply end and load end.

.13 Ground secondary service pedestals.

3.2 MANHOLES

.1 Install conveniently located grounding electrode and size 3/0 stranded copper conductor in each manhole.

.2 Install ground rod in each manhole so that top projects through bottom of manhole. Provide with lug to which grounding connection can be made.

3.3 ELECTRODES

.1 Make ground connections to continuously conductive underground water pipe on street side of water meter.

.2 Install water meter shunt.

.3 Install concrete encased electrodes in building foundation footings, with terminal connected to grounding network.

.4 Install rod electrodes and make grounding connections – either cad-weld or compression type.

.5 Bond separate, multiple electrodes together.

.6 Use size 2/0 AWG copper conductors for connections to electrodes.

.7 Make special provision for installing electrodes that will give acceptable resistance to ground value where rock or sand terrain prevails. Ground as indicated.

3.4 SYSTEM AND CIRCUIT GROUNDING

.1 Install system and circuit grounding connections to neutral of secondary 208 V system.

.2 Ground 600V system neutral through 5 Amp High-Resistance grounding resistor(s) at unit substation and stand-by emergency generator. Refer to the following spec sections and contract drawings for grounding details:

.1 26 24 02 – Incoming Entrance Board
.2 26 11 13 – Unit Substation to 15 kV
.3 26 32 13 – Diesel Fired Generator

3.5 EQUIPMENT GROUNDING

.1 Install grounding connections to typical equipment included in, but not necessarily limited to following list. Service equipment, transformers, switchgear, duct systems, frames of motors, motor control centres, starters, control panels, building steel work, generators, elevators and escalators, distribution panels, outdoor lighting and cable trays.

3.6 GROUNDING BUS

.1 Install copper grounding bus 50mm x 6mm around the perimeter of electrical room mounted on 25mm insulated supports on wall.

3. Ground items of electrical equipment in electrical room to ground bus with individual bare stranded copper connections size as indicted on drawings, where not indicted use #6 AWG stranded copper.

3.7 COMMUNICATION SYSTEMS

.1 Install grounding connections for telephone, sound, fire alarm, intercommunication systems as follows:

.1 Telephones: make telephone grounding system in accordance with telephone company's requirements.

.2 Sound, fire alarm, intercommunication systems as indicated.

3.8 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 00 – Common Work Results - Electrical and Section 01 19 13 – Commissioning (Cx) Requirements.

.2 Perform ground continuity and resistance tests using method appropriate to site conditions and to approval of Contract Administrator and local authority having jurisdiction over installation.

.3 Perform tests before energizing electrical system.

.4 Disconnect ground fault indicator during tests.

END OF SECTION

HANGERS AND SUPPORTS

PART 1 GENERAL

1.1 RELATED SECTIONS

.1 Section 26 05 00 – Common Work Requirements Electrical.

.2 Section 26 05 21 – Wires and Cables 0-1000V.

.3 Section 26 05 34 – Conduits, Fastenings and Fittings.

.4 Section 25 05 36 – Cable Trays for Electrical Systems

PART 2 PRODUCTS

2.1 SUPPORT CHANNELS

.1 U shaped aluminum channel, size 41 x 41mm, 2.5 thick, suspended or surface mounted. For use with PVC conduit and rigid aluminum conduit in corrosive areas.

.2 U shaped galvanized steel channel, size 41 x 41mm, 2.5 thick, suspended or surface mounted, for use with EMT conduit, rigid galvanized steel conduit and supports for junction boxes, wall mounted VFD's and disconnects in non-corrosive areas. On cut ends of the channel apply cold enriched zinc compound until the cut has been covered.

PART 3 EXECUTION

3.1 INSTALLATION

.1 Secure equipment to masonry, tile and plaster surfaces with lead anchors or nylon shields.

.2 Secure equipment to poured concrete with expandable inserts.

.3 Secure equipment to hollow masonry walls with toggle bolts.

.4 Secure surface mounted equipment to T bar ceilings with twist clip fasteners. Ensure that T bars are adequately supported to carry weight of equipment specified before installation.

.5 Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.

.6 Suspended support systems:

.1 Provide suspended support systems where direct fastening to building structure is impractical.

.2 Support individual cable or conduit runs with 6 mm (1/4”) diameter threaded rods and spring clips.

.3 Support 2 or more cables or conduits on channels supported by 10 mm (3/8”) diameter threaded rod hangers.

.4 Support suspended cable tray on channels supported by 13 mm (1/2”) diameter threaded rod hangers.

.5 On cut ends of the rod, apply cold enriched zinc compound until the cut end has been covered.

.7 For surface mounting of two or more conduits use channels at 1.5 m on centre spacing.

.8 Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.

.9 Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support. Provide bolted baseplates for vertical supports mounted with stainless steel anchors and leveling nuts. Fill void between underside of baseplate and slab below with non-shrink grout.

.10 Do not use wire lashing, wood blocking, plastic strap or perforated strap to support or secure raceways or cables.

.11 Do not use supports or equipment installed for other trades for conduit or cable support except with permission of other trade and approval of Contract Administrator.

.12 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer's installation recommendations.

.13 Deburr all ends of U channel and threaded rods. Provide rubber caps for the ends of all U channels.

END OF SECTION

SPLITTERS, JBS, PBS AND CABS

PART 1 GENERAL

1.1 REALTED SECTIONS

.1 Section 26 05 00 – Common Work Results – Electrical.

1.2 SUBMITTALS

.1 Submit shop drawings and product data for cabinets in accordance with Section 26 05 00 – Common Work Results – Electrical.

.2 Product Data:

.1 Provide manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish, and limitations.

PART 2 PRODUCTS

2.1 BUS SPLITTERS

.1 Sheet metal enclosure, welded corners and formed hinged cover suitable for locking in closed position.

.2 Main and branch drilled for NEMA compression lugs to match required size and number of incoming and outgoing conductors as indicated.

.3 Bus style splitters only.

2.2 JUNCTION AND PULL BOXES

.1 Welded steel construction. NEMA 12 for indoor dry locations. NEMA 4X for outdoor locations.

.2 Hinged covers for surface mounting with quarter-turn latch.

.1 Screw-on covers for boxes with largest dimension less than of 200mm.

.3 Screw-on covers with 25 mm minimum extension all around, for flush mounting.

.4 Cast feraloy bodies c/w cast aluminum threaded covers and threaded hubs suitable for installation in Class 1, Div. 1 and Div. 2, Group 'D' locations.

2.3 TERMINAL BOXES

.1 Welded steel construction. NEMA 12 for indoor dry locations. NEMA 4X for outdoor locations.

.2 Hinged covers with quarter-turn latch and removable back plane.

.3 Install screw-type terminal blocks on back plane.

2.4 CABINETS

.1 Type E: sheet steel, hinged door and return flange overlapping sides, handle, lock and catch, for surface mounting.

PART 3 EXECUTION

3.1 SPLITTER INSTALLATION

.1 Install splitters and mount plumb, true and square to the building lines.

.2 Extend splitters full length of equipment arrangement except where indicated otherwise.

.3 Provide air space with wall if mounted on exterior walls.

3.2 JUNCTION, PULL BOXES AND CABINETS INSTALLATION

.1 Install pull boxes in inconspicuous but accessible locations.

.2 Mount cabinets with top not higher than 2 m above finished floor.

.3 Provide air space with wall if mounted on exterior walls.

.4 Only main junction and pull boxes are indicated. Install pull boxes so as not to exceed 30 m of conduit run between pull boxes.

3.3 IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 00 – Common Work Results - Electrical.

.2 Install size 2 identification labels indicating system name voltage and phase.

END OF SECTION

OUTLET BOXES AND FITTINGS

PART 1 GENERAL

1.1 RELATED SECTIONS

.1 Section 26 05 00 – Common Work Requirements Electrical.

1.2 REFERENCE STANADARDS

.1 Canadian Standards Association (CSA International)

.1 CSA C22.1-02 Canadian Electrical Code, Part 1

PART 2 PRODUCTS

2.1 OUTLET AND CONDUIT BOXES GENERAL

.1 Size boxes in accordance with CSA C22.1-02.

.2 102 mm square or larger outlet boxes as required for special devices.

.3 Gangboxes where wiring devices are grouped.

.4 Blank cover plates for boxes without wiring devices.

.5 Combination boxes with barriers where outlets for more than one system are grouped.

2.2 SHEET STEEL OUTLET BOXES

.1 Electro-galvanized steel singleand multi gang flush device boxes for flush installation, minimum size 76 x 50 x 38 mm or as indicated. 102 mm square outlet boxes when more than one conduit enters one side with extension and plaster rings as required.

.2 102 mm square or octagonal outlet boxes for lighting fixture outlets.

.3 102 mm square outlet boxes with extension and plaster rings for flush mounting devices in finished plaster or tile walls.

2.3 MASONRY BOXES

.1 Electro-galvanized steel masonry single and multi gang boxes for devices flush mounted in exposed block walls.

2.4 CONCRETE BOXES

.1 Electro-galvanized sheet steel concrete type boxes for flush mount in concrete with matchingextension and plaster rings as required.

2.5 CONDUIT BOXES

.1 Cast FS or FD aluminum boxes with factory-threaded hubs and mounting feet for surface wiring of switches and receptacles. Suitable for installation in Class I, Div.I and Div.II Group D locations.

2.6 FITTINGS-GENERAL

.1 Bushing and connectors with nylon insulated throats.

.2 Knock-out fillers to prevent entry of debris.

.3 Conduit outlet bodies for conduit up to 32 mm and pull boxes for larger conduits.

.4 Double locknuts and insulated bushings on sheet metal boxes.

PART 3 EXECUTION

3.1 INSTALLATION

.1 Support boxes independently of connecting conduits.

.2 Fill boxes with paper, sponges or foam or similar approved material to prevent entry of debris during construction. Remove upon completion of work.

.3 For flush installations mount outlets flush with finished wall using plaster rings to permit wall finish to come within 6 mm of opening.

.4 Provide correct size of openings in boxes for conduit, mineral insulated and armoured cable connections. Reducing washers are not allowed.

END OF SECTION

CONDUITS, FASTENINGS, FITTINGS

PART 1 GENERAL

1.1 SECTION INCLUDES

.1 Specifications for the supply and installation of electrical conduits, fastenings and fittings.

1.2 RELATED SECTIONS

.1 Section 26 05 00 – Common Work Requirements Electrical.

.2 Section 26 05 29 – Hangers and Supports

1.3 REFERENCE STANDARDS

.1 Canadian Standards Association (CSA)

.1	CSA C22.2 No. 18.3-12	Conduit, Tubing, and Cable Fittings
.2	CSA C22.2 No. 18.4-15	Hardware for the Support of Conduit, Tubing, and Cable
.3	CSA C22.2 No. 45.1-07	Electrical Rigid Metal Conduit – Steel
.4	CSA C22.2 No. 45.2-08	Electrical Rigid Metal Conduit – Aluminum, Red Brass, and Stainless Steel
.5	CSA C22.2 No. 56-13	Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.
.6	CSA C22.2 No. 83-M1985	Electrical Metallic Tubing
.7	CSA C22.2 No. 83.1-07	Electrical Metallic Tubing – Steel
.8	CSA C22.2 No. 85-14	Rigid PVC Boxes and Fittings
.9	CSA C22.2 No. 211.1-06	Rigid Types EB1 and DB2/ES2 PVC Conduit
.10	CSA C22.2 No. 211.2-06	Rigid PVC (Unplasticized) Conduit.
.11	CSA C22.2 No. 227.2.2-14	Liquid-Tight Flexible Nonmetallic Conduit
.12	CSA C22.2 No. 227.3-15	Mechanical Protection Tubing (MPT) and Fittings

1.4 SUBMITTALS

.1 Provide submittals in accordance with Section 26 05 00 – Common Work Requirements Electrical.

.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 Conduit Routing Plan:

.1 Submit conduit routing plans per section 3 of this specification.

PART 2 PRODUCTS

2.1 CONDUITS

.1 Rigid metal conduit: to CSA C22.2 No. 45.1, hot dipped galvanized steel threaded.

.2 Epoxy coated conduit: to CSA C22.2 No. 45.1, with zinc coating and corrosion resistant epoxy finish inside and outside.

.3 Electrical metallic tubing (EMT): to CSA C22.2 No. 83, with couplings, galvanized steel.

.4 Rigid PVC conduit: to CSA C22.2 No. 211.2., schedule 40

.5 Flexible metal conduit: to CSA C22.2 No. 56, aluminum liquid-tight flexible metal.

.6 FRE conduit: to CSA C22.2.

.7 Flexible braided explosion proof conduit.

.8 Minimum conduit size: 19 mm.

2.2 CONDUIT FASTENINGS

.1 Fasten surface mounted conduit to building construction using straps.

.1 One-hole straps to secure conduits 50 mm and smaller.

.2 Two-hole straps for conduits larger than 50 mm.

.3 Two-hole PVC straps for PVC conduit

.4 Straps shall be hot dipped galvanized when used with rigid galvanized conduit and EMT conduit.

.5 Straps shall be aluminum when used with ridged aluminum conduit.

.2 Provide galvanized steel beam clamps to secure conduit to exposed steel work.

.3 Provide channel type supports, U-shape, for two or more conduits to Section 26 05 29 – Hangers and Supports.

.4 Provide suspended channel supports as required to Section 26 05 29 – Hangers and Supports.

2.3 CONDUIT FITTINGS

.1 Fittings: manufactured for use with conduit specified. Coating: same as conduit.

.1 Factory "ells" where 90º, 45 º or 22.5 º bends are required for 25 mm and larger conduits.

.2 Ensure conduit bends other than factory “ells” are made with an approved bender. Making offsets and other bends by cutting and rejoining 90-degree bends are not permitted.

.3 Connectors and couplings for EMT. Steel set-screw type, size as required.

2.4 EXPANSION FITTINGS FOR RIGID CONDUIT

.1 Weatherproof expansion fittings suitable for 100mm linear expansion.

.2 Integral bonding jumper suitable for linear expansion and 19mm deflection in all directions for metallic conduit.

2.5 FISH CORD

.1 Polypropylene 6mm minimum.

PART 3 EXECUTION

3.1 CONDUIT LAYOUT

.1 Contract drawings do not indicate all conduit runs. Those indicated are in diagrammatic form only.

.2 Prior to conduit installation, indicate on a set of drawings proposed conduit type, routing, and grouping. Review drawings with General Contractor and other trades to eliminate interferences. Submit reviewed conduit layout drawings for Engineer’s approval. Approval required before proceeding with installation.

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 datasheets.

3.3 CONDUIT KEY PLAN

.1 Use rigid hot dipped galvanized steel threaded conduit in hazardous areas and for exposed work below 2.4m above finished floor or where otherwise subject to mechanical injury in dry locations.

.2 Use epoxy coated threaded conduit for exposed work below 2.4m above finished floor or where otherwise subject to mechanical injury in damp, wet or corrosive locations.

.3 Use electrical metallic tubing (EMT), except in cast concrete, for exposed work above 2.4m and not subject to mechanical injury in dry locations, as well as concealed work in hollow masonry construction.

.4 Use Schedule 40 rigid PVC conduit in cast concrete, underground ductbanks and under concrete slab on grade unless otherwise noted on contract drawings. Also use rigid PVC for exposed work above 2.4m and not subject to mechanical injury in damp, wet or corrosive locations.

.5 Use flexible metal conduit for connection to motors in dry areas, connection to recessed and surface mount light fixtures without a prewired outlet box.

.6 Use liquid tight flexible metal conduit for connection to motors or vibrating equipment in damp, wet or corrosive locations.

.7 Use explosion proof flexible conduit for connection to explosion proof motors.

3.4 INSTALLATION - GENERAL

.1 Install all conduit, conduit fittings and accessories in accordance with the Ontario Electrical Safety Code (OESC) in a manner that does not alter, change or violate any part of the installed system components or the CSA/UL certification of these components.

.2 Install conduit below concrete slab, in applicable areas, to minimize conduit installation on walls.

.3 Install conduit sleeves: at points where conduit pass through masonry, concrete or fire rated assemblies and as indicated.

.1 Sleeves through concrete: schedule 40 galvanized steel pipe.

.2 Sizes: maximum 6mm clearance all around, between sleeve and conduit.

.3 Terminate sleeves flush with surface of concrete and masonry walls.

.4 Fill voids around conduit:

.1 Caulk between sleeve and conduit in foundation walls with waterproof fire retardant non-hardening mastic.

.2 Where sleeves pass through walls, provide space for fire-stopping. Where conduit passes through fire rated walls, maintain fire rating integrity.

.3 Ensure no contact between copper conductor and ferrous sleeve.

.4 Fill future-use sleeves with lime plaster or other easily removable filler.

.5 Coat exposed exterior surfaces of ferrous sleeves with heavy application of zinc rich paint to CGSB 1-GP-181M+Amdt.

.5 This Division shall prepare sleeving drawings indicating the size and locations of openings required in concrete walls for conduit. In case of failure to provide information in time (i.e. before the concrete is poured) any extras incurred shall be at the expense of this Division.

.6 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.

.7 Conceal conduits unless otherwise noted.

.8 Surface mounted conduit in unfinished areas, electrical and mechanical service rooms, industrial process areas, service garages or otherwise noted on contract drawings.

.9 Install conduit sealing fittings in hazardous areas. Fill with compound.

.10 Bend conduit cold. Replace conduit if kinked or flattened more than 1/10th of its original diameter.

.11 Mechanically bend steel conduit over 19mm diameter.

.12 Field threads on rigid conduit must be of sufficient length to draw conduits up tight.

.13 Install fish cord 6mm in empty conduits.

.14 Run 2 - 25mm spare conduits up to ceiling space above and 2 - 25mm spare conduits down to ceiling space below from each flush mounted panel. Terminate these conduits in 152 x 152 x 102mm junction boxes in ceiling space or in case of an exposed concrete slab, terminate each conduit in flush concrete type box.

.15 Remove and replace blocked conduit sections. Do not use liquids to clean out conduits.

.16 Dry conduits out before installing wire.

3.5 SURFACE CONDUITS

.1 Run parallel or perpendicular to building lines.

.2 Locate conduits behind infrared or gas fired heaters within 1.5m clearance.

.3 Run conduits in flanged portion of structural steel.

.4 Group conduits wherever possible on surface mounted or suspended channels.

.5 Do not pass conduits through structural members except as indicated.

.6 Do not locate conduits less than 75mm parallel to steam or hot water lines. Cross at right angles with minimum of 25mm clearance at crossovers.

.7 Do not enter conduit at tops of disconnect switches, terminal boxes, junction boxes, splice boxes or control panels. Boxes with penetrations placed in the top shall be replaced at no cost to the contract.

3.6 CONCEALED CONDUITS

.1 Run parallel or perpendicular to building lines.

.2 Do not install horizontal runs in masonry walls.

.3 Do not install conduits in terrazzo or concrete toppings.

3.7 CONDUITS IN CAST IN PLACE CONCRETE SLABS ON GRADE.

.1 Do not run conduit horizontally within concrete slabs, except as otherwise detailed in contract drawings.

.2 Horizontal conduit to be run beneath slab with minimum 75mm cover between top of conduit and underside of concrete slab.

.3 Conduit to stub up vertically and perpendicular to concrete slab. Protect conduits from damage where they stub out of concrete slab.

.4 Install conduit prior to slab installation. Locate to suit reinforcing steel.

3.8 CONDUITS UNDERGROUND

.1 Slope conduits to provide drainage.

.2 Waterproof joints (PVC excepted) with heavy coat of bituminous paint.

3.9 EXPANSION FITTINGS FOR RIGID PVC CONDUIT

.1 Provide minimum of 150mm of expansion joints for conduit exposed to ambient air conditions with minimum (1) expansion joint between fixed points. The point at which conduits rise up out of ground shall be treated as a fixed point.

END OF SECTION

CABLE TRAYS FOR ELECTRICAL SYSTEMS

PART 1 ENERAL

1.1 RELATED SECTIONS

.1 Section 01 33 00 - Submittal Procedures.

.2 Section 26 05 00 – Common Work Results - Electrical.

1.2 REFERENCES

.1 Canadian Standards Association (CSA)

.1 CAN/CSA C22.1 No. 126.1 – Metal Cable Tray Systems.

.2 National Electrical Manufacturers Association (NEMA).

.1 NEMA FG 1, Fibreglass and Cable Tray Systems.

.2 NEMA VE 1, Metal Cable Tray Systems.

1.3 SUBMITTALS

.1 Submit shop drawings and product data in accordance with Section 01 33 00 – Submittal Procedures.

.2 Product Data: submit manufacturer's product data sheets for cable tray indicating dimensions, materials, and finishes, including classifications and certifications.

.3 Shop Drawings: submit shop drawings showing materials, finish, dimensions, accessories, layout, and installation details. Shop drawings shall include coordinated routing of cable trays and supports.

.4 Submit cable tray routing plans per Part 3 of this specification.

.1 Identify types of cable trays used.

.2 Show actual cable tray installation details and suspension system.

PART 2 PRODUCTS

2.1 CABLE TRAY

.1 Aluminum, Ladder type, Class D1 with 300mm rung spacing to CAN/CSA C22.2 No.126.

.2 Width and depth as required and/or indicated on contract drawings.

.3 Ventilated Aluminum channel tray for nominal width of 150mm and less.

.4 Horizontal elbows, end plates, drop outs, vertical risers and drops, tees, wyes, expansion joints and reducers where required. Fittings: manufactured accessories for cable tray supplied. Radii on fittings: 610mm minimum for 610mm tray, 305mm minimum for 305mm tray, 102mm deep.

.1 Radii on fittings: 900 mm minimum on all larger cable tray.

.5 Solid covers for complete cable tray system including fittings.

2.2 SUPPORTS

.1 Provide supports as required – refer to typical details on contract drawings and manufacturers installation instruction.

.2 Support cable tray on both ends.

.3 Submit for review – support details.

2.3 BARRIERS

.1 Provide barriers to separate power, control and instrumentation cables when in same cable tray. Barriers to be supplied by cable tray manufacturer.

2.4 GROUNDING

.1 Run a bare stranded #2/0 CW bond conductor the full length of each power tray run. Bond to tray every 15m. Provide all bonding to meet ESA requirements.

PART 3 EXECUTION

3.1 INSTALLATION

.1 Prior to cable tray installation, indicate on a set of drawings proposed tray type, routing, and grouping. Review drawings with General Contractor and other trades to eliminate interferences. Submit reviewed cable tray layout drawings for Engineer's approval. Approval required before proceeding with installation

.2 Cable trays are shown on Contract Drawings with approximate routing. The number of tiers of cable tray runs is to be determined by Div. 26 contractor.

.3 Install vertical cable tray for vertical cable runs. Vertical drops are not detailed on plan views - refer to details.

.4 Maintain minimum 300mm vertical clearance from top of tray to underside of floors, ducts and other continuous planes above the tray. 150mm minimum clearance at crossings.

.5 Install complete cable tray systems.

.6 Support cable tray on both sides.

.7 Remove sharp burrs or projections to prevent damage to cables or injury to personnel.

.8 Bond cable tray to ground wire every 15 meters or part thereof.

.9 Prime all bare metal surfaces with zinc rich primer.

.10 Provide continuous cable tray through wall/floor/ceiling assemblies. Provide fire/smoke stopping around penetrations to Section 26 05 00 – Common Work Results – Electrical.

3.2 CABLES IN CABLE TRAY

.1 Install cables individually.

.2 Lay cables into cable tray. Use rollers when necessary to pull cables.

.3 Secure cables in cable tray at 1.5 m centres, with nylon ties. UV resistant ties in outdoor locations.

.4 Identify cables accordance with Section 26 05 00 – Common Work Results - Electrical.

.1 Every 30 m with size 2 nameplates in

.2 At terminations and both sides of wall penetrations with universal carrier strips.

.5 Space cables as per electrical code requirements.

.6 Separate control, power and instrumentation cables with barriers supplied by tray manufacturer unless Teck cable is used.

END OF SECTION

INSTALLATION OF CABLES IN TRENCHES AND IN DUCTS

PART 1 GENERAL

1.1 RELATED SECTIONS

.1 Section 31 23 33.01 – Excavating, Trenching and Backfilling.

.2 Section 26 05 00 – Common Work Requirements Electrical.

PART 2 PRODUCTS

2.1 MARKER TAPE

.1 Red warning tape with “Caution Buried Electric Line Below” or equivalent caution message.

.2 Aluminum foil backed. Detectable with non-ferrous metal detector.

PART 3 EXECUTION

3.1 DIRECT BURIAL OF CABLES

.1 Direct burial of cables is not permitted unless specifically detailed in contract drawings.

.2 Provide offsets for thermal action and minor earth movements. Offset cables 150 mm for each 60 m run maintaining minimum cable separation and bending radius requirements.

.3 Leave minimum 0.6m of surplus cable in each direction at terminations and splices.

.4 Direct buried cable shall not be spliced unless specifically detailed in contract drawings.

.1 Underground Splices shall be made within approved underground handhole/pedestals to allow for future access suitable mechanical protection.

.2 Make splices and terminations in accordance with manufacturer’s instructions using approved splicing kits.

.5 Maintain minimum bending radius per OESC and manufacturer requirements.

.6 Cable separation:

.1 Refer to contract drawings for minimum separations between cables installed in a common trench.

.2 Maintain minimum 75 mm separation between cables of different circuits.

.3 Maintain 300 mm separation between low and high voltage cables.

.4 When low voltage cable cross high voltage cables, maintain 300 mm vertical separation with low voltage cables in upper position.

.5 Maintain 75 mm vertical separation where low voltage cables cross each other.

.6 Maintain 150 mm vertical separation where high voltage cables cross each other.

.7 Maintain 300 mm minimum lateral and vertical separation for fire alarm and control cables when crossing other cables, with fire alarm and control cables in the upper position.

3.2 CABLE INSTALLATION IN UNDERGROUND DUCTS

.1 Install underground duct bank per contract drawings. Underground duct bank shall be completely installed between end points prior to pulling in cables.

.2 Do not pull spliced cables inside of ducts.

.3 Install multiple cables simultaneously.

.4 Use CSA approved lubricants with cable jacket to reduce pulling tension.

.5 To facilitate matching of colour coded multiconductor cables reel off in same direction during installation.

.6 Before pulling cable into ducts and until cables are properly terminated, seal ends of lead covered cable with wiping solder; seal ends of non-leaded cables with moisture seal tape.

.7 After installation of cables, seal duct ends with sealing compound.

3.3 MARKING

.1 Install continuous marking tape along the length of the buried conduit/cable installation.

.2 Marker tape to be buried approximately half-way between top of conduit and final grade along the centerline of the underground duct bank.

3.4 FIELD QUALITY CONTROL

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

.2 Perform tests using qualified personnel. Provide necessary instruments and equipment.

.3 Check phase rotation and identify each phase conductor of each feeder.

.4 Check each feeder for continuity, short circuits and grounds. Ensure resistance to ground of circuits is not less than 50 megohms.

.5 Pre-acceptance tests:

.1 After installing cable but before splicing and terminating, perform insulation resistance test with 1000 V megger on each phase conductor.

.2 Check insulation resistance after each splice and/or termination to ensure that cable system is ready for acceptance testing.

.6 Acceptance Tests:

.1 Ensure that terminations and accessory equipment are disconnected.

.2 Ground shields, ground wires, metallic armour and conductors not under test.

.1 High Potential (Hipot) Testing.

.1 Conduct hipot testing of original factory test voltage in accordance with manufacturer's recommendations.

.2 Leakage Current Testing.

.1 Raise voltage in steps from zero to maximum values as specified by ICEA manufacturer for type of cable being tested.

.2 Hold maximum voltage for specified time period by ICEA manufacturer.

.3 Record leakage current at each step.

.7 Provide Engineer with list of test results showing location at which each test was made, circuit tested and result of each test.

.8 Remove and replace entire length of cable if cable fails to meet any of test criteria.

END OF SECTION

LIQUID-FILLED PADMOUNT TRANSFORMER

PART 1 GENERAL

1.1 SECTION INCLUDES

.1 Materials and installation for outdoor liquid filled padmounted transformer.

1.2 RELATED SECTIONS

.1 Section 26 05 00 – Common Work Requirements - Electrical

1.3 REFERENCES

.1 American National Standards Institute (ANSI)

.1 ANSI C37.121-1989(R2000), Unit Substations - Requirements.

.2 Canadian Standards Association (CSA International)

.1 CSA-C22.2 No.58-M1989(R2000), High-Voltage Isolating Switches.

.2 CSA G40.20/G40.21-98(June 2000), General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.

.3 CSA C227.4 Three-phase, pad-mounted distribution transformers with separable insulated high-voltage connectors

.4 Losses to CSA C802.1-13.

.5 CSA-22.2 No.31 1992 Switch Gear Assemblies.

.6 CSA TIL D25 2001 Gas Filled Enclosures.

.7 CAN/CSA C2.1-06 (R2011)

.3 Electrical and Electronic Manufacturers' Association of Canada (EEMAC)

.1 EEMACG1-1, 1958, Indoor and Outdoor Switch and Bus Insulators.

.4 Underwriters' Laboratories (UL)

.1 UL 1062-97, Unit Substations.

1.4 SHOP DRAWINGS

.1 Submit shop drawings in accordance with Section 26 05 00 – Common Work Requirements – Electrical.

.2 Indicate:

.1 Single line diagram.

.2 Equipment layout.

.3 Equipment dimensions including door openings, draw-out equipment positions and workspace requirements.

.4 Dimensioned foundation template.

.5 Dimensioned cable entrance and exit locations.

.6 Dimensioned cable termination heights.

.7 Transformer nameplate data.

.8 Details of pulsed Neutral Grounding Resistor.

1.5 CLOSEOUT SUBMITTALS

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

1.6 QUALITY ASSURANCE

.1 Submit copies of production test results to Engineer. Do not ship equipment until test results have been accepted Engineer.

1.7 EXTRA MATERIALS

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

.2 Include:

.1 Fuses:

.2 6 fuse refills for each type.

PART 2 PRODUCTS

2.1 GENERAL DESCRIPTION

.1 Outdoor, tamper-proof, dead-front, dielectric filled, three-phase padmounted transformer with separable HV connectors to CSA C227.4:21.

2.2 MATERIALS

.1 Steel for cubicles: to CSA G40.21.

.2 Insulators: to CSA C22.2 No.58.

.3 Outdoor pad mounted transformers: to CSA-227.4 C22.2.

.4 High voltage-load interrupter switches CSA-C22.2 No.193.

.5 NGR to IEEE32.

2.3 RATINGS

.1 Capacity rating: 750 kVA

.2 Primary voltage: 4160/2400 V Grounded Wye

.3 Secondary voltage: 600/347 V Wye with a neutral brought out and high resistance grounded

.4 Vector group: Yn0

.5 Frequency: 60 Hz

.6 Impedance: minimum 4.5%

.7 Winding temperature rise: maximum 55 C when the maximum ambient temperature is 40 C

.8 Cooling method: self-cooled (ONAN)

.9 B.I.L.: primary winding: 95 kV secondary winding: 30 kV, fully insulated neutral

.10 Efficiency: meet the energy efficiency requirements of NEMA TP-1

.11 Insulating fluid: Envirotemp FR3 fluid or equivalent

.12 Winding conductors: copper

.13 4.16 kV Primary winding taps: full capacity high voltage taps, two 2.5% below and two 2.5% above the nominal voltage, externally operated off-circuit tap changer with provisions for locking the handle in any positions

.14 Sound level: in accordance with the requirement of CSA-C802.1-00

2.4 ENCLOSURE

.1 Enclosure: metal enclosed free standing, floor mounted, dead front, NEMA 3R outdoor tamperproof CSA Enclosure cubicle unit. Constructed from rolled flat steel sheets mm thick.

.2 Use non-corrodible bolts and hardware.

.3 Access from front only.

.4 100 mm steel channel sills for base mounting.

.5 Full height outer door reinforced with stiffeners, gasketted, provision for multiple padlocking. Three point latch, stops, to open at least 135 degrees.

.6 Hinge doors of multi-cubicle switchboard on same side.

.7 Gaskets on removable covers.

.8 Removable cover bolts not accessible from outside of cubicle.

.9 Interior hinged and bolted mesh steel screens to prevent inadvertent contact with exposed live parts.

.10 Storage container on inside surface of door spare fuses.

.11 Metal pocket on inside surface of door to accommodate drawing and diagram prints. Min. size:300mm x 300 mm.

2.5 INSULATING LIQUID

.1 Insulating liquid shall be certified to contain no detectable PCB at the time of shipment. Certification shall also be provided that the transformer or components have not been contaminated with PCBs prior to shipment.

.2 Insulating liquid shall meet or exceed requirements of ASTM D3487 standards or CAN/CSA-C50-97 (Canada).

.3 The dielectric coolant shall be listed less-flammable fluid meeting the requirements of National Electrical Code Section 450-23 and the requirements of the National Electrical Safety Code (IEEE C2-2002), Section 15. The fluid shall be Factory Mutual Approved, UL Classified Dielectric Medium (UL-EOUV) and UL Classified Transformer Fluid (UL-EOVK), Envirotemp FR3 fluid or equivalent.

2.6 HIGH VOLTAGE COMPARTMENT

.1 The high voltage compartment shall be the type of Loop Feed Deadfront and designed in accordance with IEEE C57.12.26 with the following components:

.1 Access door to be key interlocked to upstream, externally mounted load break switch.

.2 High voltage bushing wells with bushing well inserts installed

.3 Tap-changer selector switch • Stainless steel ground pad

.4 Bayonet Fusing

2.7 LOW VOLTAGE COMPARTMENT

.1 The low voltage compartment shall be the type of Radial Livefront with an X0 bushing and designed in accordance with IEEE C57.12.26 with the following components:

.1 Low voltage bushings with cable connections

.2 Stainless steel ground pad

.3 Liquid level gauge with low level contacts brought out to a terminal block

.4 1 inch upper filter press and filling plug

.5 1 inch drain valve with sampling device

.6 Dial type thermometer with resettable trailing gauge, warning contact, and alarm contacts brought out to a terminal block

.7 Automatic pressure relief valve with alarm contacts brought out to a terminal block via liquid tight flexible conduit

.8 Laser scribed anodized aluminum nameplate installed on the outside of the bushing compartments

2.8 BUSHINGS

.1 High Voltage Bushings

.2 Six (6) universal bushing wells rated at 15 kV class, with protective caps and bushing well inserts

.3 Rated for 600 amperes continuous, 95 kV B.I.L.

.4 600 Amp through current bus between bushings

.5 Standoff brackets located adjacent to bushing wells

.6 Six (6) temporary bushing dust covers

2.9 LOW VOLTAGE BUSHINGS

.1 Moulded epoxy bushing clamped to tank with NEMA 6-hole (or more) tin-plated spade type terminals

.2 Rated 150 percent of continuous full load current, 30 kV B.I.L.

.3 Internally connected neutral extending to neutral X0 bushing

.4 Neutral bushing with a current-carrying capacity equal to the other low voltage terminals, 30 kV B.I.L.

.5 Four (4) 500 MCM NEMA 2-hole long barrel compression lugs for copper conductors per phase

.6 Stainless bolts and washers with silicon bronze nuts for attaching compression lugs to spade terminals

2.10 OVER-CURRENT PROTECTION

.1 Bay-o-net with current limiting fuses for the 4.16 kV primary winding

.2 Interrupting rating of the under-oil backup current limiting fuses shall be not less than 25 kA (symmetrical, RMS)

.3 Back-up current limiting fuses for 4.16 kV application shall be provided

.4 Key-Interlock between upstream, remote mounted load break switch and removable bay-o-net fuse compartment.

.5 Drip cups below bay-o-net fuses

2.11 GROUNDING

.1 Two (2) tank grounding pads in the high and low voltage compartments shall be connected together with bare copper ground bar

.2 The ground bar shall come complete with the following:

.1 Six (6) #3 AWG NEMA 1-hole short barrel ground compression lugs for copper conductors

.2 Two (2) 4/0 AWG NEMA 1-hole short barrel ground compression lugs for copper conductors

.3 Two (2) split bolts for 3#14 AWG stranded drain wires

.4 Stainless bolts and washers with silicon bronze nuts for attaching the above

2.12 NEUTRAL GROUNDING RESISTOR (NGR)

.1 The transformer secondary winding will be connected to a high resistance neutral ground resistor (NGR) via liquid tight flexible conduit. The NGR (from I-GARD, OHMNI-6PM-5, pulsing resistor) shall be supplied as follows:

.1 347 V

.2 Maximum let-through current of 5 A

.3 Element material should not have a temperature coefficient greater than 0.0002 ohms/ C

.4 The resistor let-thru current shall not decease by greater than 20% from ambient to full operating temperature

.5 Pulsing capability, brought out to a terminal block via liquid tight flexible conduit

.6 Neutral CT, primary rating 0-5 A, turns ratio per manufacturer's recommendation, with internal wiring to a grounded shorting switch and then brought out to a terminal block

.7 NEMA 3R stainless steel enclosure with bolted access

2.13 TRANSFORMER CUBICLES

.1 The terminals shall be as per CSA C227.4, high and low compartment, side by side, separated by steel barrier bolted to tank.

.2 Vents, back, to provide adequate cooling for transformers.

.3 Mount winding and oil temperature measuring devices on front panel. Auxiliary contacts to terminal blocks.

2.14 SHOP FABRICATION

.1 Shop assemble and test components of substation.

.2 After completion of factory assembly and high potential test, prepare for shipment to site in 1 sections.

2.15 FINISHES

.1 Apply finishes in accordance with Section 26 05 00 - Common Work Results - Electrical.

.2 Cubicle exteriors: green gray.

.3 Cubicle interiors: white.

.4 Supply 2 spray cans touch up paint.

2.16 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results - Electrical.

.2 Nameplates:

.1 Transformer Section: white plate, black letters, size 7:

.1 Engraved: "TRANSFORMER TX-1" 750kVA, 4.16/2.4kV to 600V, 3-phase, 60 Hz".

.2 Winding temperature device engraved: "Winding Temperature". .3 Oil thermometer engraved: "Oil Temperature".

2.17 WARNING SIGNS

.1 Provide warning signs in accordance with Section 26 05 00 - Common Work Results - Electrical.

2.18 TRANSFORMER FOUNDATION

.1 Precast concrete transformer base with removable lid.

.1 Open bottom base.

.2 Twelve(12) 127mm(5”) cast in place conduit openings c/w Polylok pipeseals on each side of base.

.2 Utility Structures Inc. (USI) model E-10 base with E-11 transformer pad or equal.

2.19 SOURCE QUALITY CONTROL

.1 Engineer to:

.1 Inspect place of manufacture.

.2 Inspect testing of any component.

.3 Inspect testing of complete transformer prior to shipment including Hipot heat run.

.2 Notify Engineer in writing 7 days in advance that equipment is ready for inspection.

PART 3 EXECUTION

3.1 INSTALLATION

.1 Excavate and install pre-cast transformer base on minimum 150mm of leveled and compacted Granular A base such that top of pad extends 200mm above finished grade surrounding transformer installation.

.2 Extend incoming / outgoing conduits into transformer base per contract drawings.

.3 Install transformer ground grid and associated electrodes around transformer.

.4 Install incoming/outgoing cables into transformer base, coil and protect.

.5 Install transformer pad.

.6 Set and secure transformer on transformer pad, plumb and square.

.7 Check factory-made connections for mechanical security and electrical continuity.

.8 Connect incoming / outgoing and grounding connections within transformer cubicle.

.9 Run one grounding conductor 4/0 AWG bare copper in conduit from transformer ground bus to electrical room ground bus.

.10 After finishing Work, remove foreign material, including dust, before energizing transformer.

.11 Set transformer taps for secondary voltage of 600 V at no load.

.12 Check fuse sizes and relay settings against shop drawings to ensure proper working of components and that co-ordinated sequence of action is established.

3.2 FIELD QUALITY CONTROL

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

.2 Factory Tests as per CSA C227.4-06 for 8 consecutive hours, also to include:

- .1 Primary and secondary voltage at no load.
- .2 Primary and secondary voltages at normal load once per hour.
- .3 Primary and secondary current in each phase once per hour.
- .4 kW and kVA once per hour.
- .5 Transformer and ambient temperature once per hour.

END OF SECTION

DRY TYPE TRANSFORMERS, 0-600 V

PART 1 General

1.1 RELATED DOCUMENTS

.1 Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SECTION INCLUDES

.1 Materials, components, identification, and installation of dry type transformers up to 600 V primary.

.2 This Section includes the following types of dry-type transformers rated 600 V and less, with capacities up to 1000 kVA:

.1 Distribution transformers.

1.3 RELATED SECTIONS

.1 Section 01 33 00 - Submittal Procedures.

.2 Section 01 91 13 – General Commissioning (Cx) Requirements.

.3 Section 26 05 00 – Common Work Results - Electrical.

1.4 REFERENCES

.1 Canadian Standards Association (CSA)

.1 CAN/CSA-C22.2 No.47, Air-Cooled Transformers (Dry Type).
.2 CSA C9, Dry-Type Transformers.

.2 National Electrical Manufacturers Association (NEMA)

1.5 SUBMITTALS

.1 Product Data for each type and size of transformer indicated.

.1 Physical: Include rated nameplate data, impedance, X/R ratio, capacities, weights, dimensions, minimum clearances, installed devices, installation recommendations and features.
.2 Product warranty.
.3 Efficiency Data
.1 No load and full load losses per NEMA TP-1.
.2 Linear load Efficiency data @ 1/6, 1/4, 1/2, 3/4, & full load.
.3 Linear Load Efficiency @ 35% loading tested per NEMA TP-2.

.4 Efficiency under K4 load profile at 15%, 25%, 50%, 75%, 100% of nameplate rating.

.2 Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

.1 Wiring Diagrams: Power, signal, and control wiring.

.3 Qualification Data: For testing agency.

.4 Source quality-control test reports.

.5 Field quality-control test reports.

.6 Operation and Maintenance Data: For transformers to include in emergency, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

.1 Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7.

.1 Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.

.2 Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7.

.3 Source Limitations: Obtain each transformer type through one source from a single manufacturer.

.4 Electrical Components, Devices and Accessories: Listed and labelled as defined in NFPA 70, Article 100, and to Canadian Electrical Code (CEC), by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

.5 Comply with IEEE C57.12.91, "Test Code for Dry-Type Distribution and Power Transformers."

.6 Comply with IEEE C57.110-1998-IEEE recommended practise for establishing transformer capability when feeding non-sinusoidal load currents.

1.7 DELIVERY, STORAGE, AND HANDLING

.1 Temporary Heating: Apply temporary heat according to manufacturer's written instructions within the enclosure of each ventilated-type unit, throughout periods

during which equipment is not energized and when transformer is not in a space that is continuously under normal control of temperature and humidity.

1.8 COORDINATION

.1 Coordinate size and location of concrete bases with actual transformer provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and form work requirements are specified in Division 03.

.2 Coordinate installation of wall-mounting and structure-hanging supports with actual transformer provided.

PART 2 PRODUCTS

2.1 GENERAL TRANSFORMER REQUIREMENTS

.1 Description: Factory-assembled and tested, ventilated enclosure, convection air-cooled units for 60 Hz service.

.1 Transformer shall be designed, constructed, and rated to in accordance with UL, CSA, and NEMA standards.

.2 Comply with NEMA ST 20, and list and label as complying with UL 1561.

.2 Cores: Grain-oriented, non-aging silicon steel.

.1 One leg per phase.

.2 All three-phase transformers shall be constructed with three coils on a single 3-leg core.

.3 Coils: Continuous windings without splices except for taps.

.1 Internal Coil Connections: Brazed or pressure type.

.2 Coil Material: Copper.

.4 Enclosure: Ventilated, NEMA 3R, with removable front cover.

.1 Core and coil shall be vacuum pressure impregnated within resin compound, sealing out moisture and air.

.2 Finish Colour: Manufacturer’s Standard

.3 Anti-vibration pads/isolators between transformer core/coil assembly and transformer enclosure.

.4 Sound Level to NEMA ST-20.

.5 Mounting:

.1 Units up to 750lbs: factory installed brackets for floor, wall and suspension mounting with drip plate.

.2 Units over 750lbs: factory installed brackets for floor mounting only.

.6 Options:

.1 Type 4X - Stainless Steel enclosure in corrosive or wet environments.

.7 Warranty:

.1 Provide a 25-year pro-rated product Warranty.

2.2 RATINGS

.1 Primary Voltage: as indicated.

.2 Secondary Voltage: as indicated.

.3 kVA Rating: as indicated.

.4 System Frequency: 60 Hertz.

2.3 DISTRIBUTION TRANSFORMERS

.1 Insulation Class H: 220 deg C

.2 Temperature Rise: 150 deg C rise above 40 deg C ambient temperature.

.3 Efficiency: to NRCan, Energy Efficiency Act SOR/2018-201 and O.Reg. 404-12

.4 Taps for Transformers:

.1 Smaller than 3 kVA: None.

.2 7.5 to 24 kVA: One 5 percent tap above and one 5 percent tap below normal full capacity.

.3 25 kVA and larger: Two 2.5 percent taps above and four 2.0 percent taps below normal full capacity.

.5 K-Factor Rating: Transformers shall be K-Factor 4 or higher rated and comply with UL 1561 requirements for non-sinusoidal load current-handling capability to the degree defined by designated K-factor.

.1 Unit shall not overheat when carrying full-load current with harmonic distortion corresponding to designated K-factor.

.2 Indicate value of K-factor on transformer nameplate.

.6 Electrostatic Shielding: Each winding shall have an independent, single, full-width copper electrostatic shield arranged to minimize inter-winding capacitance.

.1 Arrange coil leads and terminal strips to minimize capacitive coupling between input and output terminals.

.2 Include special terminal for grounding the shield.

.3 Shield Effectiveness:

.1 Capacitance between Primary and Secondary Windings: Not to exceed 33 picofarads over a frequency range of 20 Hz to 1 MHz.

.2 Common-Mode Noise Attenuation: Minimum of minus 120 dB at 0.5 to 1.5 kHz; minimum of minus 65 dB at 1.5 to 100 kHz.

.3 Normal-Mode Noise Attenuation: Minimum of minus 52 dB at 1.5 to 10 kHz.

2.4 IDENTIFICATION DEVICES

.1 Nameplates: Engraved, laminated-plastic or metal nameplate for each distribution transformer, mounted with corrosion-resistant screws. Name-plated label products are specified in Division 26 Section “Identification for Electrical Systems”.

2.5 SOURCE QUALITY CONTROL

.1 Test and inspect transformers according to IEEE C57.12.91.

2.6 MANUFACTURERS

.1 Use transformers of one manufacturer throughout project.

.2 Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the work include, but are not limited to the following:

.1 Hammond Power Solutions Inc.;

.2 Marcus

.3 Delta

.4 Square D; Schneider Electric.

PART 3 EXECUTION

3.1 EXAMINATION

.1 Examine conditions for compliance with enclosure and ambient temperature requirements for each transformer.

.2 Verify that field measurements are as needed to maintain working clearances required by CEC-2009 and manufacturer’s written instructions.

.3 Examine walls, floors, roofs, and concrete bases for suitable mounting conditions where transformers will be installed.

.4 Verify that ground connections are in place and requirements in Division 26 Section “Grounding and Bonding for Electrical System’s have been met. Maximum ground resistance shall be 5 ohms at location of transformer.

.5 Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

.1 Install wall-mounting transformers level and plumb with wall brackets fabricated by transformer manufacturer.

.1 Brace wall-mounting transformers as specified in Division 26 Section "Vibration and seismic Controls for Electrical Systems".

.2 Construct concrete bases and anchor floor-mounting transformers according to manufacturer's written instructions, seismic codes applicable to Project, and requirements in Division 26 Section "Vibration and Seismic Controls for Electrical Systems".

3.3 CONNECTIONS

.1 Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems".

.2 Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables".

3.4 FIELD QUALITY CONTROL

.1 Perform tests and inspections and prepare test reports.

.1 Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

.2 Tests and Inspections:

.1 Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

.2 Test transformers for losses and efficiency. Verify results are consistent with the loss data provided on the submittal documenting compliance with DOE CSL 3 class efficiency.

.3 Remove and replace units that do not pass tests or inspections and retest as specified above.

.4 Infrared Scanning: Two months after Substantial Completion, perform an infrared scan of transformer connections.

.1 Use an infrared-scanning device designed to measure temperature or detect significant deviations from normal values. Provide documentation of device calibration.

.2 Perform 2 follow-up infrared scans of transformers, one at 4 months and the other at 11 months after Substantial Completion.

.3 Prepare a certified report identifying transformer checked and describing results of scanning. Include notation of deficiencies detected, remedial action taken, and scanning observations after remedial action.

.5 Test Labelling: On completion of satisfactory testing of each unit, attach a dated and signed “Satisfactory Test” label to tested component.

3.5 ADJUSTING

.1 Record transformer secondary voltage at each unit for at least 48 hours of typical occupancy period. Adjust transformer taps to provide optimum voltage conditions at secondary terminals. Optimum is defined as not exceeding name plate voltage plus 10 percent and not being lower than name plate voltage minus 3 percent at maximum load conditions. Submit recording and tap settings as test results.

.2 Connect buck-boost transformers to provide name plate voltage of equipment being served, plus or minus 5 percent, at secondary terminals.

.3 Output Settings Report: Prepare a written report recording output voltages and tap settings.

3.6 CLEANING

.1 Vacuum dirt and debris; do not use compressed air to assist in cleaning.

END OF SECTION

HARMONIC FILTERS

PART 1 General

1.1 SECTION INCLUDES

.1 Materials, components, identification, and installation of free-standing, low voltage, harmonic filters up to 600 V designed to reduce the total voltage/current harmonic distortions (THDv and THDi) within an electrical distribution system.

.2 This section does not include the requirements for harmonic filters integrated into the design of packaged variable frequency drives (VFDs). Refer to related sections for further details on

1.2 RELATED SECTIONS

.1 Section 01 33 00 - Submittal Procedures.

.2 Section 01 91 13 – General Commissioning (Cx) Requirements.

.3 Section 26 05 00 – Common Work Results - Electrical.

.4 Section 26 29 20 – Variable Frequency Drives (VFDs)

1.3 REFERENCES

.1 Canadian Standards Association (CSA)

.1 CAN/CSA-C22.2 No.14, Industrial Control Equipment

.2 Institute of Electrical and Electronics Engineers, Inc. (IEEE)

.1 ANSI/IEEE 519-2014, Guide for Harmonic Control in Electrical Power Systems.

.2 ANSI/IEEE C62.41, Guide for Surge Voltages in Low AC Power Systems

.3 ANSI/IEEE C84.1, Electrical Power Systems and Equipment – Voltage Ratings

1.4 SUBMITTALS

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

.2 Shop Drawing Submittals:

.1 Submit to engineer for approval for each type of filter provided.

.1 Nameplate data and equipment ratings

.2 Physical dimensions and weights

.3 Storage and handling recommendations.

.4 Installation recommendations and features.

.5 Computer simulation and design report to show compliance with performance requirements.

1.5 QUALITY ASSURANCE SUBMITTALS

.1 Submit copies of production test results to Engineer. Do not ship equipment until test results have been accepted by Engineer.

1.6 CLOSEOUT SUBMITTALS:

.1 Provide maintenance data and field test reports for filter for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.7 DELIVERY, STORAGE AND HANDLING

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

PART 2 PRODUCTS

2.1 ACTIVE HARMONIC FILTER

.1 Ratings:

.1 As Indicated on contract drawings.

.2 Description:

.1 The active filter shall be of the shunt configuration and of 3-wire type to filter harmonics in the phases.

.2 The active filter shall be connected at the LV level in an installation allowing for the reduction of harmonic stress at load level and to reduce transformer losses and harmonic emissions to the feeding network.

.3 The active filter shall be able to work on utility fed networks as well as on local backup generators.

.4 The active filter shall be able to do reactive power compensation. Target power factor must be settable up to unity. Both capacitive and inductive mode must be possible.

.5 The active filter shall be able to do load balancing.

.6 The active filter shall be configurable to measure load current at both supply side (close loop operation) and on load side (open loop operation). Standard current transformers of class 1 accuracy shall be sufficient for proper filter operation.

.7 The active filter power inverter shall be based on IGBT technology. It shall employ a pulse width modulated, PWM modulation technology using a fixed switching frequency.

.8 The active filter shall be able to compensate flicker.

.9 The active filter shall monitor all three phases of the low voltage line current in real time and process the measured harmonics by means of a Digital Signal Processor (DSP) based system. The output of the DSP based system shall be a PWM signal to control power modules based on IGBT (Insulated Gate Bipolar Transistor) technology that shall be controlled as a voltage source.

.10 The control of the power modules and associated reactors shall be such that harmonic currents of exactly the opposite phase of those to be filtered are injected into the source of supply to the filter so that the harmonic currents flowing in the line are reduced to levels that can be individually programmed by the user.

.11 The control system shall be such that the active filter cannot be overloaded.

.12 The active filter shall be able to co-exist with tuned and detuned capacitor banks in some way.

.13 The design of the active filter shall be such that the current rating of the filter system can be increased by the addition of extra power modules. If the cabinets are fully loaded with modules, it must be possible to add additional cabinets to increase the output capabilities of the system as a whole.

.14 Parallel systems in reactive power compensation shall be able to operate in a multi master configuration.

.15 The active filter shall be mounted in self-ventilated enclosures rated not less than NEMA 12 / Type 12.

.3 Performance Requirements:

.1 The point of common coupling (PCC) shall be the input/line side terminals of the harmonic filter.

.2 Limit THDi to less than 5% at the PCC over a range of 55% to 100% load with background THDv up to 2%, and unbalanced line voltage up to 2% as defined in IEEE Std. 519.

.3 The active filter shall be able to filter simultaneously individually programmable in a frequency range from the 2nd to the 49th harmonic. The active filter shall be able to filter even number harmonics up to the 8th.

.4 The degree of filtering shall be programmable, for each harmonic. Up to 20 harmonics shall be possible to filter simultaneously.

.5 The filter should be able to compensate harmonics created by Phase to Phase loads. The filter should be able to compensate up to 10 of these unsymmetrical harmonics.

.6 The filter shall have the possibility to work in either current control mode or voltage control mode. In voltage control mode no CT’s should be needed.

.7 The filter shall have a second set of parameters that can be activated by an external input.

.8 The active filter shall be able to do reactive power compensation and aim to compensate for a target displacement power factor ensuring correct operation in the presence of harmonics. The user must be able to choose

this target power factor in a range from 0.5 inductive to unity and in a range from 0.5 capacitive to unity.

.9 In addition to power factor targeting the filter shall also be able to generate/absorb a fixed amount of reactive power within the filter's current capabilities on the user's request.

.10 The active filter shall be able to do load balancing between the phases.

.11 The active filter shall have intelligent control technology that minimizes the filter switching losses for each operating point.

.12 The heat loss from each active filter operating at full load shall not be more than 2.5-3% of the module rating per module.

.13 The filter shall be designed to operate at +/- 10% nominal rated voltage.

.14 The filter shall be designed to operate with supply frequency of 60Hz

.15 The filter shall be designed to operate continuously under the following environmental service conditions:

.1 Ambient Temperature: 0°C to 40°C

.2 Humidity: 0 to 95%, non-condensing

.3 Altitude: Operate up to 1000m (de-rated at higher altitudes)

.4 Input / Output Contacts:

.1 Alarm Contact: The active filter shall provide a potential free alarm contacts that allows to monitor the active filter alarm status

.2 Digital input contact: The active filter shall have at least one (1) multi-purpose digital input contact.

.3 Digital output contact: The active filter shall have at least one (1) multi-purpose digital output contact. It must at least be possible to use this contact to monitor basic filter operation or to output specific alarm conditions selectable out of a predefined list.

.5 Enclosure:

.1 Ventilated, sprinkler-proof, NEMA 12.

.2 Finish Colour: Manufacturer's Standard

.6 Mounting:

.1 Units up to 750lbs: factory installed brackets for floor, wall and suspension mounting with drip plate.

.2 Units over 750lbs: factory installed brackets for floor mounting only.

.7 Protections:

.1 The active filter shall incorporate its own protection devices that ensure protection against at least overcurrent, short-circuit, thermal overload, IGBT bridge abnormal operation, network voltage phase loss, network synchronization loss and DC capacitor over- and under voltage.

.8 Acceptable Manufacturer:

.1 Use filters of one manufacturer throughout project.

.2 Subject to compliance with requirements, manufacturers offering products that may be incorporated into the work include, but are not limited to the following:

.1 Comsys ADF Series represented by ADM Engineering Ltd. (416) 259-0585, Toll Free: (877) 236-8337

2.2 IDENTIFICATION DEVICES

.1 Provide equipment identification to 26 05 00 – Electrical General Requirements

.2 Label Size 7.

2.3 SOURCE QUALITY CONTROL

.1 The active filter shall be of a fully proven design which is in production currently as a standard product or which is based on an active filter generation that has been in production for more than five years.

.2 The manufacturer shall energize the filter at full voltage in addition to performing bill of material checks, continuity checks and insulation resistance check with hi-pot.

PART 3 EXECUTION

3.1 COORDINATION

.1 Coordinate size and location of concrete bases with actual transformer provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and form work requirements are specified in Division 03.

.2 Coordinate installation of wall-mounting and structure-hanging supports with actual filter provided.

3.2 EXAMINATION

.1 Examine conditions for compliance with enclosure and ambient temperature requirements for each filter.

.2 Verify that field measurements are as needed to maintain working clearances required by OESC and manufacturer’s written instructions.

.3 Examine walls, floors, roofs, and concrete bases for suitable mounting conditions where filters will be installed.

.4 Verify that ground connections are in place and requirements in Division 26 Section “Grounding and Bonding for Electrical System’s have been met.

.5 Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 INSTALLATION

.1 The harmonic filter shall be installed in accordance with manufacturer's written instructions.

.2 Install the active filter according to the local codes, requirements and make connection to bus.

.3 Coordinate Current Transformer sensing and voltage circuit in switchgear / MCC with the manufacturer.

.4 Install wall-mounted filters level and plumb using factory installed brackets.

.1 Brace wall-mounted filters as specified in Division 26 Section "Vibration and seismic Controls for Electrical Systems".

.5 Construct concrete bases and anchor floor-mounting transformers according to manufacturer's written instructions, seismic codes applicable to Project, and requirements in Division 26 Section "Vibration and Seismic Controls for Electrical Systems".

.6 Loosen isolation pad bolts until no compression is visible.

3.4 CONNECTIONS

.1 Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems".

.2 Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables".

3.5 FIELD QUALITY CONTROL

.1 Perform tests and inspections and prepare test reports.

.1 Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

.2 Manufacturer shall fully commission the unit to the satisfaction of the Consultant.

.3 Manufacturer shall confirm that the Active Filter does not interfere with emergency generator start.

.4 Manufacturer shall perform harmonic sampling and full analysis of the entire system. Analysis shall be performed by Professional Engineer and a complete certified report to be submitted to the Consultant for review.

.5 Manufacturer shall provide Certified Start Up and Commissioning of the Active Filter.

.6 Start Up and Commissioning shall be performed according to the Manufacture's recommendations, local codes and Consultants

.2 Tests and Inspections:

.1 Harmonic compliance shall be verified with onsite field measurements of both voltage and current distortion at the input side of the harmonic filter. Field measurements shall be performed through the 50^{th} harmonic and show compliance to performance requirements included herein. Perform tests with and without the filter in service.

.3 Remove and replace units that do not pass tests or inspections and retest as specified above.

.4 Prepare and submit test reports for review by project engineer. Include copy of test report within manual specified in Section 01 78 00 - Closeout Submittals.

3.6 CLEANING

.1 Vacuum dirt and debris; do not use compressed air to assist in cleaning.

END OF SECTION

SWITCHBOARDS

PART 1 GENERAL

1.1 SCOPE

.1 This section includes the requirements for the incoming main breaker and distribution switchboard identified as follows in contract drawings:

.1 UTIL-MAIN (Main Breaker)

.2 DP-30 (Distribution Switchboard)

- The switchboard shall be furnished and installed as specified in this section and as shown on the contract drawings.

1.2 RELATED SECTIONS

.1 Section 01 33 00 – Submittals

.2 Section 01 78 00 – Closeout Submittals

.3 Section 01 91 13 – Commissioning Requirements

.4 Section 26 05 00 – Common Work Requirements Electrical.

.5 Section 26 11 13 – Unit Substation

.6 Section 26 28 16 – Moulded Case Circuit Breakers

.7 Section 26 32 13 – Diesel Fired Generator

1.3 REFERENCE STANADARDS

.1 Canadian Standards Association (CSA International)

.1 CSA C22.2 No. 31, Switchgear Assemblies

.2 The switchboard shall be designed, manufactured, and tested in facilities registered to ISO 9001.

1.4 SUBMITTALS

.1 Prior to manufacturing, submit shop drawings and product data in accordance with Section 01 33 00 - Submittals. Note: shop drawing submittal time limit.

.2 Indicate on shop drawings.

.1 Floor anchoring method and foundation template.

.2 Dimensioned cable entry and exit locations.

.3 Dimensioned position and size of bus.

.4 Overall length, height, and depth.

.5 Dimensioned layout of internal and front panel mounted ponents.

.6 Indicate painting as specified.

.7 Indicate number of pole spaces.

.8 Indicate size of pole space blank off covers.

.9 Indicate external field connections for control wiring.

.3 Include time-current characteristic curves for circuit breakers.

1.5 SOURCE QUALITY CONTROL

.1 Submit pdf copy of certified test results.

1.6 CLOSEOUT SUBMITTALS

.1 Provide maintenance data for service entrance board for incorporation into manual specified in Section 01 77 00 - Closeout Submittal.

.2 Submit pdf copy of maintenance data for complete assembly including components and recommended spare parts list.

1.7 DELIVERY, STORAGE AND HANDLING

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

PART 2 PRODUCTS

2.1 MANUFACTURERS

.1 Main Breaker section and Switchboard as specified herein shall be the product of a single manufacturer. Auxilliary equipment as otherwise specified shall be factory installed by the switchboard manufacturer.

.2 Acceptable Manufacturers:

.1 Square-D QED-2 (Schneider Electric)

.2 Eaton Pow-R-Line C Switchboard

2.2 RATINGS

.1 Nominal System Voltage: 600 volts, 3-phase, 3-wire, high-resistance grounded.

.2 Bus Rating: 1200 Amps

.3 Short Circuit Rating: 42 kA at 600 V minimum, fully rated

2.3 GENERAL REQUIREMENTS

.1 Front Accessible Switchboard: Provide fixed individually mounted main device, and group-mounted branches, with sections front and rear aligned.

.2 Revenue Metering Compartment:

.1 Provide revenue metering compartment to HydroOne standards.

.2 Submit Shop drawings for coordination of utility CT and PT installation requirements.

.3 Enclosure: NEMA Type 1

.4 Enclosure Finish: Provide factory applied finish in manufacturer's paint over a rust inhibiting primer on treated metal surface. Paint finish shall be gray in color, ANSI #49 or ANSI #61.

.5 Bussed Auxiliary Section: If required, auxiliary section shall be matched and aligned with basic switchboard.

.6 Front Covers and Doors:

.1 Front covers shall be screw removable with a single tool.

.2 All doors shall be hinged with removable hinge pins.

.7 Bus bars and main connections: to be copper

.8 Bus from load terminals of main breaker to main lugs of distribution section.

.9 Identify phases with colour coding.

.10 Copper ground bus to extend the full width of the cubicles and located at bottom.

.11 Include customer metering compartment. Complete spec below.

.12 Include Ground fault relay. Complete Spec below.

2.4 WIRING/TERMINATIONS

.1 Small wiring, necessary fuse blocks and terminal blocks within the switchboard shall be furnished as required. Control components mounted within the assembly, such as fuse blocks, relays, pushbuttons, switches, etc., shall be suitably marked for identification corresponding to appropriate designations on manufacturer’s wiring diagrams.

.2 NEMA 2-hole crimp type lugs shall be provided for all line side terminations suitable for copper or aluminum cable rated for 75 degrees C of the size indicated on the drawings.

.3 Lugs shall be provided in the incoming line section for connection of the main grounding conductor. Additional lugs for connection of other grounding conductors shall be provided as indicated on the drawings.

.4 All control wire shall be type SIS, bundled and secured with nylon ties. Insulated locking spade terminals shall be provided for all control connections, except where saddle type terminals are provided integral to a device. All current transformer secondary leads shall first be connected to conveniently accessible short-circuit terminal blocks before connecting to any other device. All groups of control wires leaving the switchboard shall be provided with terminal blocks with suitable numbering strips. Provide wire markers at each end of all control wiring.

2.5 MAIN BREAKER (UTIL-MAIN)

.1 Provide Individually mounted main breaker section to Section 26 28 16 – Moulded Case Circuit Breakers.

.2 Provide contact kit on main breaker for main breaker trip indication. Contact shall be wired to terminal blocks for field connection.

.3 Provide adjustable under voltage, over voltage and single phase protection on the main service entrance. Main breaker is not to trip on loss of Utility power. Trip cause indication is required.

.4 Provide device that records main breaker trip history with time stamps and cause of each trip-retain in memory thru outages. Access to event history to be readable from graphic display on device.

.5 Shunt Trip:

.1 Provide 120Vac shunt trip coil for remote tripping.

2.6 FEEDER/BRANCH CIRCUIT BREAKERS

.1 Branch circuit devices shall be group mounted, moulded case circuit breakers (MCCBs) to Section 26 28 21 – Moulded case circuit breakers.

2.7 DIGITAL OWNER'S METERING

.1 Provide digital owner's mains power metering cubicle within the switchboard assembly including:

.1 CT's and PT's for digital metering 0.5% accuracy c/w shorting terminal blocks for CT's.

.2 Digital 3-phase true RMS power meter with the following features:

.1 Capability of measuring and displaying:

.1 Line to neutral volts – Va, Vb, Vc.

.2 Line to line volts – Vab, Vac, Vbc.

.3 Line current - Ia, Ib, Ic.

.4 Real power - kW total.
.5 Reactive power - kVAR total
.6 Apparent power - kVA total
.7 Real energy – kWHr total.
.8 Reactive energy – kVARh total
.9 Power Factor
.10 Frequency – Hz
.11 Harmonics to 63rd, K-factor and THD.

.2 Sliding window KW peak demand and kWHr total to mimic billing from supply authority.

.3 Meter accuracy:
.1 Voltage 0.5% RSD
.2 Current 0.5% FSD
.3 Power 1.0% FSD

.4 4-20mA output proportional to instantaneous real power to CP-31.

.5 Access to device event history details c/w time stamps directly from digital display.

.6 Standard of Acceptance: Schneider PowerLogic model PM8240 power meter.

2.8 GROUND FAULT RELAY

.1 Provide ground fault relay, indication, and alarm contacts for indication of any of the following situations:

.1 Ground fault on current carrying conductors.
.2 Ground fault on conductor connecting the NGR to the system neutral.
.3 Loss of continuity of NGR from system neutral to ground.

.2 Relay to be compatible with pulsed NGR supplied by Section 26 11 13.

.3 Ground fault relay shall be capable of monitoring NGR continuity from “Normal” utility supply.

.1 Ground fault relay shall be capable of detecting a ground fault condition even in the occurrence of a loss of continuity of the impedance grounding circuit.

.4 Ground fault alarm setpoints shall be field adjustable from 10%-90% of maximum available ground fault. Factory supplied setpoint shall be 50% (default).

.5 Ground fault relay shall include feeder monitoring modules and sensors for each feeder within the main distribution switchboard as indicated on the contract drawings.

.6 Ground fault relay shall include a local panel mount display unit capable of displaying:

.1 Ground fault status
.2 Faulted phase
.3 Faulted feeder (with feeder monitoring)
.4 System leakage current

.7 Power Supply: Provide fusing and terminal blocks as necessary to accept field wiring of 120Vac power supply for ground fault relay from external UPS.

.8 Communication: Modbus RTU or Modbus TCP.

.9 Standard of Acceptance: I-Gard DSP-Ohmni Series with the following modules.

.1	DSP-DSYS-DRM	Ground fault relay and display
.2	DDR2-6	Voltage Sensing Unit
.3	DSP-DFM/V2 c/w RC-3 jumper	Feeder module(s)
.4	T9A	Zero-sequence current sensors

2.9 FINISHES

.1 Apply finishes in accordance with Section 26 05 00 - Common Work Results for Electrical.

.1 Service entrance board exterior: gray.
.2 Supply 2 spray cans of touch-up enamel.

2.10 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results for Electrical.

.2 Nameplates:

.1 White plate, black letters, size 7.
.2 Complete board labelled: "DP-30: 600V Distribution ”
.3 Main breaker labelled: "UTIL-MAIN: Main Breaker – Utility Supply".
.4 Branch disconnects labelled: as indicated.

PART 3 EXECUTION

3.1 EXAMINATION

.1 Examine equipment exterior and interior prior to installation. Report any damage and do not install any equipment that is structurally, moisture, or mildew damaged.

3.2 INSTALLATION

.1 Co-ordinate housekeeping pad and locate entrance board.

.2 Connect incoming to line terminals of switchboard.

.3 Connect load terminals of distribution breakers to feeders.

.4 Check all factory made connections for mechanical security and electrical continuity.

END OF SECTION

PART 1 GENERAL

1.1 SUMMARY

.1 This specification describes the requirements for a high-performance tracking hybrid filter designed to provide voltage surge suppression device SPD and high-frequency electrical noise filtering while connected in parallel with a facility's distribution system as defined in ANSI/IEEE C62-41-1991R1995.

.2 The specified unit shall be compatible with non-linear loads and provide effective high-energy transient voltage suppression, surge current diversion and high-frequency electrical line noise attenuation.

.3 For the purpose of this document, this device shall be known and shown in all drawings as a SPD.

.4 Only approved manufacturers and products shall be accepted. All other applications for approval shall provide detailed compliance on exception statements to the specifications herein 10 days prior to bid closing.

1.2 REFERENCES

.1 The specified unit shall be designed, manufactured, tested and installed in compliance with the following standards:

.1 American National Standards Institute/ Electrical and Electronic Engineers (ANSI/IEEE C62.41-1991-R1995, C62.45-1992-R1997, C62.1 and C62.11-1999.

.2 Canadian Standards CSA and CUL.

.3 International Electro technical Commission (IEC 61643-11:2011)

.4 Federal Information Processing Standards Publication 94 (FIPS PUB 94), National Fire Protection Association (NFPA 70).

.5 Ontario Electrical Safety Code.

.6 National Manufacturers Association (NEMA LS1-1992 R2000 Guidelines).

.7 Underwriters Laboratories UL1449 Second Edition and 1283. ANSI/IEEE C67.41, C62.45.

1.3 RELATED SECTIONS

.1 Section 01 33 00 – Submittal Procedures.

.2 Section 01 91 13 – General Commissioning (Cx) Requirements.

.3 Section 26 05 00 – Common Work Results – Electrical.

.4 Section 26 24 02 – Service Entrance Board.

.5 Section 26 23 00 – Low Voltage Switchgear.

1.4 SUBMITTALS

.1 Submittal for approval: Provide the following surge protection device submittals:

.1 Dimensional drawing of each SPD type, indicating proposed mounting arrangements.

.2 Written functional description of the surge protection circuit in terms of components, configuration, design approach, and performance capability per NEMA LS1.

.3 The means of connection of the SPD to the electrical distribution system per NEMA LS1.

.2 Provide UL-1449, Second Edition data card from manufacturer showing the Suppressed Voltage Rating (SVR) for the specific catalog number submitted. Typical UL 1449, Second Edition data is not acceptable.

.3 Per the requirements of NEC Article 285.6, mark the devices with the short circuit current rating. Meet or exceed the available fault current. Provide test data from an independent testing laboratory to demonstrate the short circuit current rating has been tested on a complete device.

.4 System shall be clearly UL and cUL Listed under UL 1449 4th Edition for Surge Protection Devices and labeled accordingly.

.5 Submit test report data clearly demonstrating the maximum surge current rating has been tested on a COMPLETE SPD unit including all necessary fusing/overcurrent protection, thermal disconnects, integral disconnects and monitoring systems.

.6 Submit data demonstrating the SPD unit, including all overcurrent protection, is fully capable of a minimum repetitive surge current rating of 10,000 ANSI/IEEE C62.41, Category C3 (10kA) impulses without failure or a change in performance characteristics of more than 10%.

1.5 WARRANTY

.1 Provide manufacturer a product warranty against defects in operation and material for a period of not less than 10 years from date of Substantial Completion.

PART 2 PRODUCTS

2.1 ENVIRONMENTAL

.1 General Requirements:

.1 The panel mounted SPD device shall be suited for operation in a 120/208VAC, 3 pole, wye, 4 wire, electrical configuration. The operating environment is classified by IEEE C62.41-1991 R1995 as Category B.

.2 The service entrance switchboard mounted SPD devices shall be suited for operation in a 600 VAC, 3 pole, wye, 4 wire, solidly grounded neutral, electrical configuration. The operating environment is classified by IEEE C62.41-(1991) R1995 as Category B.

.3 Operating temperature range shall be -40° to +85°C.

.4 Operation shall be reliable in an environment with 0% to 95% non-condensing relative humidity.

.5 The unit shall not generate any audible noise during normal operation.

.6 No appreciable magnetic fields shall be generated by the TVSS. The unit shall be capable of use directly in computer rooms in any location without danger to data storage systems or devices.

2.2 VOLTAGE SURGE PROTECTION DEVICES

.1 Protection Modes. voltage surge suppression components shall be provided for all possible common and normal modes as described in NEMA LS-1-1992 R2000 paragraph 2.2.7 and IEEE 1100-1992.

.2 Maximum Continuous Operating Voltage (MCOV). The maximum continuous operating voltage of the suppressor unit shall be greater than 125% of the facility nominal operating voltage and in compliance with test and evaluation procedures outlined in NEMA LS1-1992 R2000 paragraphs 2.2.6 and 3.6.

.3 Surge Current. The maximum peak surge current capacity per phase of the specified unit, based on ANSI/IEEE C62.41-1991 R1995.

.4 Let-Through Voltage. The TVSS shall demonstrate peak voltage Let Through characteristics as listed below. Voltage is measured L-N for WYE configurations.

CAT A3	CAT B3	CAT C1
Ring Wave	Ring Wave	Impulse
200 A	500 A	3000 A
6 kV PK 300 V	325 V	400 V

.5 Testing shall be performed in accordance with Category A3, B3 and C1 test wave forms as described in ANSI/IEEE C62.41-1991 R1995 (Guidelines for Surge Voltages in Low Voltage AC Power Circuits). The test procedure shall be in accordance with ANSI/IEEE C62.45-1992 R1997 (Guidelines on Surge Testing for Equipment Connected to Low Voltage AC Power).

.6 UL 1449 Second Edition Suppression Voltage Performance Testing. Each design configuration shall have a UL 1449 Second Edition Suppression Voltage Rating that has been tested and assigned by Underwriters Laboratories utilizing the following waveforms and procedure. The test shall be initiated with a surge of 6,000V/500A, using waveshapes defined within ANSI/IEEE C62.41-1991 R1995 as a 1.2 x 50

microsecond open circuit voltage waveform and an 8 x 20 microsecond short circuit current waveform, to benchmark the unit's suppression voltage. The unit shall then be subjected to 10 positive polarity and 10 negative polarity 1.2 x 50 microsecond 6,000V open circuit voltage waveforms and an 8 x 20 microsecond 3,000A short circuit current waveforms. For comparison with the initial benchmark voltage reading, another ANSI/IEEE surge defined as 1.2 x 50 microsecond 6000V open circuit voltage waveform and an 8 x 20 microsecond 500A short circuit current waveform shall be applied. Deviation from initial to final sampling value may not exceed ±10%. Upon successful completion, an appropriate UL 1449 Second Edition Suppression Voltage Rating is assigned by Underwriters Laboratories.

.7 Suppression System. The SPD unit shall include a solid-rate high-performance suppression system, utilizing non-linear voltage dependent metal oxide variators. The suppression system's components shall not utilize gas tubes, spark gaps, silicon avalanche diodes or other components in such fashion that they may short or crowbar the line, thus leading to interruption of normal power flow.

.8 The SPD components shall have a response time rated less than 1 nanosecond. Filter components shall respond instantaneously.

2.3 SUPPRESSION TECHNOLOGY

.1 SPD component shall incorporate a single Metal Oxide Varistor (MOV) and not a battery of individual MOV’s.

2.4 FILTERING

.1 The unit shall include a high-frequency extended range tracking filter. The filter shall reduce fast rise-time, high frequency, transients and electrical line noise. Attenuation shall be a minimum of 60dB at 100 kHz based on actual insertion loss data obtained utilizing the M1L-STD-E220A,50ohm insertion loss methodology.

.2 The SPD shall have the ability to absorb reactive current associated with the facility's non-linear loads. The sink current for the unit shall be 15 Amps.

.3 Filter attenuation high frequency power filter attenuation valves shall comply with test and evaluation procedures outlined in NEMA LS-1-1992 R2000, Paragraphs 2.2.11 and 3.11 with 6" hookup wire and 50' noise source path. Attenuation to be minimum -50dB at 100KHz, -34dB at 1MHz, -34dB at 10MHz and -47dB at 100MHz.

2.5 GENERAL FEATURES

.1 Connector. Terminals shall be provided for all of the necessary power on the SPD as determined by its model number.

.2 Internal Connections. All surge current diversion connections shall be by way of low impedance wiring. No circuit boards shall be used in transient energy paths.

.3 SPD system connections. No plug-in component modules, quick-disconnect terminals or printed circuit board shall be used in surge current-carrying paths.

.4 Enclosure. The specified system shall be approved in a heavy duty NEMA 4 dust tight, flush mount enclosure with no ventilation openings. The cover of the enclosure shall require a tool for access to internal components. A drawing pocket shall be provided inside the door. Indication of TVSS filter status shall be visible without opening the door.

.5 Unit Status Indicators. Red status indicator lamps shall be provided on the hinged front cover to indicate the protection status on all phases. The absence of the red light shall reliably indicate that one or more surge current diversion modes have failed and that service is needed to restore full operation.

.6 Dry contact for fault status to PLC-1: SCADA PLC.

.7 Warranty. The manufacturer shall provide a Five-Year repair or replacement Warranty for each item supplied.

.8 Standard of Acceptance:

.1 RayCap SPD's

PART 3 EXECUTION

3.1 GENERAL REQUIREMENTS

.1 Install suppression system immediately next to or on top of service equipment where so approved by the Owner's Representative.

.2 Install conductors between suppressor and point of attachment to service equipment sized in accordance with manufacturer's Shop Drawings and conductor lengths as short as possible, preferably not to exceed 600 mm. Provide information from manufacturers who offer an integrated SPD in the main service entrance equipment clearly showing lead lengths, including the neutral and ground connections.

.3 Grounding: Bond suppressor ground to the equipment grounding conductor and service entrance ground.

3.2 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 00 – Common Work results - Electrical and in accordance with Section 01 91 13 – General Commissioning (Cx) Requirements.

.2 Install with conductors tapped from the electrical service. Conductors are to be as short and straight as possible; no greater than 200mm in length. Input conductors to the SPD shall be twisted to reduce impedance during high frequency filtering. The

SPD should be installed following the manufacturer's recommended practices and in compliance with all applicable codes.

.3 Inspect primary and secondary connections for tightness and signs of overheating.

.4 Check fuses for correctness of type and size.

.5 Check grounding connections.

END OF SECTION

PANEL BOARDS BREAKER TYPE

PART 1 General

1.1 SECTION INCLUDES

.1 Materials and installation for standard and custom breaker type panelboards.

1.2 RELATED SECTIONS

.1 Section 01 33 00 - Submittal Procedures.

.2 Section 01 91 13 – General Commissioning (Cx) Requirements.

.3 Section 06 10 00 - Rough Carpentry.

.4 Section 26 05 00 – Common Work Results - Electrical.

.5 Section 26 28 16.02 - Moulded Case Circuit Breakers.

1.3 REFERENCES

.1 Canadian Standards Association (CSA)

.1 CSA C22.2 No.29, Panelboards and enclosed Panelboards.

1.4 SUBMITTALS

.1 Submit shop drawings in accordance with Section 01 33 00 – Submittals.

.2 Drawings to include electrical detail of panel, branch breaker type, quantity, ampacity and enclosure dimension.

PART 2 Products

2.1 PANELBOARDS

.1 Panelboards: to CSA C22.2 No.29 and product of one manufacturer.

.1 Install circuit breakers in panelboards before shipment.

.2 In addition to CSA requirements manufacturer's nameplate must show fault current that panel including breakers has been built to withstand.

.2 250 and 600 V panelboards: bus and breakers rated for 10,000 and 25,000 A (symmetrical) minimum interrupting capacity respectively or as indicated on electrical drawings.

.3 Sequence phase bussing with odd numbered breakers on left and even on right, with each breaker identified by permanent number identification as to circuit number and phase.

.4 Panelboards: mains, number of circuits, and number and size of branch circuit breakers as indicated.

.5 Two keys for each panelboard and key panelboards alike.

.6 Tin plated copper bus with neutral of same ampere rating as mains.

.7 Mains: suitable for bolt-on breakers.

.8 Trim with concealed front bolts and hinges.

.9 Trim and door finish: baked grey enamel.

2.2 CUSTOM BUILT PANELBOARD ASSEMBLIES

.1 125 mm relay section on one or both sides of panels as indicated for installation of low voltage remote control switching components.

.2 Double stack panels as indicated.

.3 Contactors in mains as indicated.

.4 Feed through lugs as indicated.

2.3 BREAKERS

.1 Breakers: to Section 26 28 16.02 - Moulded Case Circuit Breakers.

.2 Breakers with thermal and magnetic tripping in panelboards except as indicated otherwise.

.3 Main breaker: separately mounted on top or bottom of panel to suit cable entry. When mounted vertically, down position should open breaker.

.4 Lock-on devices for 10% of 15 to 30 A breakers installed as indicated. Turn over unused lock-on devices to Departmental Representative.

.5 Lock-on devices for receptacles, fire alarm clock outlet, emergency, door supervisory, intercom, stairway, exit and night light circuits as indicated.

2.4 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 00 – Common Work Results - Electrical.

.2 Nameplate for each panelboard size 4 engraved as indicated.

.3 Nameplate for each circuit in distribution panelboards size 2 engraved as indicated.

.4 Complete circuit directory with typewritten legend showing location and load of each circuit.

2.5 ACCEPTABLE MANUFACTURERS

.1 Square D (Schneider).

.2 Cutler Hammer (Eaton).

.3 Siemens.

PART 3 Execution

3.1 INSTALLATION

.1 Locate panelboards as indicated and mount securely, plumb, true and square, to adjoining surfaces.

.2 Install surface mounted panelboards on plywood backboards in accordance with Section 06 10 00 - Rough Carpentry. Where practical, group panelboards on common backboard.

.3 Mount panelboards to height specified in Section 26 05 00 – Common Work Results - Electrical or as indicated.

.4 Connect loads to circuits.

.5 Connect neutral conductors to common neutral bus with respective neutral identified.

END OF SECTION

WIRING DEVICES

PART 1 GENERAL

1.1 SECTION INCLUDES

.1 Switches, receptacles, wiring devices, cover plates and their installation.

1.2 RELATED SECTIONS

.1 Section 01 33 00 - Submittal Procedures.

.2 Section 01 91 13 – General Commissioning (Cx) Requirements.

.3 Section 26 05 00 – Common Work Results - Electrical.

1.3 REFERENCES

.1 Canadian Standards Association (CSA)

.1 CSA-C22.2 No.42, General Use Receptacles, Attachment Plugs and Similar Devices.

.2 CSA-C22.2 No.42.1, Cover Plates for Flush-Mounted Wiring Devices (Bi-national standard, with UL 514D).

.3 CSA-C22.2 No.55, Special Use Switches.

.4 CSA-C22.2 No.111, General-Use Snap Switches (Bi-national standard, with UL 20, twelfth edition).

1.4 SUBMITTALS

.1 Submit shop drawings and product data related sections to Section 01 33 00 – Submittal Procedures.

PART 2 PRODUCTS

2.1 SWITCHES

.1 20 A, 120 V, & 347 V as noted, single pole, three-way and four-way switches as indicated to: CSA-C22.2 No.55 and CSA-C22.2 No.111.

.2 Manually-operated general purpose ac switches with following features:

.1 Terminal holes approved for No. 10 AWG wire.

.2 Silver alloy contacts.

.3 Urea or melamine moulding for parts subject to carbon tracking.

.4 Suitable for back and side wiring.

.5 White toggle.

.6 Extra Heavy Duty Industrial Grade.

.3 Toggle operated fully rated for tungsten filament and fluorescent lamps, and up to 80% of rated capacity of motor loads.

.4 20A, 120V as noted, single pole, three-way and four-way switches single and two gang, dead end and feed through c/w threaded hubs, boxes and covers of copper free aluminum suitable for Class I, Div. I & Div. II, Group 'D' installation.

.5 Switches of one manufacturer throughout project.

.6 Acceptable products:

.1 Hubbel HBL 1221 W,
.2 Leviton 1221-2W,

2.2 RECEPTACLES

.1 Duplex receptacles, CSA type 5-15 R, 125 V, 15 A, U ground, to: CSA-C22.2 No.42 with following features:

.1 Ivory thermoplastic moulded housing.
.2 Suitable for No. 10 AWG for back and side wiring.
.3 Break-off links for use as split receptacles.
.4 Eight back wired entrances, four side wiring screws.
.5 Triple wipe contacts and rivetted grounding contacts.

.2 Simplex receptacles, CSA type 5-15 R, 125 V, 15 A, U ground with following features:

.1 Ivory thermoplastic moulded housing.
.2 Suitable for No. 10 AWG for back and side wiring.
.3 Four back wired entrances, 2 side wiring screws.

.3 Other receptacles with ampacity and voltage as indicated.

.4 Receptacles of one manufacturer throughout project.

.5 Specification grade.

.6 Acceptable products:

.1 Hubbel 5262-W,
.2 Leviton 5262-W,

2.3 SURGE SUPPRESSION RECEPTACLES

.1 Duplex receptacle, CSA 5-15R 125V, 15Amp, 'U' ground with following features.

.1 Blue urea molded housing.
.2 Suitable for no 10AWG for back and side wiring.
.3 Damage alter-alarm with muting screw.

.4 Power-on indicator.
.5 CSA certified to C22.2 No.42m.
.6 120V-60Hz.
.7 Response time 5NS.
.8 Peak energy 210 joules.
.9 Peak current 13000 amps.
.10 EMI/RFI attenuation at 50 OHMS-500KHZ-100MHZ.

2.4 SPECIAL WIRING DEVICES

.1 Special wiring devices:

.1 Clock hanger outlets, 15 A, 125 V, 3 wire, grounding type, suitable for No. 10 AWG for installation in flush outlet box.
.2 Pilot lights: heavy duty, oil tight, LED cluster Push-To-Test type, 30 mm diameter, lens colour as indicated, 120V supply voltage, labels as indicated.
.3 GFCI to trip on 5mA ground fault.
.4 Hatch switches: Turck Rectangular Inductive Proximity Sensors, Intrinsically Safe, 35mm sensing range.
.5 Motion sensors: GE Precision Line Dual Technology sensors.
.6 Intrinsically safe motion sensors: GE 6190 series sensors.
.7 Adjustable CT current relays: Hawkeye Series H735 or approved alternate
.8 Door switches: GRI 4460A

2.5 WIRING DEVICES FOR COMPUTER ROOMS

.1 As indicated.

2.6 COVER PLATES

.1 Cover plates for wiring devices to: CSA-C22.2 No.42.1.

.2 Cover plates from one manufacturer throughout project.

.3 Stainless steel cover, thickness 1 mm for wiring devices mounted in flush-mounted outlet box.

.4 Sheet metal cover plates for wiring devices mounted in surface-mounted FS or FD type conduit boxes.

.5 Weatherproof, Extra Duty, while in use, cast aluminum cover plates, complete with gaskets for duplex receptacles as indicated.

.6 Gang type coverplates when more than one switch or outlet is required.

.7 Label cover plates to Section 26 05 00 – Common Work Requirements

PART 3 EXECUTION

3.1 INSTALLATION

.1 Switches:

.1 Install single throw switches with handle in "UP" position when switch closed.

.2 Install switches in gang type outlet box when more than one switch is required in one location.

.3 Mount toggle switches at height in accordance with Section 26 05 00 – Common Work Results - Electrical.

.2 Receptacles:

.1 Install receptacles in gang type outlet box when more than one receptacle is required in one location.

.2 Mount receptacles at height in accordance with Section 26 05 00 – Common Work Results - Electrical.

.3 Where split receptacle has one portion switched, mount vertically and switch upper portion.

.3 Cover plates:

.1 Protect cover plate finish with paper or plastic film until painting and other work is finished.

.2 Install suitable common cover plates where wiring devices are grouped.

.3 Do not use cover plates meant for flush outlet boxes on surface-mounted boxes.

END OF SECTION

FUSES, LOW VOLTAGE

PART 1 GENERAL

1.1 RELATED SECTIONS

.1 Section 01 78 00 – Closeout Submittals.

.2 Section 01 91 13 – Commissioning (Cx) Requirements.

.3 Section 26 05 00 – Common Work Results - Electrical.

1.2 REFERENCES

.1 Canadian Standards Association (CSA)

.1 CSA C22.2 No.248.1 to .16, Low Voltage Fuses Parts 1 to 16, edition as shown in Appendix A of Ontario Electrical Safety Code.

1.3 SUBMITTALS

.1 Submit shop drawings and product data in accordance with Section 01 33 00 – Submittal Procedures.

.2 Submit fuse performance data characteristics for each fuse type and size above 200 A. Performance data to include: average melting time-current characteristics.

1.4 DELIVERY AND STORAGE

.1 Ship fuses in original containers.

.2 Do not ship fuses installed in switchboard.

.3 Store fuses in original containers in moisture free location.

1.5 MAINTENACE MATERIALS

.1 Provide maintenance materials in accordance with Section 01 33 00 – Closeout Submittals.

.2 Provide three spare fuses of each type and size installed above 200A.

PART 2 PRODUCTS

2.1 FUSES GENERAL

.1 Fuse type references L1, L2, J1, R1, etc. have been adopted for use in this specification.

.2 Fuses installed in fused disconnect switches shall have blown fuse indictors.

.3 Fuses: product of one manufacturer for entire project.

2.2 FUSE TYPES

.1 Class J fuses (formerly HRCI- J).

.1 Type J1, time delay, capable of carrying 500% of its rated current for 10 s minimum.

2.3 FUSE STORAGE CABINET

.1 Fuse storage cabinet, manufactured from 2.0 mm thick aluminum 750 mm high, 600 mm wide, 300 mm deep, hinged, lockable front access door finished in accordance with Section 26 05 00 – Common Work Results - Electrical.

PART 3 EXECUTION

3.1 INSTALLATION

.1 Install fuses in mounting devices immediately before energizing circuit. Ensure correct fuses fitted to physically matched mounting devices.

.1 Install Class R rejection clips for HRCI-R fuses.

.2 Ensure correct fuses fitted to assigned electrical circuit.

.3 Where UL Class RK1 fuses are specified, install warning label "Use only UL Class RK1 fuses for replacement" on equipment.

.4 Install spare fuses in fuse storage cabinet.

END OF SECTION

MOULDED CASE CIRCUIT BREAKERS

PART 1 GENERAL

1.1 RELATED SECTIONS

.1 Section 01 33 00 - Submittal Procedures.

.2 Section 01 91 13 - General Commissioning (Cx) Requirements.

.3 Section 26 05 00 - Common Work Results – Electrical.

.4 Section 26 24 02 – Service Entrance Board

.5 Section 26 24 17 – Panelboards Breaker Type

1.2 SUBMITTALS

.1 Submit product data in accordance with Section 01 33 00 – Submittals.

.2 Include time-current characteristic curves for all breakers.

PART 2 PRODUCTS

2.1 BREAKERS GENERAL

.1 Bolt-on moulded case circuit breaker: quick-make, quick-break type, for manual and automatic operation with temperature compensation for 40°C ambient.

.2 Common-trip breakers: with single handle for multi-pole applications.

.3 Magnetic instantaneous trip elements in circuit breakers to operate only when value of current reaches setting. Trip settings on breakers with adjustable trips to range from 3-8 times current rating.

.4 Circuit breakers with interchangeable trips as indicated.

.5 Provide electronic trip units for all breakers sized 100 amps and upwards.

2.2 THERMAL MAGNETIC BREAKERS DESIGN A

.1 Moulded case circuit breaker to operate automatically by means of thermal and magnetic tripping devices to provide:

.1 inverse time current tripping under overload condition, and

.2 instantaneous tripping for short circuit protection.

2.3 SOLID STATE TRIP BREAKERS DESIGN C

.1 Moulded case circuit breaker to operate by means of a solid-state trip unit with associated current monitors and self-powered shunt trip to provide:

.1 inverse time current trip under overload condition, and

.2 long-time, short-time, and instantaneous tripping for phase and ground fault short circuit protection.

2.4 OPTIONAL FEATURES

.1 Include:

.1 on-off locking device.

.2 handle mechanism.

.3 shunt trip as indicated.

.4 auxiliary switch as indicated.

.5 motor-operated mechanism c/w time delay unit as indicated.

.6 under-voltage release as indicated.

2.5 ENCLOSURE

.1 Mounted in NEMA 1A type enclosure, sprinkler proof as indicated.

PART 3 EXECUTION

3.1 INSTALLATION

.1 Install circuit breakers as indicated.

END OF SECTION

DISCONNECT SWITCHES FUSED AND NON-FUSED

PART 1 GENERAL

1.1 RELATED SECTIONS

.1 Section 01 33 00 - Submittal Procedures.

.2 Section 01 91 13 – General Commissioning (Cx) Requirements.

.3 Section 26 05 00 – Common Work Results for Electrical.

.4 Section 26 28 13 – Fuses – Low Voltage.

1.2 REFERENCE STANDARDS

.1 CSA-C22.2 No.4, Enclosed and Dead-Front Switches.

.2 CSA C22.2 No.39, Fuseholder Assemblies.

1.3 SUBMITTALS

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

.2 Submit product data and dimensions.

PART 2 PRODUCTS

2.1 DISCONNECT SWITCHES

.1 Fusible and non-fusible disconnect switches shall be sized as indicated on drawings and enclosed in:

.1 NEMA 12 enclosures in indoor, non-hazardous, dry locations.
.2 NEMA 7 enclosures in hazardous areas, or
.3 NEMA 4X enclosures unless indicated otherwise.

.2 Service entrance type where required.

.3 Flange mounted, visible blade c/w viewing window.

.4 Provision for padlocking in on-off switch position by three locks.

.5 Mechanically interlocked door to prevent opening when handle in ON position.

.6 Fuses: type and size as indicated, to Section 26 28 13.01 - Fuses - Low Voltage.

.7 Fuse-holders: suitable without adaptors, for type and size of fuse indicated.

.8 Quick-make, quick-break action.

.9 ON-OFF switch position indication on switch enclosure cover.

.10 Manufacturer:

.1 Use products of a single manufacturer throughout project.

.2 Acceptable Manufacturers:

.1 Square 'D' Heavy Duty

.2 Siemens Heavy Duty

.3 Eaton / Cutler Hammer Heavy Duty.

2.2 PLUG/RECEPTACLE SWITCHES

.1 Decontactor series, HP rated to suit load.

.2 Padlockable in OFF position.

.3 Decontactor to include 3 pilot contacts for motor temperature and moisture protection wiring. Also required for pumps with motor leads and pump protection wiring in same cable.

.4 Manufacturer: Meltric "Decontactor" series switch rated plugs and receptacles.

2.3 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 00 – Common Work Results for Electrical.

.2 Indicate name of load controlled on size 4 nameplate.

PART 3 EXECUTION

3.1 INSTALLATION

.1 Install disconnect switches complete with fuses as indicated.

.2 Ensure all wiring enters/exits the sides or bottom. (Do not enter top of unit).

.3 Ensure line and load conductors enter/exit the disconnect switch in separate conduits.

.4 Ensure line and load side conductors do not come into contact with or cross each other inside the disconnect switch.

.5 Install SS drip hoods over all disconnects installed in sprinklered areas and outdoors.

END OF SECTION

CONTACTORS

PART 1 GENERAL

1.1 SECTION INCLUDES

.1 Materials and installation for contactors for system voltages up to 600 V

1.2 RELATED SECTIONS

.1 Section 01 33 00 - Submittal Procedures.

.2 Section 01 91 13 – General Commissioning (Cx) Requirements.

.3 Section 26 05 00 – Common Work Results - Electrical.

.4 Section 26 29 03 - Control Devices.

1.3 REFERENCES

.1 Canadian Standards Association (CSA)

.1 CSA C22.2 No.14, Industrial Control Equipment.

1.4 SUBMITTALS

.1 Submit product data in accordance with Section 01 33 00 – Submittal Procedures.

PART 2 PRODUCTS

2.1 CONTACTORS

.1 Contactors: to CSA C22.2 No.14, NEMA rated.

.2 Electrically held controlled by pilot devices as indicated and rated for type of load controlled. Half size contactors not accepted.

.3 Fused switch combination contactor as indicated.

.4 Complete with 2 normally open and 2 normally closed auxiliary contacts unless indicated otherwise.

.5 Mount in NEMA 12 enclosure unless otherwise indicated.

.6 Include following options in cover:

.1 Red indicating lamp.

.2 Hand-Off-Auto selector switch.

.7 Control transformer: in accordance with Section 26 29 03 - Control Devices, in contactor enclosure. Oversized capacity of 100VA.

.8 Combination starters to be supplied with oversized enclosure with din rail space for dry run protection relays.

2.2 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 00 – Common Work Results - Electrical.

.2 Size 4 nameplate indicating name of load controlled as indicated.

PART 3 EXECUTION

3.1 INSTALLATION

.1 Install contactors and connect auxiliary control devices.

END OF SECTION

CONTROL DEVICES

PART 1 GENERAL

1.1 SECTION INCLUDES

.1 Materials and installation for industrial control devices including pushbutton stations, local control panels, and relay panels.

1.2 RELATED SECTIONS

.1 Section 01 33 00 - Submittal Procedures.

.2 26 05 00 – Common Work Results - Electrical

1.3 REFERENCES

.1 Canadian Standards Association (CSA)

.1 CSA C22.2 No.14, Industrial Control Equipment.

.2 National Electrical Manufacturers Association (NEMA)

.1 NEMA ICS 1, Industrial Control and Systems: General Requirements.

1.4 SUBMITTALS

.1 Submit shop drawings in accordance with Section 01 33 00 – Submittals Procedures.

.1 Include schematic, wiring, and interconnection diagrams.

1.5 QUALITY ASSURANCE

.1 Submit to Owner’s Representative one copy of test results.

PART 2 PRODUCTS

2.1 AC CONTROL RELAYS

.1 Control Relays: to CSA C22.2 No.14 and NEMA ICS 1.

.2 Sealed contact type: electrically held with 2 DDT contacts and indicating light.

.1 Coil rating: 120Vac, 5VA.

.2 Contact rating: 120V, 10A.

.3 Socket bases and DIN rail mounting.

2.2 RELAY ACCESSORIES

.1 Standard contact cartridges: normally-open, convertible to normally-closed in field.

2.3 OILTIGHT LIMIT SWITCHES

.1 Snap action type: roller rod or fork lever, top, side, push or wobble stick actuator, CSA type 1 enclosure. Contact rating as indicated.

.2 Surface mounted.

.3 Standard contact block.

2.4 SEALED CONTACT OILTIGHT LIMIT SWITCHES

.1 Lever type switches: roller fork or rod operated, single or double pole, double throw. Contact rating: as indicated.

.2 Push type switches: actuated by rod or plunger located on side of operating head, spring return single pole, throw. Contact rating: as indicated.

.3 Wobble stick cat whisker type switches: actuated by rod or stick extending from tip of operating head. Moving rod in any direction operates contacts. Single pole, double throw. Contact rating: as indicated.

.4 Lever operated: time delay switch: adjustable time delay from 1/2s to 15s plus 25%. Contact rating: as indicated.

.5 Plug-in construction switches: CSA Type 4, two or four circuit, lever push or wobble stick type, contact rating: as indicated.

2.5 SOLID STATE TIMING RELAYS

.1 Construction: AC operated electronic timing relay with solid-state timing circuit to operate output contact. Timing circuit and output contact completely encapsulated to protect against vibration, humidity and atmospheric contaminants.

.2 Operation: on-delay or off-delay.

.3 Potentiometer: self contained to provide time interval adjustment.

.4 Supply voltage: 120VAC or 24 VAC, 60 Hz, as indicated.

.5 Temperature range: -20 degrees C to +60 degrees C.

.6 Output contact rating: maximum voltage 300 V AC or DC. Current: NEMA ICS 1 as indicated.

.7 Timing ranges: minimum 0.5 maximum 60s.

2.6 INSTANTANEOUS TRIP CURRENT RELAYS

.1 Enclosure: CSA Type 1.

.2 Contacts: NO, NC automatic reset with adjustable tripping point.

.3 Control: 3 wire, with provision for shorting contacts during accelerating period of motor.

.4 Contact rating: NEMA ICS 1 as indicated.

2.7 OPERATOR CONTROL STATIONS

.1 Enclosure: CSA Type 12 enclosure, surface mounting.

.2 Wiring: tin-plated copper stranded conductors, 19 strands minimum, thermosetting type insulation.

2.8 PUSHBUTTONS

.1 Momentary contact type: Heavy duty – oil tight, operator flush type, 30mm diameter, colour as indicated, 1-NO and 1-NC contacts rated 10A at 120VAC, labels as indicated.

.2 Push-pull contact type: Heavy duty – oil tight, operator mushroom head type, 30mm diameter, red colour, provision for padlocking in “OFF” position, 2-NO and 2-NC contacts rated 10A at 120VAC, labels as indicated.

2.9 SELECTOR SWITCHES

.1 Maintained contact type: 2 or 3 positions (as indicated), heavy duty – oil tight, operator’s standard knob, 30mm diameter, contact arrangement as indicated rated 10A at 120V AC, labels as indicated.

.2 Rotary potentiometer type: heavy duty, oil tight, operator’s standard knob, 30mm diameter, label as indicated.

.1 Coordinate power requirements with device being wired to.

2.10 INDICATING LIGHTS

.1 Heavy duty – oil tight, LED cluster Push-To-Test type, 30mm diameter, lens colour: as indicated, supply voltage: 120VAC, labels as indicated.

2.11 LOCAL CONTROL AND RELAY PANELS

.1 NEMA 4X stainless steel enclosure. Surface mount with hinged padlockable access door, accommodating relays, timers, labels, as indicated.

.2 Provide identified terminals for field wiring termination.

.3 Wiring: tin-plated copper stranded conductors, 19 strands minimum, thermosetting type insulation.

.1 Crimped ferrules on all wires terminating on terminal blocks

.2 Digital control wiring: type REW wire, irradiated (cross-linked) PVC insulation.

.3 Analog control wire: type CIC wire, XLPE insulation, twisted-shielded pair/triad as required.

.4 Anti-condensation heater c/w thermostat control and insulated enclosure for outdoor locations.

.5 Factory assembled by CSA certified panel shop.

2.12 CONTROL CIRCUIT TRANSFORMERS

.1 Single phase, dry type.

.2 Primary: 208, 240 or 600 V, 60 Hz ac.

.3 Secondary: 120 V, or 24V ac.

.4 Rating: 50, 150, 250, 350 or 500 VA, as indicated, oversized by 100VA.

.5 Secondary fuse: size as required.

.6 Close voltage regulation as required by magnet coils and solenoid valves.

2.13 THERMOSTAT (LINE VOLTAGE)

.1 Wall mounted, for exhaust fan control.

.2 Full load rating: Amps as indicated at 120 V.

.3 Temperature setting range: 10 degrees C to 30 degrees C.

.4 Thermometer Range: 10 degrees C to 30 degrees C.

.5 Markings in 5 degrees increments.

.6 Differential temperature fixed at 20 degrees C.

.7 Standard of Acceptance: Crouse-Hinds Eaton HRC Thermostat with Honeywell Control Model HRC85.

2.14 MOTION DETECTOR (HMS-1)

.1 CSA Approved, Explosion Proof

.2 Motion Detection

.3 Tilt Angles: -90° to +30° in elevation

.4 Output Hold Time: 0.5 s to 15 min (Adjustable)

.5 Standard of Acceptance: Larson Electronics Part # EXP-MS-N4X-AT-HV

PART 3 EXECUTION

3.1 INSTALLATION

.1 Install pushbutton stations, control and relay panels, control devices as indicated.

3.2 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 00 - Electrical General Requirements.

.2 Depending upon magnitude and complexity, divide control system into convenient sections, energize one section at a time and check out operation of section.

.3 Upon completion of sectional test, undertake group testing.

.4 Check out complete system for operational sequencing.

.5 Submit to Engineer one copy of test results.

END OF SECTION

MOTOR STARTERS TO 600V

PART 1 GENERAL

1.1 RELATED SECTIONS

.1 Section 01 33 00 – Submittal Procedures.

.2 Section 01 91 13 – General Commissioning (Cx) Requirements.

.3 Section 26 05 00 – Common Work Results - Electrical.

.4 Section 26 24 19 – Motor Control Center

.5 Section 26 29 03 – Control Devices.

1.2 REFERENCES

.1 Canadian Standards Association (CSA)

.1 CAN/CSA-C22.2 No.14, Industrial Control Equipment

.2 National Electrical Manufacturer's Association (NEMA)

.1 NEMA ICS 2 - Industrial Control and Systems: Controllers, Contactors and Overload Relays Rated 600 Volts

1.3 SUBMITTALS

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

.2 Shop Drawing Submittals:

.1 Submit to engineer for approval for each type of starter provided.

.1 Mounting method and dimensions.

.2 Starter size and type.

.3 Layout of identified internal and front panel components.

.4 Enclosure types.

.5 Wiring diagram for each starter.

.6 Interconnection diagrams.

.2 For factory manufactured motor starters, submit shop drawings from a manufacturer certified by CSA, IEC or CUL.

.3 For custom/built assembled motor starters/control panels, submit shop drawings and control diagrams from a CSA certified Control Panel Supplier.

1.4 CLOSEOUT SUBMITTALS

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

.2 Include operation and maintenance data for each type and style of starter.

1.5 EXTRA MATERIALS

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

.2 Provide listed spare parts for each different size and type of starter:

.1 3 contacts, stationary.
.2 3 contacts, movable.
.3 1 contacts, auxiliary.
.4 1 control transformer.
.5 1 operating coil.
.6 2 fuses.
.7 10% indicating lamp bulbs used.

PART 2 PRODUCTS

2.1 MATERIALS

.1 Starters to NEMA/EEMAC 1CS2 and CSA C22.2 No.14.

.2 Minimum starter size: Size 1.

2.2 MANUAL MOTOR STARTERS

.1 Single and Three phase manual motor starters with components as follows:

.1 Switching mechanism, quick make and break.
.2 One and Three overload heaters, as indicated, manual reset, trip indicating handle.

.2 Accessories:

.1 Toggle switch or pushbutton: heavy duty labelled as indicated.
.2 Indicating light: heavy duty type and colour as indicated.
.3 Locking tab to permit padlocking in "ON" or "OFF" position.

2.3 FULL VOLTAGE NON-REVERSING MAGNETIC STARTERS

.1 Magnetic and combination magnetic starters of size, type, rating and enclosure type as indicated with components as follows:

.1 Contactor solenoid operated, rapid action type.
.2 Motor electronic overload protective device in each phase, manually reset from outside enclosure.
.3 Wiring and schematic diagram inside starter enclosure in visible location.

.4 Identify each wire and terminal for external connections, within starter, with oil resistant permanent number marking identical to diagram.

.2 Combination type starters to include motor circuit protector with flange mounted operating lever on outside of enclosure to control motor circuit protector, and provision for:

.1 Locking in "OFF" position with up to 3 padlocks.

.2 Independent locking of enclosure door.

.3 Provision for preventing switching to "ON" position while enclosure door open.

2.4 FULL VOLTAGE REVERSING MAGNETIC STARTERS

.1 Full voltage reversing magnetic starters of size, type, rating and enclosure type as indicated with components as follows:

.1 Two - 3 pole magnetic contactors mounted on common base.

.2 Mechanical and electrical interlocks to prevent both contactors from operating at same time.

.3 Electronic overload relays, manually reset on door.

.2 Accessories:

.1 Pushbuttons and selector switches: heavy duty, oil tight, labelled as indicated.

.2 Indicating lights: heavy duty, oil tight type, LED type and color as indicated.

.3 Auxiliary control devices as indicated.

2.5 MULTI-SPEED STARTERS

.1 2 speed starters of size, type, rating, and enclosure type as indicated. Starter suitable for constant kW type motor and with components as follows:

.1 One-3 pole contactor for each winding for separate winding motors.

.2 One-3 pole and one-5 pole contactor for each reconnectable winding for consequent pole type motors.

.3 Electronic overload relays and manual reset for each speed on door.

.2 Accessories:

.1 Pushbuttons and selector switches: heavy duty, oil tight, labelled as indicated.

.2 Indicating lights: heavy duty, oil tight type and color as indicated.

.3 Auxiliary control devices as indicated.

.4 Automatic sequence relays for each speed.

2.6 MAGNETIC STARTER, REDUCED VOLTAGE, AUTO-TRANSFORMER

.1 Auto-transformer starter closed circuit transition type, of size, type, rating and enclosure type as indicated and with following components:

.1 Three-3 pole contactors.
.2 Auto-transformer with 50%, 65% and 80% taps.
.3 One adjustable pneumatic timing relay.
.4 One-3 pole manual reset overload device.
.5 Electronic overload protection of auto-transformers.

.2 Accessories:

.1 Pushbuttons and selector switches: heavy duty, oil tight, labelled as indicated.
.2 Indicating lights: heavy duty, oil tight type, LED type and color as indicated.
.3 Auxiliary control devices as indicated.

2.7 2.7 MAGNETIC STARTER REDUCED VOLTAGE STAR-DELTA

.1 Reduced voltage star-delta open transition starter, of size, type, rating and enclosure type as indicated, with components as follows:

.1 Two-3 pole delta contactors with auxiliary relays and interlocks.
.2 One-3 pole star contactor with auxiliary relays and interlocks.
.3 Mechanical interlock to interlock one delta contactor and the star contactor.
.4 One timing relay.
.5 Three pole manual reset electronic overload relays.
.6 Reduced voltage star-delta closed transition starter, of size, type, rating and enclosure type as indicated, with components as follows:
.7 Two-3 pole delta contactors with auxiliary relays and interlocks.
.8 One-3 pole star contactor with auxiliary relay and interlocks.
.9 One-3 pole transition contactor.
.10 One set of transition resistors.
.11 Mechanical interlock, to interlock one delta contactor and the star contactor.
.12 One timing relay.
.13 Three pole manual reset electronic overload relays.

.2 Accessories:

.1 Pushbuttons and selector switches: heavy duty, oil tight, labelled as indicated.
.2 Indicating lights: heavy duty, oil tight type, LED type and color as indicated.
.3 Auxiliary control devices as indicated.

2.8 MAGNETIC STARTER REDUCED VOLTAGE PART WINDING

.1 Two-step reduced voltage, part winding starter of size, type, rating and enclosure type as indicated, with components as follows:

.1 Two-3 pole contactors.

.2 Adjustable pneumatic timer.

.3 Six manual reset electronic overload relays.

.4 Three step reduced voltage part winding starter of size, type, rating and enclosure type as indicated, with components as follows:

.5 Three-3 pole contactors.

.6 One set starting resistors.

.7 Six manual reset electronic overload relays.

.2 Accessories:

.1 Pushbuttons and selector switches: heavy duty, oil tight, labelled as indicated.

.2 Indicating lights: heavy duty, oil tight type, LED type and color as indicated.

.3 Auxiliary control devices as indicated.

2.9 THREE PHASE MANUAL REVERSING STARTER

.1 Three phase manual reversing starter of size, type, rating and enclosure type as indicated, with components as follows:

.1 Two-3 pole manual motor starters, quick make and break.

.2 Six overload relays and manual reset.

.3 Mechanical interlock to prevent both switches from closing at same time.

.2 Accessories

.1 Pushbuttons and selector switches: heavy duty, oil tight, labelled as indicated.

.2 Indicating lights: heavy duty, oil tight type and color as indicated.

2.10 THREE PHASE MANUAL TWO SPEED SEPARATE WINDING STARTERS

.1 Three phase manual two speed separate winding starters of size, type, rating and enclosure type as indicated with components as follows:

.1 Two-3 pole manual motor starters, quick make and break.

.2 Six overload relays and manual reset.

.3 Mechanical interlock to prevent both switches from closing at same time.

.2 Accessories:

.1 Pushbuttons and selector switches: heavy duty, oil tight, labelled as indicated.

.2 Indicating lights: heavy duty, oil tight type and color as indicated.

2.11 DC FULL VOLTAGE NON-REVERSING STARTERS

.1 DC full voltage non-reversing starters of size, type, rating and enclosure type as indicated, with components as follows:

.1 Contactor: single or two pole solenoid operated type as required.

.2 Indirectly-heated, manual reset thermal overload relay.

.2 Accessories:

.1 Pushbuttons: heavy duty, oil tight labelled as indicated.

.2 Selector switches: heavy duty, oil tight labelled as indicated.

.3 Indicating lights: heavy duty type and colour as indicated.

2.12 DC FULL VOLTAGE REVERSING STARTERS

.1 DC full voltage reversing starter of size, type, rating and enclosure type as indicated, with components as follows:

.1 Two contactors: single or two pole solenoid operated type, mechanically and electrically interlocked.

.2 Indirectly-heated, manual reset thermal overload relay.

.2 Accessories:

.1 Pushbuttons and selector switches: heavy duty, oil tight, labelled as indicated.

.2 Indicating lights: heavy duty, oil tight type and color as indicated.

.3 Auxiliary control devices as indicated.

2.13 CONTROL TRANSFORMER

.1 Single phase, dry type, control transformer with primary voltage as indicated and 24 or 120 V secondary, complete with secondary fuse, installed in with starter as indicated.

.2 Size control transformer for control circuit load plus 100VA spare capacity.

2.14 ENCLOSURE

.1 Welded steel enclosure with hinged front cover suitable for surface mounting.

.1 NEMA 12 enclosures in indoor, non-hazardous, dry locations.

.2 NEMA 7 enclosures in hazardous areas, or

.3 NEMA 4X stainless steel enclosures unless indicated otherwise.

.2 Oversized enclosure with DIN rail space and unused terminal blocks where pump protection relays or additional control relays are required as indicated on contract drawings.

.3 Apply finishes to enclosure in accordance with Section 26 05 00 – Common Work Results - Electrical.

2.15 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 00 – Common Work Results - Electrical.

.2 Manual starter designation label, white plate, black letters, size 1, engraved as indicated.

.3 Magnetic starter designation label, white plate, black letters, size 2 engraved as indicated.

PART 3 EXECUTION

3.1 INSTALLATION

.1 Install starters, connect power and control as indicated.

.2 Ensure correct fuses and electronic overload devices set correctly.

.3 Confirm motor nameplate and adjust overload device settings to suit.

.4 Ensure all wiring enters/exits the sides or bottom of starter. (Do not enter top of unit.).

.5 Ensure line and load conductors enter/exit the disconnect switch in separate conduits.

.6 Ensure line and load side conductors do not come into contact with or cross each other inside the starter enclosure.

3.2 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 00 – Common Work Results - Electrical, manufacturer's instructions and Section 01 91 13 – General Commissioning (Cx) Requirements.

.2 Operate switches, contactors to verify correct functioning.

.3 Perform starting and stopping sequences of contactors and relays.

.4 Check that sequence controls, interlocking with other separate related starters, equipment, control devices, operate as indicated.

END OF SECTION

PART 1 GENERAL

1.1 RELATED SECTIONS

.1 Section 01 33 00 – Submittals.

.2 Section 01 91 13 –Commissioning Requirements.

.3 Section 25 05 01 – Control Panels.

.4 Section 26 05 00 – Common Work Requirements Electrical.

.5 Division 44 07 51 – Submersible Pumps.

1.2 REFERENCES

.1 Variable Frequency drives standard of acceptance shall be Allen Bradley Powerflex 753 Class with ethernet communication module

.2 The drive shall meet the following specifications:

.1 NFPA 70-US National Electrical Code.

.2 NEMA ICS 3.1 - Safety standards for Construction and Guide for Selection, Installation and Operation of Adjustable Speed Drive Systems.

.3 NEMA 250 - Enclosures for Electrical Equipment.

.4 CAN/CSA-C22 No.14-95R2001. - Canadian Standards Association.

.5 IEC 146 - International Electrical Code.

1.3 REGULATORY REQUIREMENTS

.1 The drive conforms to the following requirements:

.1 NFPA 70.

.2 IEC 146.

.3 C-UL marking to provide an approved listing for Canadian users.

.4 UL listing.

.1 Manufacturer will furnish the product as listed and classified by Underwriter's Laboratories as suitable for the purpose specified and indicated.

.5 EN Standard/CE marked for the following directives:

.1 Low Voltage Directive (73/23/EEC) EN50178 Electronic Equipment for use in power installations.

.2 EMC Directive (89/336/EEC) EN61800-3 Adjustable Speed electrical power drive systems Part 3.

.2 The drive shall have an internal EMC filter capable of meeting the Second Environment levels for the EMC directive without the need for additional components. First environment classification shall require an additional, external filter.

1.4 SUBMITTALS

.1 All submittals shall be in accordance with the Submittal Procedures – Specification Section 01 33 00.

.2 Submit shop drawings to indicate:

.1 Mounting method and dimensions.
.2 VFD size and type.
.3 Layout of identified internal and front panel components.
.4 Enclosure types.
.5 Wiring diagram for each VFD.
.6 Interconnection diagrams.

.3 For factory manufactured Variable Frequency Drives, submit shop drawings from a manufacturer certified by CSA, IEC or CUL.

1.5 CLOSEOUT SUBMITTALS

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

.2 Include operation and maintenance data for each type and style of VFD.

PART 2 PRODUCTS

2.1 GENERAL

.1 Furnish complete variable frequency drives utilizing pulse width modulated (PWM) design as specified herein for the motors indicated on the drawings and in the specifications to be speed controlled by frequency drives. All features shall be included within the VFD enclosure, unless otherwise specified. VFD enclosure shall be minimum NEMA 12. The VFD shall be rated 600 volt ±10% and shall operate continuously without failure when connected to a three phase supply line. The VFD shall be highly reliable and rated for 250,000 hours mean time before failure (MTBF).

.2 The VFD and options shall be tested to ANSI/UL Standard 508. The complete VFD, including all specified options, shall be assembled by the manufacturer, which shall be UL-508 certified for the building and assembly of option panels. Assembly of the option panels by a third-party panel shop is not acceptable. The appropriate UL stickers shall be applied in both the VFD and option panel, in the

case where these are not contained in one panel. When these VFD's are to be located in Canada, CSA or C-UL certifications shall apply.

.3 Acceptable manufacturer: Allen Bradley.

2.2 BASIC DESIGN

.1 The adjustable frequency drive shall produce adjustable frequency output. Drives utilizing six step technology are not acceptable. To eliminate the need for isolation transformers and/or line suppression equipment, input line passive harmonic filter will be an integral part of the input section of the drive. If isolation transformers or other external suppression equipment is needed to meet this specification, the supply and additional electrical installation, shall be included as part of this work. The VFD shall have an internally mounted passive harmonic filter as a minimum to reduce input current harmonic content and provide isolation from power line transients such as utility power factor correction capacitor switching transients and to reduce RFI emissions. The enclosure shall also house the dV/dT output filter.

.2 Line noise shall be no greater than 3% harmonic distortion and no more than a 16,400 volt-microsecond commutation notch area, in accordance with IEEE Standard 519-1992 for special applications.

.3 The VFD shall be capable of starting into a rotating load (forward or reverse) and accelerating to setpoint without tripping or damaging components.

.4 The VFD shall have five programmable critical frequency lockout ranges to prevent the VFD from operating at an unstable speed.

.5 The VFD shall have an intelligent motor overload feature to protect the motor at different operating speeds and loads. The VFD shall provide electronic motor overload protection qualified per UL508C.

.6 The VFD shall protect against a stalled motor. The stall frequency/time shall be programmable.

.7 The unit and internal components shall be enclosed within a NEMA 12 enclosure.

.8 The output current rating of the VFD shall exceed the motor nameplate full load current rating as indicated on drawings.

.9 Appropriate enclosure cooling design to operate indoors in a maximum ambient temperature of 40^{o}C.

2.3 LOCAL/HAND CONTROL PANEL

Interface to the drive shall be a removable Human Interface Module (HIM) with integral display. The door-mounted display shall be an IP66/UL Type 4X LCD style consisting of 4 lines by 20 characters back lit alphanumeric display and a key pad. The control panel shall include the following:

.1 Hand/Off/Auto switch
.2 Local/Remote switch
.3 Manual speed control
.4 Meter function selector

.2 The control panel shall include a back lit LCD meter that will display % speed, % load, or output voltage. The desired display is selected by a pushbutton. The following drive status indicator displays shall be included on the control panel. Faults shall be displayed in plain English.

.1 Power ON
.2 Ready
.3 Run
.4 Running at commanded speed
.5 Reverse
.6 Fault
.7 Overload
.8 Phase loss
.9 Overtemperature
.10 Overcurrent
.11 Undervoltage
.12 Overvoltage
.13 Ground fault
.14 External fault

2.4 INTERNAL ADJUSTMENTS

.1 All adjustments noted below should be programmable only. Potentiometers and DIP switches are not acceptable.

.1 Minimum speed adjustment
.2 Maximum speed adjustment
.3 Gain and offset adjustments for signal follower
.4 Overload
.5 Current limit

.2 In addition, the drive shall be programmable to control the following functions from the local/hand control panel.

.1 Acceleration time - programmable from approximately 3 to 280 seconds.
.2 Deceleration time - programmable from approximately 3 to 280 seconds.
.3 Fault counter reset - to limit fault reset attempts to 7, the fault counter reset is turned on.
.4 Variable overload - to protect motor from excess current at low speeds.

.5 Individually selectable, resettable fault control - automatic functioning of the fault counter reset can be allowed or denied for ground fault, overvoltage fault, undervoltage fault, overcurrent fault, and phase-loss fault.

.6 Follower selection.

.7 Deceleration control or coast-to-rest.

.8 Reverse rotation.

.9 Output frequency - 30 to 60 Hz.

.10 Output voltages.

.11 Provide at least storage for 4 parameter sets.

.12 Speed Control functions include:

.1 Adjustment min/max speed.

.2 Three preset speeds.

.3 At least two sets of critical speed lockouts.

.4 At least 1 PID control loop.

.5 Three analog inputs.

.13 Output control functions:

.1 Flux optimization or automatic voltage optimization to limit audible motor noise.

.2 Current and torque limit.

.3 Torque regulated operating mode.

2.5 INTERNAL INDICATORS

.1 The key pad is to be used for troubleshooting.

2.6 SERVICE CONDITIONS

.1 Elevation to 1,000 m ASL without derating.

.2 Ambient temperature -10 to 60°C.

.3 Humidity to 95% non-condensing.

2.7 FEATURES

.1 Control interface inputs/outputs. Supply as standard all independently programmable:

.1 Three analog inputs, one 0-10v and two 4-20ma.

.2 Six discrete inputs.

.3 Two analog outputs.

.4 Relay contact outputs as required.

.5 Communication capabilities shall include RS232 and Ethernet/IP

.2 In addition to the start/stop and variable speed features in the drive, the following protective functions shall be supplied as standard:

.1 A minimum of 32 most recent fault codes and drive status information at the time of fault occurrence (c/w time stamps) shall be stored in the drives fault history.

.2 The VFD shall include MOV's for phase to phase to ground line voltage transient protection.

.3 Output short circuit and ground fault protection rated for 65,000 amps per UL508C without relying on fuses.

.4 Electronic class 10 motor overload protection per UL508C.

.5 AC line or DC bus over voltage and under voltage.

.6 Power loss ride through.

.7 Stall protection shall be programmable.

.8 Underload protection shall be programmable.

.9 VFD overtemperature protection.

2.8 SPECIAL FEATURES

.1 The VFD shall be factory installed within:

.1 An MCC lineup to Section 26 24 19 by MCC equipment manufacturer, or

.2 Suitable wall/floor mounted control panel assembled by CSA authorized panel shop.

.2 In either case, the following special features shall be included in the VFD enclosure.

.1 The unit shall maintain its UL or ETL Listing.

.2 Appropriate enclosure cooling design to operate indoors in a maximum ambient temperature of 40^{o}C.

.3 Flange mounted disconnect switch interlocked to door.

.4 Line side overcurrent protection as indicated on contract drawings.

.5 Provide a control power transformer with a rated secondary voltage of 120V AC. The control power transformer shall be provided with primary and secondary fusing.

.6 Provide door-mounted pilot devices per the contract drawing wiring diagrams.

.7 Provide door-mounted 120V AC push-to-test pilot lights with LED lamps as indicated on contract drawings.

.8 Provide a door-mounted human interface module for programming, display and control.

.9 Provide a door-mounted motor protection relay as indicated on contract drawings.

.10 Input Line Reactors, as indicated on contract drawings: 5% impedance

.11 Passive Harmonic input filter, as indicated on contract drawings:

.1 Passive Input Harmonic filter c/w Capacitor contactor and over temperature interlock contact:

.2 VFD supplied with 3-phase power: Mirus Lineator AUHF or approved equivalent, size to be coordinated with VFD size.

.3 VFD supplied with 1-phase power: Mirus Lineator 1Q3 or approved equivalent, size to be coordinated with VFD size.

.12 Output Line Reactor, as indicated on contract drawings: 3%

.13 Output dv/dt Filter, as indicated on contract drawings:

.1 TCI series or approved equivalent, size to be coordinated with VFD size.

.14 Relay contacts shall be provided for Ready, Running, and Fault Status

.3 The design shall provide for short circuit and locked rotor protection for the motor in both the line and drive position.

PART 3 EXECUTION

3.1 INSTALLATION

.1 Install drives within the control panels as shown on the design drawings.

.2 Power and control wiring for drive to be by Division 26.

3.2 START UP SERVICE

.1 The manufacturer shall provide start-up commissioning of the variable frequency drive and its optional circuits by a factory certified service technician who is experienced in start-up and repair services. The commissioning personnel shall be the same personnel that will provide the factory service and warranty repairs at the customer's site. Sales personnel and other agents who are not factory certified technicians for drive field repair shall not be acceptable as commissioning agents.

.2 Start-up services shall include checking for verification of proper operation and installation for the VFD, its options and its interface wiring to the building automation system. Included in this service shall be (as a minimum):

.1 Verification of contractor wire terminations to the VFD and its operational circuitry.

.2 Installation verification for proper operation and reliability of the VFD, the motor being driven, and the building automation system.

.3 Up to eight hours of customer operator training on operation and service diagnostics at the time of the equipment commissioning. This is a requirement for substantial completion.

.4 Measurement for verification of proper operation on each of the following items:

.1 Motor voltage and frequency. Verification of proper motor operation.

.2 Control input for proper building automation system interface and control calibration.

.3 Calibration check for the following setpoints (and adjustment as necessary) (1) minimum speed, (2) maximum speed, (3) acceleration and deceleration rates.

3.3 CONFIGURATION

.1 Auto Restart

.1 The drive provides up to nine automatic fault resets and restarts following a fault condition before locking out and requiring manual restart. The automatic mode is not applicable to a ground fault, shorted output faults, and other internal microprocessor faults. The time between restarts is adjustable from 0.5 to 30.0 seconds. Final parameter values will be determined during installation and should initially be configured for 3 reset/restarts, 30 seconds apart.

.2 Minimum speed

.1 The minimum drive speed parameter shall be set by the PLC and communicated to the drive over the Ethernet connection.

3.4 WARRANTY

.1 The VFD shall be warranted by the manufacturer for a period of 36 months from date of shipment. The warranty shall include parts, labour, travel costs and living expenses incurred by the manufacturer to provide factory authorized on-site service.

3.5 EXAMINATION

.1 Contractor to verify that job site conditions for installation meet factory recommended and code required conditions for VFD installation prior to start-up. These shall include as a minimum:

.1 Clearance spacing.

.2 Temperature, contamination, dust, and moisture of the environment.

.3 Separate conduit installation of the motor wiring, power wiring, and control wiring.

.4 Installation per the manufacturer's recommendations.

.2 The VFD is to be covered and protected from installation dust and contamination until the environment is cleaned and ready for operation. The VFD shall not be operated while the unit is covered.

3.6 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 00 – Common Work Requirements Electrical, manufacturer's instructions and Section 01 91 13 – Commissioning Requirements.

.2 Submit test record to Engineer.

.3 Submit configuration parameter settings printouts and PDF copy.

.4 Provide electronic data sheet files on USB Drive for each variable frequency drive.

.5 Submit manufacturer’s factory trained technician’s commissioning and configuration report to Engineer.

3.7 COMMISSIONING

.1 Submit the start-up report to the Engineer. Assist the Commissioning Agent in performing verification testing. Include all time required in the tendered price to assist the commissioning agent.

END OF SECTION

Part 1 GENERAL

1.1 SCOPE

.1 Provide complete factory assembled generator set equipment with digital electronic controls.

.2 Provide factory test, startup by a supplier authorized by the manufacturer, and on-site testing of the system.

.3 The generator set manufacturer shall warrant all equipment provided under this section, whether or not it is manufactured by the generator set manufacturer, so that there is one source for warranty and product service. Technicians specifically trained and certified by the manufacturer to support the product and employed by the generator set supplier shall service the generator sets.

1.2 CODES AND STANDARDS

.1 The generator set and its installation and on-site testing shall conform to the requirements of the following codes and standards:

.1 CSA C22.2, No.14-M91 Industrial Control Equipment.

.2 EN50082-2, Electromagnetic Compatibility - Generic Immunity Requirements, Part 2: Industrial.

.3 EN55011, Limits and Methods of Measurement of Radio Interference Characteristics of Industrial, Scientific and Medical Equipment.

.4 FCC Part 15, Subpart B.

.5 IEC8528 part 4. Control Systems for Generator Sets.

.6 IEC Std 801.2, 801.3, and 801.5 for susceptibility, conducted, and radiated electromagnetic emissions.

.7 IEEE446 - Recommended Practice for Emergency and Standby Power Systems for Commercial and Industrial Applications.

.8 IEEE587 for voltage surge resistance.

.9 NEMA ICS10-1993 - AC Generator sets.

.10 NFPA70 - National Electrical Code. Equipment shall be suitable for use in systems in compliance to Article 700, 701 and 702.

.11 NFPA110 - Emergency and Standby Power Systems. The generator set shall meet all requirements for Level 1 systems. Level 1 prototype tests required by this standard shall have been performed on a complete and functional unit, component level type tests will not substitute for this requirement.

.12 NEMA MG1, Part 33. Alternator shall comply with the requirements of this standard.

.13 UL1236 - Battery Chargers.

.14 UL2200. The generator set shall be listed to UL2200 or submit to an independent third party certification process to verify compliance as installed.

.15 UL508. The entire control system of the generator set shall be UL508 listed and labeled.

.16 CSA C282:19 Emergency Electrical Power Supply for Buildings.

.17 CSA C282 Logbook:20 Emergency electrical power supply for buildings maintenance logbook.

.18 CSA B139:19 Installation code for oil-burning equipment

.2 The generator set manufacturer shall be certified to ISO 9001 International Quality Standard and shall have third party certification verifying quality assurance in design/development, production, installation, and service, in accordance with ISO 9001.

1.3 ACCEPTABLE MANUFACTURERS

.1 Only approved bidders shall supply equipment provided under this contract. Equipment proposals must include a line by line compliance statement based on this specification.

.2 Caterpillar Toromont Power Systems Ltd. is an approved bidder for generators and generator accessories.

.3 Cummins is an approved bidder for generator and generator accessories.

1.4 SUBMITTALS

.1 Submit submittals in accordance with Section 01 33 00 – Submittal Procedures.

.2 Provide PDF copies of the following information for review.

.1 Manufacturer's product literature and performance data, sufficient to verify compliance to specification requirements.

.2 A paragraph by paragraph specification compliance statement, describing the differences between the specified and the proposed equipment.

.3 Manufacturer's certification of prototype testing.

.4 Manufacturer's published warranty documents.

.5 Verification report for generator sizing calculations, complete with design margin comments/recommendations.

.6 Shop drawings showing plan and elevation views with certified overall dimensions, as well as wiring interconnection details.

.7 Interconnection wiring diagrams showing all external connections required; with field wiring terminals marked in a consistent point-to-point manner.

.8 Manufacturer's installation instructions.

1.5 CLOSEOUT SUBMITTALS

.1 Provide operation and maintenance data for diesel generator for incorporation into manual specified in Section 01 78 00 – Closeout Submittals.

.2 Include in Operation and Maintenance Manual instructions for particular unit supplied and not general description of units manufactured by supplier and:

.1 Operation and maintenance instructions for engine, alternator, control panel, automatic transfer switch, manual bypass switch, battery charger, battery, fuel system, engine room ventilation system, exhaust system and accessories, to permit effective operation, maintenance and repair.

.2 Technical data:

.1 Illustrated parts lists with parts catalogue numbers.

.2 Schematic diagram of electrical controls.

.3 Flow diagrams for:

.1 Fuel system.

.2 Lubricating oil.

.3 Cooling system.

.4 Certified copy of factory test results.

.5 Maintenance and overhaul instructions and schedules.

.6 Precise details for adjustment and setting of time delay relays or sensing controls which require on site adjustment.

.3 Provide two copies of generator operation and maintenance data, in separate binders, per clause 11.2.1 of CSA C282:19.

.4 Provide an inspection, testing, and maintenance logbook, as described in Clause 11.1.2 of CSA C282:19. Logbook shall be CSA C282 Logbook:19.

Part 2 PRODUCTS

2.1 GENERATOR SET

.1 Ratings

.1 The generator set shall operate at 1800rpm and at a voltage of: 600/347 Volts AC, Three phase, Four-wire, 60 hertz.

.2 The generator set shall be rated at 750kW, 937.5kVA at 0.8 PF, standby rating, based on site conditions of: 250ft., ambient temperatures up to 40°C.

.3 The generator set rating shall be based on emergency/standby service.

.2 Performance

.1 Voltage regulation shall be plus or minus 0.5 percent for any constant load between no load and rated load for both parallel and non-parallel

applications. Random voltage variation with any steady load form no load to full load shall not exceed plus or minus 0.5 percent.

.2 Frequency regulation shall be isochronous from steady state no load to steady state rated load. Random frequency variation with any steady load form no load to full load shall not exceed plus or minus 0.25%.

.3 The engine-generator set shall be capable of single step load pick up of 100% nameplate kW and power factor, less applicable derating factors, with the engine-generator set at operating temperature.

.4 The alternator shall produce a clean AC voltage waveform, with not more than 5% total harmonic distortion at full linear load, when measured from line to neutral, and with not more than 3% in any single harmonic. Telephone influence factor shall be less than 40.

.3 Construction

.1 The engine-generator set shall be mounted on a heavy-duty steel base to maintain alignment between components. The base shall incorporate a battery tray with hold-down clamps within the rails. For engine leak & blow-by containment, include suitably sized drip tray to mount beneath generator set. The gen-set shall be mounted on a dual wall sub-base diesel fuel tank sized for minimum 24hour runtime at 100% load. Containments leak checked as UL and ULC requirements.

.2 All switches, lamps, and meters in the control system shall be oil-tight and dust-tight, and the enclosure door shall be gasketed. There shall be no exposed points in the control (with the door open) that operate in excess of 50 volts.

.3 Walk-in Weather Protective Sound Attenuation Enclosure:

.1 A sound-attenuated housing which allows the generator to operate a full rated load in the ambient conditions previously specified. The enclosure shall reduce the sound level of the generator set while operating at full rated load to an average of 55 dBA at 23' (7 meters) from the generator set in a free field environment. Housing configuration and materials used may be of any suitable design which meets application needs, except that acoustical materials used shall be oil and water resistant. No foam materials shall be used unless they can be demonstrated to have the same density and life as fiberglass.

.2 The enclosure shall include doors for access to both sides of the engine and alternator, and the control equipment. Key-locking and padlock able door latches shall be provided for all doors or access panels. Door hinges shall be stainless steel.

.3 The enclosure shall be provided with an exhaust silencer which is mounted inside of the enclosure and allows the generator set package to meet specified sound level requirements. Silencer and exhaust shall include a raincap and rainshield.

.4 All Sheetmetal shall be primed for corrosion protection and finish painted with the manufacturers standard colour. All surfaces of all metal parts shall be primed and painted.

.5 Painting of hoses, clamps, wiring harnesses, and other non-metallic service parts shall not be acceptable. Fasteners used shall be corrosion resistant and designed to minimize marring of the surface when removed for normal installation or service work.

.6 The enclosure shall be provided with 24VAC motor closed, spring opened fail safe air inlet and air outlet louvers and heaters to maintain the enclosure inside temperature at 10°C or more at all times except when the generator is running.

.7 The enclosure shall be provided with emergency battery pack complete with 2 heads and 2 hrs. battery duration that complies with CSA C22.2 No.141 inside the enclosure and one outdoor weatherproof light fixture with photocell.

.4 Connections

.1 The generator set load connections shall be composed of tin plated copper bus bars, drilled to accept compression terminations of the number and type as shown on the drawings. Sufficient lug space shall be provided for use with cables of the number and size as shown on the drawings.

.2 Power connections to auxiliary devices shall be made at the devices, with required protection located at a wall-mounted common distribution panel.

.3 Generator set control interfaces to other system components shall be made on a common, permanently labeled terminal block assembly.

2.2 ENGINE AND ENGINE EQUIPMENT

.1 The engine shall be diesel fueled, radiator and fan cooled. Minimum displacement shall be in litres with 8 cylinders. The horsepower rating of the engine at its minimum tolerance level shall be sufficient to drive the alternator and all connected accessories. Two cycle engines are not acceptable. Engine accessories and features shall include:

.1 Complete engine fuel system, including all pressure regulators, strainers, and control valves. The fuel system shall be plumbed to the generator set skid for ease of site connections to the generator set.

.2 An electronic governor system shall provide automatic isochronous frequency regulation. The governing system dynamic capabilities shall be controlled as a function of engine coolant temperature to provide fast, stable operation at varying engine operating temperature conditions. The control system shall actively control the fuel rate and excitation as appropriate to the state of the generator set. Fuel rate shall be regulated as a function of starting, accelerating to start disconnect speed, accelerating to rated speed, and operating in various isochronous or parallel states.

.3 Skid-mounted radiator and cooling system rated for full load operation in 40°C ambient as measured at the generator air inlet, based on 0.5 in H¨0 external static head. Radiator shall be sized based on a core temperature which is 20°F higher than the rated operation temperature, or prototype tested to verify cooling performance of the engine/radiator/fan operation in a controlled environment. Radiator shall be provided with a duct adapter flange. The cooling system shall be filled with a 50/50-ethylene glycol/water mixture by the equipment manufacturer. Rotating parts shall be guarded against accidental contact.

.4 Electric starter(s) capable of three complete cranking cycles without overheating.

.5 Positive displacement, mechanical, full pressure, lubrication oil pump.

.6 Full flow lubrication oil filters with replaceable spin-on canister elements and dipstick oil level indicator.

.7 Replaceable dry element air cleaner with restriction indicator.

.8 Flexible supply fuel line.

.9 Engine mounted battery charging alternator of, 40-ampere minimum, and solid-state voltage regulator.

.10 Coolant heater

.1 Engine mounted, thermostatically controlled, coolant heater(s) for each engine. Heater voltage shall be as shown on the project drawings. The coolant heater shall be rated 120V or 240V for full heating capacity.

.2 The coolant heater shall be installed on the engine with silicone hose connections. Steel tubing shall be used for connections into the engine coolant system wherever the length of pipe run exceeds 1 ft. The coolant heater installation shall be specifically designed to provide proper venting of the system. The coolant heaters shall be installed using quick disconnect couplers to isolate the heater for replacement of the heater element. The quick disconnect/automatic sealing couplers shall allow the heater element to be replaced without draining the engine cooling system or significant coolant loss.

.3 The coolant heater shall be provided with a 12VDC thermostat, installed at the engine thermostat housing. An AC power connection box shall be provided for a single AC power connection to the coolant heater system.

.4 The coolant heater(s) shall be sized as recommended by the engine manufacturer to warm the engine to a minimum of 100°F (40°C) in a 40°F ambient, in compliance with NFPA110 requirements, or the temperature required for starting and load pickup requirements of this specification.

.11 Provide vibration isolators, pad type, quantity as recommended by the generator set manufacturer.

.12 Starting and Control Batteries shall be calcium/lead antimony type, 12 volt DC, sized as recommended by the engine manufacturer, complete with battery cables and connectors.

.13 Provide exhaust silencer for the engine of size and type as recommended by the generator set manufacturer and approved by the engine manufacturer. The mufflers shall be as required to allow the generator set package to meet specified sound level requirements. Exhaust system shall be installed according to the engine manufacturer's recommendations and applicable codes and standards.

.14 A CSA certified 10 amp voltage regulated battery charger shall be provided. The charger shall be located in the generator enclosure. Input AC voltage and DC output voltage shall be as required. Charger shall be equipped with float, taper and equalize charge settings. Operational monitors shall provide visual output along with individual form C contacts rated at 4 amps, 120VAC, 30VDC for remote indication of:

.1 Loss of AC power - red light

.2 Low battery voltage - red light.

.3 High battery voltage - red light.

.4 Power ON - green light (no relay contact) Charger shall include an Analog DC voltmeter and ammeter, 12 hour equalize charge timer, and AC and DC fuses.

.15 A distribution panel, minimum 60A, 120/208V, single phase, c/w main disconnect/breaker, shall be provided within the enclosure. Heaters and battery charger shall be prewired to the distribution panel and fed from Building Normal Power.

2.3 AC GENERATOR

.1 The AC generator shall be; synchronous, four pole, 2/3 pitch, revolving field, drip-proof construction, single prelubricated sealed bearing, air cooled by a direct drive centrifugal blower fan, and directly connected to the engine with flexible drive disc. All insulation system components shall meet NEMA MG1 temperature limits for Class H insulation system. Actual temperature rise measured by resistance method at full load shall not exceed 80 degrees Centigrade.

.2 The generator shall be capable of delivering rated output (kVA) at rated frequency and power factor, at any voltage not more than 5 percent above or below rated voltage.

.3 A permanent magnet generator (PMG) shall be included to provide a reliable source of excitation power for optimum motor starting and short circuit performance. The PMG and controls shall be capable of sustaining and regulating current supplied to a single phase or three phase fault at approximately 300% of rated current for not more than 10 seconds.

.4 The sub transient reactance of the alternator shall not exceed 15 percent, based on the standby rating of the generator set.

.5 A generator space heater shall be provided along with thermostat and wired to the distribution panel within the enclosure.

.6 Provide warning sign at the generator connection box stating that the neutral is isolated from ground.

2.4 GENERATOR SET CONTROL

.1 The generator set shall be provided with a microprocessor-based control system that is designed to provide automatic starting, monitoring, and control functions for the generator set. The control system shall also be designed to allow local monitoring and control of the generator set, and remote monitoring and control as described in this specification. The generator control panel shall be integral with the generator set. The control shall be vibration isolated and prototype tested to verify the durability of all components in the system under vibration conditions encountered. The integral control shall include the specified features and functions.

.2 Control Switches

.1 Mode Select Switch. The mode select switch shall initiate the following control modes. When in the RUN or MANUAL position the generator set shall start and accelerate to rated speed and voltage as directed by the operator. In the OFF position the generator set shall immediately stop, bypassing at all time delays. In the AUTO position the generator set shall be ready to accept a signal from a remote device to start and accelerate to rated speed and voltage.

.2 Emergency Stop Switch. Switch shall be Red "mushroom-head" push-button. Depressing the emergency stop switch shall cause the generator set to immediately shut down, and be locked out from automatic restarting.

.3 Reset Switch. The reset switch shall be used to clear a fault and allow restarting the generator set after it has shut down for any fault condition.

.4 Panel Lamp Switch. Depressing the panel lamp switch shall cause the entire panel to be lighted with DC control power. The panel lamps shall automatically be switched off 10 minutes after the switch is depressed, or after the switch is depressed a second time.

.3 Generator Set AC Output Metering. The generator set shall be provided with a metering set including the following features and functions:

.1 Analog voltmeter, ammeter, frequency meter, and kilowatt (KW) meter. Voltmeter and ammeter shall display all three phases. Ammeter and KW meter scales shall be color coded in the following fashion: readings from 0-90% of generator set standby rating: green; readings from 90-100% of standby rating: amber; readings in excess of 100%: red.

.2 Digital metering set, 0.5% accuracy, to indicate generator RMS voltage and current, frequency, output current, output KW, KW-hours, and power factor. Generator output voltage shall be available in line-to-line and line-to-neutral voltages and shall display all three phase voltages (line to neutral or line to line) simultaneously.

.3 Both analog and digital metering are required. The analog and digital metering equipment shall be driven by a single microprocessor, to provide consistent readings and performance.

.4 Generator Set Alarm and Status Display.

.1 The generator set shall be provided with alarm and status indicating lamps to indicate non-automatic generator status, and existing warning and shutdown conditions. The lamps shall be high-intensity LED type. The lamp condition shall be clearly apparent under bright room lighting conditions. The generator set control shall indicate the existence of the following alarm and shutdown conditions on an alphanumeric digital display panel:

.1 low oil pressure (alarm)
.2 low oil pressure (shutdown)
.3 oil pressure sender failure (alarm)
.4 low coolant temperature (alarm)
.5 high coolant temperature (alarm)
.6 high coolant temperature (shutdown)
.7 engine temperature sender failure (alarm)
.8 low coolant level (alarm or shutdown-selectable)
.9 fail to crank (shutdown)
.10 fail to start/overcrank (shutdown)
.11 overspeed (shutdown)
.12 low DC voltage (alarm)
.13 high DC voltage (alarm)
.14 weak battery (alarm)
.15 high AC voltage (shutdown)
.16 low AC voltage (shutdown)
.17 under frequency (shutdown)
.18 over current (warning)
.19 over current (shutdown)
.20 short circuit (shutdown)
.21 overload (alarm)
.22 emergency stop (shutdown)
.23 Fuel valve closed (alarm)
.24 ATS - in bypass mode (warning)
.25 Main breaker open (warning)

.2 Provisions shall be made for indication of four customer-specified alarm or shutdown conditions. Labeling of the customer-specified alarm or shutdown conditions shall be of the same type and quality as the above specified conditions. The non-automatic indicating lamp shall be red, and shall flash to indicate that the generator set is not able to automatically respond to a command to start from a remote location.

.5 Engine Status Monitoring

.1 The following information shall be available from a digital status panel on the generator set control:

.1 engine oil pressure (psi or kPA)

.2 engine coolant temperature (degrees F or C)

.3 engine oil temperature (degrees F or C)

.4 engine speed (rpm)

.5 number of hours of operation (hours)

.6 number of start attempts

.7 battery voltage (DC volts)

.2 The control system shall also incorporate a data logging and display provision to allow logging of the last 10 warning or shutdown indications on the generator set, as well as total time of operation at various loads, as a percent of the standby rating of the generator set.

.6 Engine Control Functions

.1 The control system provided shall include a cycle cranking system, which allows for user selected crank time, rest time, and # of cycles. Initial settings shall be for 3 cranking periods of 15 seconds each, with 15-seconds rest period between cranking periods.

.2 The control system shall include an idle mode control, which allows the engine to run in idle mode in the RUN position only. In this mode, the alternator excitation system shall be disabled.

.3 The control system shall include an engine governor control, which functions to provide steady state frequency regulation as noted elsewhere in this specification. The governor control shall include adjustments for gain, damping, and a ramping function to control engine speed and limit exhaust smoke while the unit is starting. The governor control shall be suitable for use in paralleling applications without component changes.

.4 The control system shall include time delay start (adjustable 0-300 seconds) and time delay stop (adjustable 0-600 seconds) functions.

.5 The control system shall include sender failure monitoring logic for speed sensing, oil pressure, and engine temperature which can discriminate between failed sender or wiring components, and an actual failure condition.

.7 Alternator Control Functions

.1 The generator set shall include an automatic digital voltage regulation system that is matched and prototype tested by the engine manufacturer with the governing system provided. It shall be immune from mis operation due to load-induced voltage waveform distortion and provide a pulse width modulated form mis operation due to load-induced voltage waveform distortion and provide a pulse width modulated output to the alternator exciter. The voltage regulation system shall be equipped with three-phase RMS sensing and shall control buildup of AC generator voltage to provide a linear rise and limit overshoot. The system shall include a torque-matching characteristic, which shall reduce output voltage in proportion to frequency below a threshold of 58HZ. The voltage regulator shall include adjustments for gain, damping, and frequency roll-off. Adjustments shall be broad range, and made via digital raise-lower switches, with an alphanumeric LED readout to indicate setting level. Rotary potentiometers for system adjustments are not acceptable.

.2 Controls shall be provided to monitor the output current of the generator set and initiate an alarm (over current warning) when load current exceeds 100% of the rated current of the generator set on any phase for more than 60 seconds. The controls shall shut down and lock out the generator set when output current level approaches the thermal damage point of the alternator (over current shutdown). The protective functions provided shall be in compliance to the requirements of NFPA70 article 445.

.3 Controls shall be provided to individually monitor all three phases of the output current for short circuit conditions. The control/protection system shall monitor the current level and voltage. The controls shall shut down and lock out the generator set when output current level approaches the thermal damage point of the alternator (short circuit shutdown). The protective functions provided shall be in compliance to the requirements of NFPA70 article 445.

.4 Controls shall be provided to monitor the KW load on the generator set, and initiate an alarm condition (overload) when total load on the generator set exceeds the generator set rating for in excess of 5 seconds. Controls shall include a load shed control, to operate a set of dry contacts (for use in shedding customer load devices) when the generator set is overloaded.

.5 An AC over/under voltage monitoring system that responds only to true RMS voltage conditions shall be provided. The system shall initiate shutdown of the generator set when alternator output voltage exceeds 110% of the operator-set voltage level for more than 10 seconds, or with no intentional delay when voltage exceeds 130%. Under voltage shutdown shall occur when the output voltage of the alternator is less than 85% for more than 10 seconds.

.8 Provide and install a 18-light LED type remote alarm annunciator panel with horn, located as shown on the drawings. The remote annunciator shall provide all the audible and visual alarms called for by NFPA Standard 110 for level 1 systems; and in addition shall provide indications for high battery voltage, low battery voltage, loss of normal power to the charger, ATS in Bypass Mode, Main Breaker Open. Spare lamps shall be provided to allow future addition of other alarm and

status functions to the annunciator. Provisions for labeling of the annunciator in a fashion consistent with the specified functions shall be provided. Alarm silence and lamp test switch(es) shall be provided. LED lamps shall be replaceable. Alarm horn shall be switchable for all annunciation points. Alarm horn (when switched on) shall sound for first fault, and all subsequent faults, regardless of whether first fault has been cleared, in compliance with NFPA110 3-5.6.2.

.9 The generator set shall be provided with a mounted 1000A-3P pad lockable main line, LSI, circuit breaker, sized to carry the rated output current of the generator set on a continuous basis. The circuit breaker shall incorporate an electronic trip unit that operates to protect the alternator under all overcurrent conditions, or with other overcurrent protection devices that positively protect the alternator under overcurrent conditions. The supplier shall submit time overcurrent characteristic curves and thermal damage curve for the alternator, demonstrating the effectiveness of the protection provided.

.10 A second 1000A-2P circuit breaker shall be provided for Load Bank testing. This unit shall be supplied with a shunt trip, interlocked with the ATS starting contact.

.11 Control Interfaces for Remote Monitoring

.1 All control and interconnection points from the generator set to remote components shall be brought to a separate connection box. No field connections shall be made in the control enclosure or in the AC power output enclosure. Provide the following features in the control system:

.2 Form "C" dry common alarm contact set rated 2A @ 30VDC to indicate existence of any alarm or shutdown condition on the generator set.

.3 One set of contacts rated 2A @ 30VDC to indicate generator set is ready to load. The contacts shall operate when voltage and frequency are greater than 90% of rated condition.

.4 A fused 10 amp switched 12VDC power supply circuit shall be provided for customer use. DC power shall be available from this circuit whenever the generator set is running.

.5 Analogue output 4-20mA signal for generator output kw power.

.6 Analogue output 4-20mA signal for fuel tank level.

.7 Modbus communication interface for remote monitoring by CP-300.

2.5 NEUTRAL GROUNDING RESISTOR (NGR)

.1 The generator secondary winding will be connected to a high resistance neutral ground resistor (NGR) via liquid tight flexible conduit. The NGR (from I-GARD, OHMNI-6PM-5, pulsing resistor) shall be supplied as follows:

.1 347 V

.2 Maximum let-through current of 5 A.

.3 Element material should not have a temperature coefficient greater than 0.0002 ohms/°C.

.4 The resistor let-thru current shall not decease by greater than 20% from ambient to full operating temperature.

.5 Pulsing capability, brought out to a terminal block via liquid tight flexible conduit.

.6 Neutral CT, primary rating 0-5 A, turns ratio per manufacturer's recommendation, with internal wiring to a grounded shorting switch and then brought out to a terminal block

.7 NEMA 3R/12 stainless steel enclosure with bolted access installed in walk-in enclosure.

.8 Provide fully monitored iGARD NGR / ground fault relay with alarm contacts to CP-300. Enclosure mounted inside generator walk-in enclosure.

Part 3 EXECUTION

3.1 SEQUENCE OF OPERATION

.1 Generator set shall start on receipt of a start signal from the transfer switch. The start signal shall be via hardwired connection to the generator set control.

.2 The generator set shall complete a time delay start period as programmed into the control.

.3 The generator set control shall initiate the starting sequence for the generator set. The starting sequence shall include the following functions:

.1 The control system shall verify that the engine is rotating when the starter is signaled to operate. If the engine does not rotate after two attempts, the control system shall shut down and lock out the generator set and indicate "fail to crank" shutdown.

.2 The engine shall fire and accelerate as quickly as practical to start disconnect speed. If the engine has not started, it shall complete a cycle cranking process as described elsewhere in this specification. If the engine has not started by the completion of the cycle cranking sequence, it shall be shut down and locked out, and the control system shall indicate "fail to start".

.3 The engine shall accelerate to rated speed and the alternator to rated voltage. Excitation shall be disabled until the engine has exceeded programmed idle speed, and regulated to prevent over voltage conditions and oscillation as the engine accelerates and the alternator builds to rated voltage.

.4 On reaching rated speed and voltage, the generator set shall operate as dictated by the control system in isochronous, synchronize, load share, load demand, or load govern state.

.5 When all start signals have been removed from the generator set, it shall complete a time delay stop sequence. The duration of the time delay stop period shall be adjustable by the operator.

.6 On completion of the time delay stop period, the generator set control shall switch off the excitation system and shall shut down.

.1 Any start signal received after the time stop sequence has begun shall immediately terminate the stopping sequence and return the generator set to isochronous operation.

3.2 FACTORY TESTING

.1 The generator set manufacturer shall perform a complete operational test on the generator set prior to shipping form the factory. A certified test report shall be provided. Equipment supplied shall be fully tested at the factory for function and performance.

.2 Generator set factory tests on the equipment shall be performed at rated load and rated power factor. Generator sets that have not been factory tested at rated power factor will not be acceptable. Tests shall include: run at full load for 4 hours, maximum power, voltage regulation, transient and steady-state governing, single step load pickup, and function of safety shutdowns.

3.3 INSTALLATION

.1 Equipment shall be installed by the contractor in accordance with final submittals and contract documents. Installation shall comply with applicable state and local codes as required by the authority having jurisdiction. Install equipment in accordance with manufacturer's instructions and instructions included in the listing or labeling of UL listed products.

.2 Installation of equipment shall include furnishing and installing all interconnecting wiring between all major equipment provided for the on-site power system. The contractor shall also perform interconnecting wiring between equipment sections (when required), under the supervision of the equipment supplier.

.3 Equipment shall be installed on concrete housekeeping pads. Equipment shall be permanently fastened to the pad in accordance with manufacturer's instructions and seismic requirements of the site.

.4 Equipment shall be initially started and operated by representatives of the manufacturer.

.5 All equipment shall be physically inspected for damage. Scratches and other installation damage shall be thoroughly cleaned to remove all dirt and construction debris prior to initial operation and final testing of the system.

3.4 ON-SITE ACCEPTANCE TEST

.1 The complete installation shall be tested for compliance with the specification following completion of all site work. Testing shall be conducted by representatives of the manufacturer, who will supply the required diesel fuel. The Owner and Engineer shall be notified in advance (2 weeks' notice) and shall have the option to witness the tests.

.2 Installation acceptance tests to be conducted on-site shall include a "cold start" test, a four-hour full load test, and a one-step rated load pickup test in accordance with NFPA 110. Provide a resistive load bank and make temporary connections for full load test.

.3 Perform a power failure test on the entire installed system. This test shall be conducted by opening the power supply from the utility service and observing proper operation of the system for at least 2 hours. Coordinate timing and obtain approval for start of test with site personnel.

3.5 TRAINING

.1 The equipment supplier shall provide training for the facility operating personnel covering operation and maintenance of the equipment provided. The training program shall be not less than 1-4 hours in duration and the class size shall be limited to 5 persons. Training date shall be coordinated with the facility owner.

3.6 SERVICE AND SUPPORT

.1 The manufacturer of the generator set shall maintain service parts inventory at a central location which is accessible to the service location 24 hours per day, 365 days per year.

.2 The generator set shall be serviced by a local service organization that is trained and factory certified in generator set service. The supplier shall maintain an inventory of critical replacement parts at the local service organization, and in service vehicles. The service organization shall be on call 24 hours per day, 365 days per year.

.3 The manufacturer shall maintain model and serial number records of each generator set provided for at least 20 years.

3.7 WARRANTY

.1 The generator set and associated equipment shall be warranted for a period of not less than 5 years from the date of commissioning against defects in materials and workmanship.

.2 The warranty shall be comprehensive. No deductibles shall be allowed for travel time, service hours, repair parts cost, etc.

END OF SECTION

AUTOMATIC LOAD TRANSFER EQUIPMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

.1 Materials and installation for automatic load transfer equipment which can monitor voltage on all phases of normal power supply, initiate cranking of standby generator unit, transfer loads and shut down standby unit.

1.2 RELATED SECTIONS

.1 Information For Tenderers.

.2 Section 26 05 00 - Common Work Results - Electrical.

1.3 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CAN3-C13-M83(R1998), Instrument Transformers.

.2 CSA C22.2 No.5-02, Moulded-Case Circuit Breakers, Moulded-Case Switches and Circuit-Breaker Enclosures (Tri-national standard with UL 489, tenth edition, and the second edition of NMX-J-266-ANCE).

.3 CSA C22.2 No.178-1978(R2001), Automatic Transfer Switches.

.2 American National Standards Institute (ANSI)/National Electrical Manufacturers Association (NEMA)

.1 ANSI/NEMA ICS 2-2000, Industrial Control and Systems: Controllers, Contactors, and Overload Relays, Rated Not More Than 2000 Volts AC or 750 Volts DC.

1.4 SYSTEM DESCRIPTION

.1 Automatic load transfer equipment to:

.1 Monitor voltage on phases of normal power supply.

.2 Initiate cranking of standby generator unit on normal power failure or abnormal voltage on any one phase below preset adjustable limits for adjustable period of time.

.3 Transfer load from normal supply to standby unit when standby unit reaches rated frequency and voltage pre-set adjustable limits.

.4 Transfer load from standby unit to normal power supply when normal power restored, confirmed by sensing of voltage on phases above adjustable pre-set limit for adjustable time period.

.5 Shut down standby unit after running unloaded to cool down using adjustable time delay relay.

1.5 SHOP DRAWINGS

.1 Submit shop drawings in accordance with Information For Tenderers.

.2 Shop drawings shall include:

- .1 Make, model and type.
- .2 Load classification:
- .3 Single line diagram showing controls and relays.
- .4 Description of equipment operation including:
  - .1 Automatic starting and transfer to standby unit and back to normal power.
  - .2 Test control.
  - .3 Manual control.
  - .4 Automatic shutdown.

1.6 CLOSEOUT SUBMITTALS

.1 Provide operation and maintenance data for automatic load transfer equipment for incorporation into manual specified in Information For Tenderers.

.2 Detailed instructions to permit effective operation, maintenance, and repair.

.3 Technical data:

- .1 Schematic diagram of components, controls, and relays.
- .2 Illustrated parts lists with parts catalogue numbers.
- .3 Certified copy of factory test results.

PART 2 PRODUCTS

2.1 MATERIALS

.1 Instrument transformers: to CAN3-C13.

.2 Contactors: to ANSI/NEMA ICS2.

2.2 CONTACTOR TYPE TRANSFER EQUIPMENT

.1 Contact Type Transfer Equipment: to CSA C22.2 No.178.

.2 Two - 3 phase contactors mounted on common frame, in double throw arrangement, mechanically and electrically interlocked, motor operated, open type mounted in switchboard. Transition mode: Open transition with adjustable time delay in open position.

.3 Rated: 347/600 V, 60Hz, 150amp rating, 3-phase, 4 wire, solid neutral. Duty service 120/240V.

.4 Main contacts: silver surfaced, protected by arc disruption means.

.5 Switch and relay contacts, coils, spring and control elements accessible for inspection and maintenance from front of panel without removal of switch panel or disconnection of drive linkages and power conductors.

.6 Auxiliary contact: silver plated, to initiate emergency generator start-up on failure of normal power.

.7 Fault withstand rating: 25kA symmetrical for 3 cycles with maximum peak value of 25 kA.

.8 Lever to operate switch manually when switch is isolated.

.9 Solid neutral bar, rated: capacity as shown on drawing.

2.3 CONTROLS

.1 Selector switch - four position "Test", "Auto", "Manual", "Engine start".

.1 Test position - Normal power failure simulated. Engine starts and transfer takes place. Return switch to "Auto" to stop engine.

.2 Auto position - Normal operation of transfer switch on failure of normal power; retransfers on return of normal voltage and shuts down engine.

.3 Manual position - Transfer switch may be operated by manual handle, but transfer switch will not operate automatically, and engine will not start.

.4 Engine start position - Engine starts but unit will not transfer unless normal power supply fails. Switch must be returned to "Auto" to stop engine.

.2 Control transformers: dry type with 120V secondary to isolate control circuits from:

.1 Normal power supply.

.2 Emergency power supply.

.3 Relays: continuous duty, industrial control type, with wiping action contacts rated 10 A minimum:

.1 Voltage sensing: 3-phase for normal power and on one phase only for emergency, solid state type, adjustable drop out and pick up, close differential, 2V minimum undervoltage and over voltage protection.

.2 Time delay: normal power to standby, adjustable solid state, 0 to 60s.

.3 Time delay on engine starting to override momentary power outages or dips, adjustable solid state, 0 to 60s delay.

.4 Time delay on retransfer from standby to normal power, adjustable 0 to 60s.

.5 Time delay for engine cool-off to permit standby set to run unloaded after retransfer to normal power, adjustable solid state, 20s intervals to 10 min.

.6 Frequency sensing, to prevent transfer from normal power supply until frequency of standby unit reaches preset adjustable values.

.4 Solid state electronic in-phase monitor.

2.4 ACCESSORIES

.1 Pilot lights to indicate power availability normal and standby, switch position, green for normal, red for standby, mounted in switchboard.

.2 Plant exerciser: 168h timer to start standby unit once each week for selected interval transfers load to emergency supply and retransfers to normal supply on standby unit shutdown. Timer adjustable 0-168h in 15 min intervals.

.3 Auxiliary relay to provide 2 N.O. and 2 N.C. contacts for remote alarms.

.4 Manual by-pass isolation switch capable of by-pass to normal or by-pass to standby while in isolated position.

.5 Anti-condensation heater with thermostat connected to load side of transfer switch.

.6 NEMA 3R enclosure.

2.5 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 01 - Common Work Results - For Electrical.

2.6 SOURCE QUALITY CONTROL

.1 Complete equipment, including transfer mechanism, controls, relays and accessories factory assembled and tested in presence of Engineer.

.2 Notify Engineer 10 days in advance of date of factory test.

.3 Tests shall include:

.1 Operate equipment both mechanically and electrically to ensure proper performance.

.2 Check selector switch, in modes of operation Test, Auto, Manual, Engine Start and record results.

.3 Check voltage sensing and time delay relay settings.

.4 Check:

.1 Automatic starting and transfer of load on failure of normal power.

.2 Retransfer of load when normal power supply resumed.

.3 Automatic shutdown.

.4 In-phase monitor operation.

2.7 WARRANTY

.1 The transfer switch and associated equipment shall be warranted for a period of not less than 5 years from the date of commissioning against defects in materials and workmanship.

.2 The warranty shall be comprehensive. No deductibles shall be allowed for travel time, service hours, repair parts cost, etc.

2.8 ACCEPTABLE MANUFACTURER

.1 Asco 7000 Series.

.2 Onan/Cummins BTPC.

.3 Cutler Hammer contactor-based ATS c/w ATC-800 controller.

.4 Non-breaker-type approved equivalent.

PART 3 EXECUTION

3.1 INSTALLATION

.1 Install on 4" (100mm) thick concrete pad, extending 2" (50 mm) beyond equipment. Exact dimensions to be confirmed after receipt of shop drawings.

.2 Locate, install, and connect transfer equipment.

.3 Check relays, solid state monitors and adjust as required.

.4 Install and connect battery.

3.2 FIELD QUALITY CONTROL

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

.2 Energize transfer equipment from normal power supply.

.3 Set selector switch in "Test" position to ensure proper standby start, running, transfer, retransfer. Return selector switch to "Auto" position to ensure standby shuts down.

.4 Set selector switch in "Manual" position and check to ensure proper performance.

.5 Set selector switch in "Engine start" position and check to ensure proper performance. Return switch to "Auto" to stop engine.

.6 Set selector switch in "Auto" position and open normal power supply disconnect. Standby should start, come up to rated voltage and frequency, and then load should transfer to standby. Allow to operate for 10 min, then close main power supply disconnect. Load should transfer back to normal power supply and standby should shutdown.

.7 Commissioning to be performed by a factory trained technician representing the manufacturer. Commission report to be forwarded to Engineer without delay.

END OF SECTION

LIGHTING EQUIPMENT

PART 1 GENERAL

1.1 REFERENCES

.1 American National Standards Institute (ANSI)

.2 ANSI C82.11-1993, lamp current crest factor.

.3 ANSI C82.2 Input wattage.

1.2 RELATED SECTIONS

.1 Information For Tenderers.

.2 Refer to Section 26 05 00 Common Work Results - Electrical for related Sections applicable to this Project.

1.3 SHOP DRAWINGS AND PRODUCT DATA

.1 Submit shop drawings and product data in accordance with Section 26 05 00 Common Work Results - Electrical.

.2 Submit complete photometric data prepared by independent testing laboratory for luminaires.

.3 Submit list of replacement lamp data for each luminaire. Include lamp type, voltage, wattage, base type and order code. Include list in Maintenance Manual.

.4 Submit a luminaire and driver and lamp shop drawing for each luminaire type.

.5 Ensure that each of the specified driver features is specifically shown on the shop drawings.

.6 Provide test reports for LED modules and drivers.

1.4 CODE REQUIREMENTS

.1 Installation of lighting equipment to conform to Section 30, Canadian Electrical Code, Part I, and as amended or supplemented by Provincial, municipal, or other regulatory agencies having jurisdiction.

1.5 OPERATION AND MAINTENANCE DATA

.1 Provide operation and maintenance data for incorporation into manual specified in Section 26 05 00 Common Work Results – Electrical.

1.6 GUARANTEE

.1 Replace:

.1 Drivers that fail or exceed their labelled noise level rating within 12 months of substantial completion

.2 Luminaires which show evidence of corrosion, rough handling, scratching of finishes, etc., are to be replace with new luminaires at no additional cost.

1.7 OPERATIONAL TESTING

.1 Check wiring for agreement with design circuits.

.2 Test for short circuits and improper grounds.

.3 Test operation of luminaire and lamp with ballast.

.4 Allow for third party testing of all lighting controls.

1.8 LAMP USED FOR TEMPORARY LIGHTING

.1 Fluorescent lamps may be used for temporary lighting and lamps used for this purpose will be accepted when the project or portions of the work are turned over to the Owner Representative. Spot re-lamp faulty or burned out lamps prior to acceptance.

.2 Metal halide, incandescent and quartz lamps are not to be used for temporary lighting unless all lamps so used are replaced with new lamps immediately prior to completion.

PART 2 PRODUCTS

2.1 GENERAL

.1 Verify the Catalogue Number of all fixtures with the description prior to ordering and check for final ceiling finish in all areas where recessed fixtures are called for in order to purchase ceiling trim, flanges and mounting brackets to suit the particular construction used where the fixtures are installed.

.2 Different luminaires may be supplied by different manufacturers. Similar luminaires shall be supplied by the same manufacturer.

.3 Provide only luminaires which are structurally well designed and constructed and which use new parts and materials of highest commercial grade available.

.4 Use cadmium-plated chains for suspended luminaires in unfinished areas.

.5 Luminaires shall carry the CSA label.

.6 Provide supporting devices, plaster frames, junction boxes and outlet boxes where required.

.7 Provide lenses or diffusers of glass or acrylic material as indicated. Acrylic lenses shall be minimum 3mm thick.

.8 Include finishes to Section 26 05 00 Common Work Results - Electrical and as indicated.

.9 Where soffits or ceilings have thermal insulation, provide luminaires which are CSA approved for such use.

2.2 LAMPS

.1 Provide lamps as recommended by the luminaire manufacturer.

.2 LED sources to be high power, minimum rated 50,000 hour, white, 3500 K (+/-500 per full fixture), minimum 80 CRI, replaceable modules. Exterior LED sources shall have a high power, minimum rated 50,000 hour, white 4100 K.

.3 Lamps shall be installed one month before substantial completion of the building. Luminaires and lenses shall be thoroughly cleaned before installation of lamps upon completion of construction.

2.3 DRIVERS AND ACCESSORIES

.1 LED Drivers:

.1 120V 50/60 Hz, Class 1 LED drivers

.2 Power Factor: >90%

.3 Total Harmonic Distortion (THD): <10% of full load

.4 Complete with integral 9kV surge suppression protection

2.4 FINISHES

.1 Baked enamel finish:

.1 Conditioning of metal before painting:

.1 For corrosion resistance conversion coating to ASTM F 1137.

.2 For paint base, conversion coating to ASTM F 1137.

.2 Metal surfaces of luminaire housing and reflectors finished with high gloss baked enamel aluminum to give smooth, uniform appearance, free from pinholes or defects.

.3 Reflector and other inside surfaces finished as follows:

.1 White, minimum reflection factor 85%.

.2 Colour fastness: yellowness factor not above 0.02 and after 250 hours exposure in Atlas fade-ometer not to exceed 0.05.

.3 Film thickness, not less than 0.03 mm average and in no areas less than 0.025 mm.

.4 Gloss not less than 80 units as measured with Gardner 60 gloss meter.

.5 Flexibility: withstand bending over 12 mm mandrel without showing signs of cracking or flaking under 10 times magnification.

.6 Adhesion: 24 mm square lattice made of 3 mm squares cut through film to metal with sharp razor blade. Adhesive cellulose tape applied over lattice and pulled. Adhesion satisfactory if no coating removed.

.2 Alzak finish:

.1 Aluminium sheet fabricated from special aluminum alloys and chemically brightened, subsequently anodically treated to specifications established by Alcoa, to produce:

.1 Finish for mild commercial service, minimum density of coating 7.8 g/m , minimum reflectivity 83% for specular, 80.5% for semi-specular and 75% for diffuse.

.2 Finish for regular industrial service, minimum density of coating 14.8 g/m , minimum reflectivity 82% for specular and 73% for diffuse.

.3 Finish for heavy duty service, minimum density of coating 21.8 g/m , minimum reflectivity 85% for specular, 65% for diffuse.

2.5 LENSES

.1 Design K-12

.1 100% virgin acrylic, UV stabilized, clear.

.2 .113 overall thickness.

.3 Square base male conical per 625mm 64 prisms.

.4 Suitable for 1 x 4’, nominal fixture dimensions.

.5 Meets or exceeds flame and smoke density rating.

.2 Design K-19

.1 100% virgin acrylic, UV stabilized, clear.

.2 .187 overall thickness.

.3 Square base male conical per 625mm 64 prisms.

.4 Suitable for 2 x 4’, nominal fixture dimensions.

.5 Meets or exceeds flame and smoke density rating.

2.6 LIGHTING FIXTURES

.1 Type letters for each lighting fixture shown on the drawings are indicated on lighting fixture schedule and/or legend.

.2 Manufacturer's names and products listed in the luminaires schedule indicate the standard of acceptance for each lighting fixtures.

.3 Acceptable manufacturers:

.1 Interior fluorescent fixtures: CFI, Columbia, Cooper, Crouse-Hinds, Hubbell, Lithonia, Metalux, Peerless, Philips, Thomas,

.2 Exterior fixtures: Emco, Lithonia, Keene, Hubbell, Kim and Mcgraw Edison

.3 Other acceptable manufacturers may be indicated on the schedule for specified fixtures.

2.7 LUMINAIRES SCHEDULE

.1 Refer to Legend on Electrical drawings for Luminaire types.

PART 3 EXECUTION

3.1 INSTALLATION

.1 Locate and install luminaires as indicated, complete with all wiring, connections, fittings, hangers, aligners, box covers and accessories, as required.

.2 Review all ceiling types, construction details and mounting arrangements before placing luminaire orders and ensure that all mounting assemblies, framing rings and similar features are included and match the required installation.

.3 Install luminaires and lens materials in architectural details.

.4 Install luminaires parallel with building lines. Wall-mounted luminaires shall be installed plumb.

.5 All luminaires and assemblies shall be properly secured and supported. Support luminaires independent of the ceiling construction, complete with all fasteners such as 'S' hooks, framing and hangars, as may be required. Do not secure luminaires to mechanical ductwork or other vibration producing apparatus, unless specifically detailed on the drawings.

.6 Where a luminaire is suspended from the ceiling using a self-aligning box cover, an additional ground wire from the outlet box to the luminaire shall be provided.

.7 Coordinate the installation of luminaires with the work of other trades, ensuring that the necessary depths and mounting spaces are provided. Luminaires which cannot be installed due to a conflict with structural members, pipes or ductwork shall be relocated to a more suitable location, as directed by Engineer.

3.2 WIRING

.1 Connect luminaires to lighting circuits:

.1 Directly for luminaire designs.

.2 Through rigid conduit for luminaire designs.

.3 By use of modular wiring system for luminaire design.

.2 Connect luminaires to lighting circuits rated to CEC.

.3 Ground lighting equipment to a separate grounding conductor.

3.3 LUMINAIRE ALIGNMENT

.1 Align luminaires mounted in continuous rows to form straight uninterrupted line.

.2 Support luminaire independently of ceiling. Using "S" hooks and chains to structural steel or suspended "U" channels and in accordance with Ontario Hydro Safety Code.

.3 Explosion fixture to be mounted to the underside of precast concrete roof slab unless noted otherwise on drawings.

.4 Support continuous row mounted fluorescent fixtures every 1M.

.5 Weatherproof fluorescent to be mounted to the underside of pre-cast concrete roof slab unless noted otherwise on drawings.

3.4 CO-ORDINATION OTHER DIVISIONS

.1 Fully co-ordinate with other divisions to avoid interference with ductwork and piping and other services.

3.5 TEST

.1 Perform tests in accordance with Section 26 08 01 - Electrical Testing Requirements.

.2 Check luminaires and replace defective lamps, ballasts, lenses, drivers, modules, and accessories.

3.6 3.6 CLEANING

.1 Prior to take-over of the project, clean the lenses and reflectors of all luminaires with damp cloth to remove dust, smudges and fingerprints.

END OF SECTION

COMMISSIONING OF ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SCOPE OF WORK

.1 Testing and commissioning are called for throughout the individual specifications. This does not relieve this trade from providing all testing and commissioning necessary to ensure that systems and equipment operate as required and that they interface with other systems and equipment as required.

1.2 SECTION INCLUDES

.1 Commissioning of all building electrical systems and component including:

.1 Testing and adjustment.
.2 Demonstrations and Training.
.3 Instructions of all procedures for Owner's personnel.
.4 Updating as-built data.
.5 Co-ordination of Operation and Maintenance material.

1.3 RELATED SECTION

.1 Section 01 77 00 – Closeout Procedures.

.2 Section 01 91 13 – General Commissioning (Cx) Requirements.

.3 Section 26 05 00 – Common Work Results - Electrical.

1.4 REFERENCES

.1 CSA (Canadian Standards Association).

.2 Underwriters Laboratories of Canada.

1.5 QUALITY ASSURANCE

.1 Provide qualified trades persons, certified testing agencies, factory trained and approved by the Commissioning Team Leader.

.2 Submit the names of all personnel to be used during the Commissioning activities for Owner Approval.

1.6 COMMISSIONING

.1 The purpose of the commissioning process is to fully test all building systems including architectural, mechanical and electrical components and operating procedures by challenging these systems to realistic operation conditions.

.2 The Commissioning activities shall be coordinated by the General Contractor.

.3 Commissioning activities for the electrical systems must have available up to date as-built drawing information and accurate Operations and Maintenance Manuals. These documents shall be a major part of this activity.

.4 Contractor shall be responsible to update all documentation with information and any changes noted during the Commissioning exercise.

.5 Contractor shall arrange for all outside suppliers, equipment manufacturers, test agencies and others as identified in the commissioning sections of this specification. The cost associated with this requirement shall be included as part of the tender price.

1.7 SUBMITTALS

.1 A commissioning document shall be prepared by the Owner's Representative prior to conducting these activities for use by the Commissioning Team.

.2 The electrical sub-contractor shall be responsible for ensuring all activities are properly documented in this manual and coordinated through the General Contractor.

.3 As-built drawings and data books must be available two weeks prior to commissioning for review and use by the consultant and Commissioning Team prior to the start of the commissioning activities.

1.8 PREPARATION

.1 Provide test instruments required for all activities as defined in the commissioning documents.

.2 Verify all systems are in compliance with the requirements of the commissioning documents prior to the pre-commissioning check out operation.

.3 Confirm all scheduled activities have identified personnel available.

.4 Where systems or equipment do not operate as required, make the necessary corrections or modifications, re-test and re-commission.

1.9 SYSTEM DESCRIPTION

.1 Perform all start-up operations, control adjustment, trouble shooting, servicing and maintenance of each item of equipment as defined in the commissioning documentation.

.2 Owner will provide list of personnel to receive instructions and will co-ordinate their attendance at agreed upon times.

.3 Prepare and insert additional data in the operations and maintenance manuals and update as-built drawings when need for additional data becomes apparent during the commissioning exercise.

.4 Where instruction is specified in the commissioning manual, instruct personnel in all phases of operation and maintenance using operation and maintenance manuals as the basis of instruction.

.5 Conduct presentation on Owner's premises. Owner will provide space.

1.10 FINAL REPORT

.1 This trade shall assemble all testing data and commissioning reports and submit them to the Owner.

.2 Each form shall bear signature of recorder, and that of supervisor of reporting organizer.

1.11 SCHEDULE OF ACTIVITIES

.1 Commissioning activities shall be conducted based on pre-established schedule with all members of the commissioning team, refer to Section 01 91 13 – General Commissioning (Cx) Requirements.

.2 In addition, there will be two meetings held through the contract duration to introduce the parties of the commissioning team, establish the schedules and deadlines for the various activities and review the Commissioning Manual.

.3 Adhering to the established schedule is very important as the co-ordination and scheduling of the participants will be difficult to alter once this is established. Close co-ordination of this schedule is important.

.4 In the event project cannot be commissioned in the allotted time slot, the contractor shall pay for all costs associated with assembling the Commissioning Team at a later date. If the contractor has not performed his duties to reach commissioning stage as outlined earlier, he will incur all expenses of other trades and the Commissioning Team due to his non-compliance.

END OF SECTION

WIRING OF EQUIPMENT SUPPLIED BY OTHERS

PART 1 GENERAL

1.1 GENERAL

.1 This section describes the extent of services to be provided for wiring of equipment supplied by others.

.2 Within the context of this section, Others means:

.1 Other divisions of this specification (i.e.: Division 25 – Integrated Automation).

.2 The Owner, as defined in the Contract.

.3 Other contractors supplying and installing equipment to the contract.

1.2 EXTENT OF SERVICES PROVIDED

.1 The work of this contract is to include all power and control wiring of equipment which is provided by Division 26.

.2 All power and control wiring for equipment supplied by all other divisions, including but not limited to, Division 22, 25, 27, 28 & 44 will be the responsibility of this contractor. Coordinate with Integrated Automation contractor for exact control wiring requirements.

.3 All power and control wiring associated with equipment supplied by Division 01 will be the responsibility of this contractor. Coordinate with general contractor for exact requirements. See Section 26 27 97 – Door Hardware Wiring for exceptions for wiring of door lock systems.

.4 Final connection of all wiring to equipment provided by Others will be by Division 26. Coordinate with the provider for connection instructions.

1.3 RESPONSIBILITY OF DIVISION 26

.1 It is the responsibility of the Division 26 contractor to verify final requirements for wiring of all equipment noted. Verification of wiring requirements to include:

.1 Confirmation of electrical characteristics.

.2 Location of connection point.

.3 Method of connection (i.e. direct or plug-in etc.)

.2 Obtain and become familiar with shop drawings for all relevant equipment.

.3 No claim for extra will be entertained for wiring equipment which has been indicated, or changes to installed wiring where installation proceeded prior to verification of electrical requirements.

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION (NOT APPLICABLE)

END OF SECTION

DIVISION 27 INDEX

TELECOMMUNICATIONS RACEWAY SYSTEM

PART 1 GENERAL

1.1 SYSTEM DESCRIPTION

.1 Empty telecommunications raceways system consisting of outlet boxes, cover plates, conduits, cabletroughs, pull boxes, sleeves and caps, fish wires, service poles, service fittings, concrete encased ducts.

.2 Cable tray and underground distribution system.

PART 2 PRODUCTS

2.1 MATERIAL

.1 Underground conduits: PVC type, in accordance with Section 26 05 34 – Conduits, Conduit Fastenings and Conduit Fittings.

.2 Junction boxes, pull boxes, cabinets type E: in accordance with Section 25 05 31 – Splitters, Junction, Pull Boxes and Cabinets.

.3 Outlet boxes, conduit boxes, and fittings: in accordance with Section 25 05 31 – Splitters, Junction, Pull Boxes and Cabinets.

.4 Fish wire: polypropylene type.

PART 3 EXECUTION

3.1 INSTALLATION

.1 Install empty raceway system, including overhead distribution system, fish wire, terminal cabinets, outlet boxes, floor boxes, pull boxes, cover plates, conduit, sleeves and caps, cabletroughs, service poles, miscellaneous and positioning material to constitute complete system.

END OF SECTION

COMMUNICATION CABLES - INSIDE BUILDINGS

PART 1 GENERAL

1.1 RELATED SECTIONS

.1 Section 27 11 19 – Terminals and Connectors for Building Communication Conductors

1.2 REFERENCES

.1 CAN/CSA-T530-M90, Building Facilities, Design Guidelines for Telecommunications.

.2 CAN/CSA-T529-M91, Design Guidelines for Telecommunications Wiring System in Commercial Buildings.

.3 CAN/CSA-C22.2 No. 214-M90, Communications Cables.

.4 CAN/CSA-C22.2 No. 182.4-M90, Plugs, Receptacles, and Connectors for Communication Systems.

.5 EIA/TIA Bulletin TSB-36, Technical Systems Bulletin Additional Cable Specifications for Unshielded Twisted Pair Cables, Electronic Industries Association (USA), November 1991.

1.3 SYSTEM DESCRIPTION

.1 Structured telecommunications wiring system consist of copper unshielded-twisted-pair and optical fibre cables, terminations, connectors, cross-connection hardware and related equipment installed inside buildings for occupant's telecommunications systems.

.2 Installed in physical star configuration with separate horizontal and backbone sub-systems.

.1 Horizontal cables link work areas to telecommunications closet located on same floor.
.2 Telecommunications closets linked to central equipment room by backbone cables.

PART 2 PRODUCTS

2.1 STATION WIRE (ZSW)

.1 4-pair, 24 AWG, 100 ohm cable with insulated copper conductor in separate outer jacket: to C22.2 No.214. FT-6 fire-rated jacket.

.2 Voice-grade electrical transmission requirements: to CAN/CSA T529 and TSB-36, Category 6.

.3 Data-grade electrical transmission requirements to: CAN/CSA T529 and TSB-36, Category 6. Process related data CAT 6 cables – Blue coloured jackets. Security related CAT 6 cables, including security cameras – Red coloured jackets.

2.2 COMMUNICATIONS BUILDING CABLE (CBC)

.1 Data Line Cable:

.1 Data-grade electrical transmission requirements to: CAN/CSA T529 and TSB-36, Category 6.

.2 Fiber Optic Cable

.1 6 pair, 12 fiber 62.5mm/125 LT Direct Burial PE Armoured, Grade 3.5/1.0 DB 200/500 Mhz-MM fiber.

PART 3 EXECUTION

3.1 INSTALLATION OF HORIZONTAL DISTRIBUTION CABLES

.1 Install ZSW horizontal cables, as indicated in conduits from telecommunications closet to outlets.

.2 Install ZSW cables, as indicated in equipment room.

.3 Terminate 2 ZSW cables per work station terminated in accordance with CAN/CSA C22.2 No.182.4.

.1 2 service outlet(s) terminated in accordance with C22.2 No.182.4 and CAN/CSA-T529.

.2 Wall termination unit interconnecting ZSW to CFC wiring transition.

3.2 INSTALLATION OF BACKBONE CABLES

.1 Install CBC cable, as indicated in conduit from termination in each telecommunications closet to equipment room. Termination: to CAN/CSA-T529.

.2 Terminate CBC ZSW cables in accordance with CAN/CSA-T529 on patch panel.

3.3 TERMINATION FOR FIBER OPTIC CABLES

.1 Terminate all fiber with SC connectors.

3.4 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 00 - Electrical General Requirements.

.2 Test UTP cable installations for:

.1 Continuity: including open/short, polarity, and pair transpositions.

.2 DC loop resistance.

.3 Test fiber optic cable after terminated. Test report to be forwarded to Engineer.

3.5 COORDINATION WITH BELL CANADA

.1 Coordinate and pay for connection of static IP fibre internet service.

END OF SECTION

TERMINALS AND CONNECTORS FOR BUILDING COMMUNICATION CONDUCTORS

PART 1 GENERAL

1.1 RELATED SECTIONS

.1 Section 27 10 05 – Communication Cables - Inside Buildings

.2 Section 27 05 28 – Telecommunications Raceway System

1.2 REFERENCES

.1 CAN/CSA-T530-M90, Building Facilities, Design Guidelines for Telecommunications.

.2 CAN/CSA C22.2 No. 182.4-M90, Plugs, Receptacles and Connectors for Communication Systems.

.3 CAN/CSA T529-91, Design Guidelines for Telecommunications Wiring Systems in Commercial Buildings.

.4 Canadian Open Systems Application Criteria (COSAC) Profile for the Telecommunications Wiring System in Government Owned and Leased Buildings, Treasury Board Information Technology Standards TBITS-6.9

1.3 SYSTEM DESCRIPTION

.1 Termination, patch cords, and cross-connection equipment installed inside buildings for voice and data telecommunications systems employing unshielded twisted pair (UTP) and fiber optic cables.

PART 2 PRODUCTS

2.1 TERMINATIONS AND CROSS-CONNECTION SYSTEM FOR UNSHIELDED-TWISTED-PAIR (UTP) CABLES

.1 Cross-connect patch panel mounted on wall: to CAN/CSA-T529

2.2 TERMINATIONS AND CROSS-CONNECTION SYSTEM FOR FIFTY OHM COAXIAL CABLES

.1 Patch panel employing type BNC connectors: to CAN/CSA-T529 to terminate horizontal cables, type N connectors: to CAN/CSA-T529 to terminate backbone cables.

2.3 BUILDING TELECOMMUNICATION AND CROSS-CONNECTION SYSTEM FOR OPTICAL FIBRE CABLES

.1 Panel mounted self-contained interconnect unit equipped with SC connectors

PART 3 EXECUTION

3.1 INSTALLATION

.1 Install building communications terminating and cross-connecting systems in locations as shown in Contract Drawings, and in accordance with manufacturer's instructions.

3.2 INSTALLATION OF COMMUNICATION WIRES / CABLES

.1 Colour match conductors on terminal strip in accordance with C22.2 No. 214 and CAN/CSA-T529. For IDC-type connections, use tool with seating and cutting heads for connecting conductors to terminals

.2 Harness slack wire in cabinets, terminals and cross-connecting terminating systems.

3.3 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 00 – Electrical General Requirements.

END OF SECTION

INTRUSION DETECTION

PART 1 GENERAL

1.1 REFERENCE STANDARDS

.1 System shall meet all required Underwriters' Laboratory of Canada (ULC) standards, including:

.1 ULC Commercial and Residential Fire/Burglar Alarm.

.2 CAN/ULC-S303 Local Burglar Alarm Units and Systems.

.3 CAN/ULC-S304 Central and Monitoring Station Burglar Alarm Units.

.2 System shall be installed in compliance with the Ontario Electrical Safety Code.

1.2 RELATED REQUIREMENTS

.1 Section 01 33 00 – Submittals

.2 Section 01 78 00 – Closeout Submittals

.3 Section 01 91 13 – Commissioning Requirements

.4 Section 26 05 00 – Common Work Requirements Electrical

.5 Section 26 90 00 – Wiring of Equipment Supplied by Others

1.3 SUBMITTALS

.1 Submit the following in accordance with 01 33 00 – Submittal Procedures:

.1 PDF shop drawings and product data.

.2 Descriptive System Document for all devices / wiring circuits to be installed in hazardous locations, in accordance with OESC rule 18-066 1) and Appendix F.

.3 Items as required in Section 26 05 00 – Common Work Requirements Electrical.

.2 Submit verification test report in accordance with 01 78 00 – Closeout Submittals.

1.4 SCOPE OF WORK

.1 Contractor shall solicit the services of the Township’s Security System Maintenance Contractor:

Rangard Security & Electronic Systems Inc.
433 Tollgate Rd. West
Cornwall, ON
K6H 5R6

.2 Security System Contractor shall:

.1 Recommend and supply all security system components (system controller w/ panel, keypads, door contacts, etc.).

.3 Contractor shall supply all other materials required for the security system (wiring, relays, conduit, junction boxes, pull boxes, etc.).

.4 Contractor shall be responsible for all other aspects of providing a complete system, including but not limited to installation, configuration, & verification.

.5 Contractor shall be responsible for all coordination with Security System Contractor.

.6 All work performed under this specification by the Contractor will be completed to the satisfaction of the Security System Contractor and the Contract Administrator. Contractor shall redo any deficient work identified at no additional cost.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

.1 Contractor shall provide a complete electronically supervised, burglary and alarming system with rechargeable backup battery.

.2 Contractor shall provide a supervised door access control system for keyless entry to buildings where indicated on contract drawings.

.3 System shall consist of:

.1 Non-volatile memory c/w integral static and lightning protection circuitry.

.2 Alarm communications complete with integrated digital communicator capable of being programmed to transmit up to three phone numbers or locations with 2 account numbers, capable of communicating in all major formats.

.3 Events transmitted shall be programmable to include: burglary alarms trouble alarms, supervisory conditions, alarm restoral codes, opening (disarming) and closing (arming) codes, partial closing codes and opening after alarm codes.

.4 Continuous system supervision of AC power failure, low battery, loss of internal clock, fail to communicate, module fault (supervisory or tamper), trouble by zone, telephone line trouble, bell output trouble, tamper by zone, and aux. power supply fault.

.5 Ability to page personnel on the occurrence of any of the events listed in 2.1.2.3 as selected.

.6 Ability to supervise the telephone line.

.7 Auxiliary power of up to 1.55 Amps (@12.5 VDC) for modules and alarm devices.

.8 Capacity for 9 low current (50mA) and 5 high current (300mA) programmable outputs.

.9 700mA PTC-protected, supervised bell/siren circuit that will drive a bell/siren until reset or silenced.

.10 Surface mounted hardwired keypad with 32 character LCD with zone indicators as required and with backlit keys and displays.

.11 Ability to allow 38 – 4 to 6 digit access codes.

.12 False alarm prevention features.

.13 Voice-assisted security & automation.

.14 Upload/Download capability.

.15 An authorized entry via a controlled access door (keycard entry) shall automatically disarm the building's security system.

.4 System shall be comprised of, but not be limited to, the following components, as shown on the Contract Drawings:

.1 Alarm controllers in NEMA 1 enclosure

.2 Alarm horns

.3 Keypads

.4 Door contacts

.5 Networked Door Controllers

.6 Request to exist devices

.7 Key Fob and Readers at secured door locations.

2.2 ALARM CONTROLLERS

.1 Alarm controllers shall be as recommended by Security System Contractor and have the following features, at a minimum:

.1 Minimum of 6 onboard, fully supervised programmable zones

.2 Integrated power supply

.3 Supervised digital alarm communicator

.4 Auxiliary power supply for powering security detection devices

.5 Two programmable outputs

.6 Configurability of expansion / functional modules

.2 The controller shall be complete with all the software required to implement every system feature and to allow for the addition of every expansion or functional module without changes to the basic software.

.3 The controller shall be fully programmable via the keypads, and also allows event buffer viewing via the alphanumeric LCD keypads.

.4 The controller shall have a separate PC-based upload/download software that provides the ability to fully program the system and to read all current system programming, including the event buffer.

2.3 SYSTEM KEYPADS:

.1 LED, alphanumeric LCD, or fixed ICON LCD type, as recommended by Security System Contractor.

.2 At a minimum, keypads shall include:

.1 "Armed" indication LED
.2 "Ready" indication LED
.3 "Trouble" indication LED
.4 "Power" indication LED
.5 5 programmable function keys
.6 3 keypad activated alarm buttons
.7 Power Save mode functionality in the event of a power failure

2.4 MANUFACTURER

.1 Manufacturer of security system components shall be DSC, or as recommended by the Security System Contractor.

.2 Manufacturer of door contacts shall be G.R.I. (George Rick Industries, Inc.), or as recommended by the Security System Contractor.

.3 Manufacturer of Door Access controllers shall be Kantech.), or as recommended by the Security System Contractor.

PART 3 EXECUTION

3.1 INSTALLATION

.1 Install the work of this section in accordance with manufacturer's printed instructions and reference standards, and as detailed on the drawings.

.2 Wiring for door contacts shall be concealed within masonry between door contact and nearest junction box.

.3 Install all intrinsically safe circuits in hazardous locations according to the Descriptive System Documents.

3.2 TESTING AND CERTIFICATION

.1 The system shall be tested in accordance with the manufacturer's recommendations, industry standard practices and in accordance with Section 01 91 13 – Commissioning Requirements.

.2 Submit a copy of the testing & verification report / certificate for review by the Contract Administrator.

.3 Include a copy of the testing & validation report / certification in the Operating and Maintenance manuals.

END OF SECTION

PART 1 GENERAL

1.1 REGULATORY REQUIREMENTS

.1 All equipment shall be listed by Underwriters' Laboratory of Canada (ULC).

.2 All components of the system shall be the product of a single manufacturer.

.3 The system and installation shall conform to the latest edition of the Ontario Building Code (OBC) and the Ontario Electrical Safety Code (OESC).

.4 The system shall be installed in accordance with CAN/ULC-S524-14, and shall be subject to the approval of the local Authority Having Jurisdiction.

.5 Fire Alarm System to be verified to CAN/ULC-S537-13

1.2 RELATED REQUIREMENTS

.1 Section 01 33 00 – Submittals

.2 Section 01 78 00 – Closeout Submittals

.3 Section 01 91 13 – Commissioning Requirements

.4 Section 26 05 00 – Common Work Requirements Electrical

.5 Section 26 90 00 – Wiring of Equipment Supplied by Others

1.3 SUBMITTALS

.1 Submit pdf shop drawings in accordance with 01 33 00 – Submittal Procedures.

.2 Shop drawings must be submitted and approved by project Engineer before any equipment is shipped to site.

.3 Shop drawings to consist of the following:

- .1 Project title page with project name, Engineer, contractor, and equipment manufacturers.
- .2 Project detailed equipment list
- .3 Project verification requirements
- .4 System/device data sheets and typical wiring schematics
- .5 Graphic annunciators detailed construction drawings.
- .6 Main fire alarm control panel.
- .7 Fire alarm transponder panel (if applicable).

.4 Provide ‘as-built’ drawings upon completion showing all devices c/w addresses including line isolator and conduit runs.

1.4 OPERATION AND MAINTENANCE MANUALS

.1 Operation and maintenance manuals to consist of the following:

.1 Operation and maintenance instructions for the complete fire alarm system to permit effective operation and maintenance.

.2 Recommended spare parts list with parts catalogue numbers.

.3 Copy of approved shop drawings.

1.5 MAINTENANCE

.1 Provide one year's free maintenance with two inspections by manufacturer during the year. Inspection tests to conform to CAN/ULC-S537-13.

1.6 TRAINING

.1 Provide on-site lectures and demonstrations by fire alarm equipment manufacturer, to train operational personnel in use and maintenance of the fire alarm system. Two separate lectures a minimum of 2 hours each. Coordinate training schedule with Owner.

1.7 QUALIFICATIONS OF MANUFACTURERS

.1 Manufacturers bidding this project must provide a Letter of Compliance, indicating they have met the specifications and system operation exactly.

1.8 SYSTEM DESCRIPTION

.1 Existing conventional fire alarm system to be replaced with new addressable system. New system to be extended to buildings on site, as per the contract drawings.

.2 Provide a supervised, micro-processor based, zoned, non-coded, single-stage, addressable fire alarm system, utilizing automatic/manual devices, wired in DCLA style 6 configuration, and operating at 24 VDC nominal voltage from a rectified 120 VAC power supply.

.3 Any circuit wiring leaving or entering a building shall be provided with a combination choke, MOV, and gas-discharge transient protector. Any circuit servicing a Class 1, Div. 2 area shall be isolated using intrinsically safe barriers.

.4 System shall notify the fire department of an alarm condition by way of a signal to a central monitoring station conforming to CAN/ULC-S561.

PART 2 PRODUCTS

2.1 MATERIALS

.1 Equipment and devices: ULC listed and labelled; standard product of single manufacturer. Addressable type unless otherwise noted.

.2 Power supply: to CAN/ULC-S524 and OBC requirements.

.3 Audible signal devices: to ULC-S525.

.4 Control unit: to CAN/ULC-S527.

.5 Manual fire alarm stations: to ULC-S528.

.6 Smoke detectors: to CAN/ULC-S529.

.7 Thermal detectors: to ULC-S530.

2.2 SYSTEM OPERATION – SINGLE STAGE

.1 Single stage operation. Operation of any alarm initiating device:

- .1 Cause on electronic latch to lock-in the alarm state at the control panel.
- .2 Cause audible signal devices to sound throughout entire building.
- .3 Transmit signal to remote monitoring station via telephone line to CAN/ULC S561.
- .4 Cause zone of alarm signal to be indicated on fire alarm control panel and remote annunciator panel.
- .5 Automatically record the time, date and zone of alarm at the control panel.
- .6 Cause fire doors and smoke control doors if normally held open, to close automatically.
- .7 Fire alarm system shall automatically shut down the A/C systems and fans which are fitted with duct smoke detectors or otherwise indicated. Provide relay as required.
- .8 Fire alarm system shall recall elevator in the event of fire detection in the elevator machine room.

.2 Supervisory Device Activation

- .1 Actuation of and supervisory device shall:
  - .1 Cause on electronic latch to lock-in the supervisory state at the control panel.
  - .2 Indicate the respective supervisory zone at the control panel.
  - .3 Automatically record the event by time and date at the control panel.
  - .4 Cause a distinctive audible signal at the control panel.
  - .5 Activate a common supervisory sequence.

.3 Resetting System:

.1 Resetting the alarm or supervisory device and the system shall:

.1 Be automatically recorded at the control panel.

.2 Return all other system indications/functions back to normal.

.4 Trouble Activation:

.1 The system shall continuously monitor the system devices and wiring. Any trouble on the system shall:

.1 Indicate the circuit/device in trouble on the control panel.

.2 Automatically record the time, date and device in trouble.

.3 Activate the “system trouble” indication, buzzer and the common trouble sequence. Acknowledging the trouble condition shall silence the audible indication, whereas the visual indication shall remain until the trouble is cleared and the system is back to normal.

2.3 CONTROL PANEL

.1 DCLA System style in accordance with CAN-ULC-S524. Minimum of one loop per floor and one spare loop capacity.

.2 Each device individually addressed unless otherwise noted.

.3 Non-coded.

.4 Enclosure: CSA Enclosure 1, c/w lockable concealed hinged door, full viewing window, flush lock and 2 keys, wall mounted, max. 750 mm width.

.5 Central Processing Unit (CPU):

.1 The CPU is to monitor and control the entire system and allow control of all systems components connected to the system. The CPU shall be of modular design.

.2 The Central Processing Unit (CPU) shall be complete with forty (40) character alphanumeric display and keypad. All components shall be fully operational while the system is operating on the standby batteries.

.3 Basically all events are to be logged automatically in the system for future review.

.4 The CPU electronics shall be microprocessor-based. Basic life safety software shall be retained in erasable programmable read only memory (EPROM) and executed from random access memory (RAM) to allow password protected field editing. The CPU shall have the capacity to monitor the number of addressable points required for this project plus 25% spare capacity.

.5 The CPU must incorporate circuitry to continuously monitor the communications and data processing cycles of the microprocessor. On

CPU failure, an audible and visual trouble signal shall initiate and provide a remote trouble at Fire Department Control panel.

.6 The CPU shall be equipped with software routines to provide event initiated programs (EIP) whereby the receipt of an alarm or supervisory trouble condition may be programmed to operate any or all of the system's control points. EIP actions for life safety functions shall be retained in the non-volatile PROM memory for reliability. The CPU shall also be retained in the non-volatile PROM memory for reliability. The CPU shall also be capable of reprogramming these EIP functions in the field and retaining the changes in the RAM memory until a new set of PROM are programmed.

.7 The control unit shall be able to process and evaluate incoming signals from addressable devices such as automatic detectors, manual pull station, supervisory valves, etc., via DCLA style link.

.8 The control unit shall be able to handle the following maximum number of addressable links and field-programmable zones:

.1 Up to four addressable links per control unit.

.2 Up to 100 detection devices per line. Maximum initial loading to be no more than 80.

.9 Provide operating power for the detection devices through a regular two-wire line.

.10 Each addressable line module is to have its own microprocessor based circuit, working independently from the central processor board located in the control unit and independently from each other.

.11 All addressable circuits shall be monitored against open circuits and ground faults. Should a malfunction occur in any circuit, this must result in an indication of a trouble condition of this address location at the Control Panel while all other addresses continue operating normally.

.12 Should a detection device respond with either an alarm or trouble condition, its location must be displayed along with its user text of 40 characters. For maintenance purposes. The panel shall have the ability to display the address information of the device in alarm/trouble condition.

.13 Auxiliary relays: plug-in type, dust cover, supervised against unauthorized removal by common trouble circuit and c/w individual bypass switch.

.1 Contacts: 2 A, 120 V ac, for functions such as release of door holders or initiation of fan shut down. Provide also 2 N.O. and 2 N.C. contacts for security system monitoring of 'trouble' and 'alarm' connections to Control panel.

.2 Contact terminal size capable of accepting 22-12 AWG wire.

.14 The system shall be capable of logging and storing 300 events in an alarm log and300 events in a trouble log. These events shall be stored in a battery protected random access memory. Each recorded event shall include the time and date of that event's occurrence.

.1 The following Historical Alarm log events shall be stored:

.1 Alarms.

.2 Alarm acknowledgement.

.3 Trouble acknowledgement.

.4 Supervisory acknowledgement.

.5 Alarm verification tallies.

.6 Trouble Historical log cleared.

.15 Provide a general evacuation switch in the control panel to provide the fire department the option of causing a general alarm.

.6 General System Operation:

.1 Reset of the alarm system and return of the control panel to normal operation will be accomplished as follows:

.1 Resetting the fire alarm system shall not be possible until all the alarm zones have been reset or properly cleared after the Code required time delay.

.2 A supervisory input signal initiated by the actuation of a standpipe supervised valve shall cause:

.1 An audible trouble signal shall sound only at the control panel until acknowledged by authorized personnel.

.2 A latched-type visual indication of the location of the supervisory zone on the control panel.

.3 Print out of the time, date and the trouble zone on the printers.

.4 An open circuit fault on a supervisory circuit shall result in a specific trouble indication.

.5 Manual pull station, heat detectors, or flow switches will immediately cause the system to activate and report an alarm condition without verification requirement.

.3 The system will be programmable on site as outlined below:

.1 The fire alarm system shall allow for on-site loading or editing of the fire alarm programs as required to accommodate and facilitate expandability, building parameter changes or changes as required by the authority having jurisdiction.

.2 Fire alarm programs shall be written in an equation format comparable to ladder logic equations. The equations shall consist of input and output statements providing selective input/output control functions based on binary logic (and, or, not, timing) and other specially coded operational commands.

.3 Programming or editing a forty (40) character description label shall be made possible for any system monitor or control point. Extension of messages for any system point or group of points shall be field programmable.

.4 Assigning the same control point more than one level of control priority indifferent equations shall be possible to allow for automatic and/or manual override functions.

.5 The following conditions shall exist when disabling any part of the system.

.1 When a point has been disabled from the system it shall not disable the supervisory circuit for that zone. Tampering with the wiring of the disabled circuit shall initiate a point trouble condition at the Control Panel CPU.

.2 For an alarm received from any other monitor circuit which has not been disabled, the system shall operate as programmed.

.3 Whenever an initiating circuit has been disabled or disconnected a trouble condition shall be initiated and its location displayed at the main CPU and the monitoring control centre.

.6 All on-site programming or editing changes to the fire alarm system shall be password protected.

2.4 POWER SUPPLY

.1 The Control Panel is to contain the power supply for the entire system. 120 VAC, 60 Hz input, 24 VDC output from rectifier to operate alarm and signal circuits, with standby power of gel cell battery minimum expected life of four years, sized in accordance with OBC.

.2 The power supply unit must contain suitable over-voltage protection to prevent any malfunction or damage which might occur from line power surges.

.3 Upon loss of mains power, the power supply unit must contain suitable over-voltage protection to prevent any malfunction or damage which might occur from line power surges.

.4 When battery voltage drops below 22V, a fault indication is to be provided to indicate a battery fault condition.

.5 A visible and audible signal is to be generated to indicate that the control unit is operating under emergency power.

.6 The master fault indicator on the control unit is to be illuminated until power has been returned.

.7 When the AC power is restored, the control unit must automatically revert to normal operation without requiring any manual restarting procedures.

.8 Battery Charger shall be designed to suit the characteristics of the battery providing automatic boost charge facility when the battery bank potential falls below acceptable voltage for maintaining a working system and return to float charge when the battery bank reaches maximum acceptable voltage.

.9 Automatic equalizing type battery charger must be rated to recharge to at least 70% within 12 hours, and to operate from 120V, 60 Hz, single phase input.

2.5 MANUAL PULL STATIONS

.1 All manual stations shall be addressable.

.2 Manual alarm stations: pull lever, break glass, wall mounted flush type, non-coded single pole normally open contact for single stage.

2.6 AUTOMATIC ALARM INITIATING DEVICES

.1 All automatic initiating devices to be addressable.

.2 Heat detectors, combination fixed temperature and rate of rise, non-restorable fixed temperature element, self-restoring rate of rise, fixed temperature 57°C, rate of rise 8.3°C per minute. Low profile type.

.3 Heat detector base to be compatible with smoke detectors.

.4 Smoke detector: ionization type

.1 Plug-in type.

.2 Wire-in base assembly with integral continuously lit red LED, when in alarm mode. Flashing or alarm pulsating is not acceptable.

.3 Base compatible with heat detectors.

.4 Low profile type.

.5 Duct type smoke detectors; ionization type addressable c/w remote indicating lamp.

.6 All devices to be low profile type.

2.7 ADDRESSIBLE INTERFACE MODULES

.1 Provide addressable interface modules to interface non-addressable devices to the addressable loop including kitchen fire suppression system.

.2 Actuated as a distinct and separate address for each supervisory device.

2.8 AUDIBLE/VISUAL SIGNAL DEVICES

.1 Red Flush Mount Housing

.2 Horns and Horn/Strobes with field adjustable Hi/Lo dB setting.

.3 Strobes and Horn/Strobes with field adjustable 15/30/75/110cd strobe output.

.4 Equivalent to Edwards Genesis Series Horns and Strobes.

.5 Provide protective wire cages in arena setting.

2.9 GRAPHIC ZONE MAP

.1 Provide a graphic zone map indicating the name and extents of each zone for installation adjacent to the main control panel and remote annunciator panel.

.2 Floor plan, graphic style at: 1:200 scale, include:

- .1 Building Outline
- .2 Entrance and exit locations.
- .3 “You are here” indications.
- .4 Zone Boundaries.
- .5 North Arrow.
- .6 Stairwells
- .7 Elevators

.3 Construct graphic in black on white non-fade medium. (Do not use ink as it will fade).

.4 Address (Zone) wording to correspond to panel annunciator wording.

.5 Upper case mechanically printed lettering. Sized for each reading.

.6 Building orientation to suit exact building layout when viewed from front.

.7 Building outline and zone boundaries to be distinguished by line thicknesses, line types, etc.

.8 Set in polished metallic frame with mark resistant Lexan overall cover.

.9 Suitable for screw fixing to wall.

.10 Submit PDF copy of graphic drawing for Engineer's approval prior to manufacturing.

2.10 SPARE PARTS

.1 Provide the following spare parts:

- .1 5 glass rods for pull stations

2.11 SYSTEM MANUFACTURES

.1 Acceptable manufacturers:

- .1 Edwards
- .2 Simplex

PART 3 EXECUTION

3.1 INSTALLATION

.1 Install systems in accordance with CAN-ULC-S524.

.2 Install main control panel and connect to ac power supply, ac dc standby power. Install unit so that alphanumeric display is between 1500 mm and 1700 mm A.F.F.

.3 Locate and install manual alarm stations and connect to the addressable loop.

.4 Locate and install detectors and connect them to the addressable loop. Do not mount detectors within 1 m of air outlets. Maintain at least 600 mm radius clear space on ceiling, below and around detectors.

.5 Connect addressable loops to main control panel.

.6 Locate and install horns and strobes and connect to signaling circuits.

.7 Connect signaling circuits to main control panel. Alternate signal circuits within floor space (i.e. circuit 'A' device adjacent to circuit 'B' device)

.8 Locate and wire door releasing devices.

.9 Install all wiring for fire alarm system monitoring, control and communication circuits in conduit. Minimum conduit size shall be 21 mm. All wiring must be clear of shorts, opens and grounds on completion of installation. All wires must be clearly identified at all termination points.

.10 Ensure wire and cable are copper conductors with insulation rated at 300 V minimum, as follows:

.1 Fire alarm addressable circuits shall be #18 AWG twisted shielded pair. Maximum allowable length of run (wire distance) must not exceed 762 m.

.2 Signal circuit: 300 V 105°C PVC insulated copper conductors. Minimum conductor size #12 AWG. Voltage drop must not exceed the maximum permissible value recommended by the manufacturer.

.3 All wiring to be in conduit, unless otherwise specified on Contract Drawings.

.11 Ground panel and conduits.

.12 Provide connection to security system for remote monitoring of 'alarm' and 'trouble'.

.13 All Fire Alarm devices shall have both the device and its base labelled with p-touch to indicate building (if in a campus), floor, column line, device type. i.e. device labelled as T2-5-G3-SD would indicate tower 2, floor 5, column G3, smoke detector. This description should also be indicated at the annunciator and control panel.

.14 All fire alarm work is to be logged in at the main security station by the contractor, and shall indicate the location of the work, a description of the work, and the name of the contractor performing the work.

.15 The installation contractor shall notify the building owner of verification times, so the owner can include their maintenance contractor in review.

3.2 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical and CAN/ULC S536.

.2 Fire alarm system:

.1 Test each device and alarm circuit to ensure manual stations, thermal and smoke detectors transmit alarm to control panel and actuate general alarm ancillary devices.

.2 Test to demonstrate correct operation of each interlock device, auxiliary device, and by-pass switches.

.3 Check annunciator panels to ensure zones are shown correctly.

.4 Simulate grounds and breaks on alarm and signaling circuits to ensure proper operation of trouble signals and the capability for providing a subsequent alarm during any imposed single circuit fault condition (open, ground).

.5 Perform the system verification and certification per Clause 3.3 "Verification and Certification".

3.3 CERTIFICATION AND VERIFICATION

.1 Verify system to "CAN-ULC-S537".

.2 Verification is the responsibility of the manufacturer for testing the wiring in relation to field devices operation.

.3 To avoid unnecessary alarms during testing, the system's program shall be capable of being temporarily disabled to disconnect only the audible signals that are being tested. Re-enable the zones after the testing is performed at the end of the day.

.4 Inspect and test wiring to every device to verify the removal of the device or breaking the wire will cause a trouble condition at the Control Panel.

.5 Inspect all equipment installed as part of the system for visible damage or tampering which may be a potential problem with its intended operation.

.6 Activate each manual initiating device to verify and ensure their proper operation.

.7 Test each self-restoring heat detector utilizing a heat source to test the device operation.

.8 Test each ionization smoke detector. Detector operation shall be tested by introducing "smoke" into the detector head.

.9 Test all audible signals for proper operation. Tests shall be made to determine that the signal is audible throughout the area and above the normal ambient noise level.

.10 Verify all field wiring and terminate on a single conductor per terminals basis.

.11 Test system annunciators to ensure proper operation correct zoning and visibility of window inscriptions. All lamps and indicators shall be tested for proper operation.

.12 Test all control equipment for proper operation. Inspect and test all cable terminals, plug connectors, plug-in modules circuitry, lamp sockets and controls to confirm that their mechanical and electrical connections and mounting are acceptable to confirm their electrical supervision.

.13 Test ancillary equipment connections. Inspect such equipment to ensure that faults and malfunctions will not interfere with the alarm system.

.14 Test the following control functions for proper supervision, operation and annunciation.

.1 The Central station connection.

.15 Only make changes to the system program or zone identifications as approved by authorized personnel.

.16 Notify and demonstrate the complete system to Owner's representative and Building Inspection's representatives only after testing and verification performances has been completed and all deficiencies rectified. In their presence, demonstrate the proper functioning of the system. Have system manufacturer's certified technician present.

.17 Upon completion of the inspection and when all of the above conditions have been performed and complied with, the manufacturer shall issue to the Owner's representative the following:

.1 A copy of the inspection report identifying the location of each device and certifying the test results of each device.

.2 A certificate of verification confirming that the inspection has been completed and outlining the conditions upon which such an inspection and certification have been rendered.

.3 Proof of liability insurance for the inspection.

.18 All costs involved in this inspection for both the manufacturer's and the Contractor's work shall be included in the overall tender price.

3.4 VERIFICATION RECORDS

.1 Complete accurate records of the verification shall be maintained with the following requirements but not limited to:

.1 Show the date on which each device and equipment has been verified.

.2 Show the date of all deficiencies encountered in the control system equipment, wiring and field devices.

.3 Show the date when the deficiencies have been corrected and re-verified.

.4 Show dB levels measured during verification.

3.5 MONITORING COMPANY

.1 Arrange and pay for remote monitoring by an authorized (ULC listed) firm (approved by the Owner) for transmission of signals over leased line. Include one year of monitoring. Owner to pay for leased line.

3.6 INTEGRATED SYSTEMS TESTING

.1 Following are tests required to show system integration with other systems. Initiate a fire alarm via a manual pull station verify the following:

.1 Alarm initiated.

.2 Elevators return to ground level.

.3 Signal sent to central alarm facility.

.4 Signal sent to security system.

.5 Alarm annunciates at fire control panel.

.6 Fire shutters release & close.

.7 Audible devices are operating.

.2 Verify connections to elevators. Coordinate all wiring and functionality with elevator system provider.

.1 Simulate activate of ground floor lobby smoke detector and verify that elevator returns to alternate floor.

END OF SECTION

GAS DETECTION SYSTEM

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

.1 Section 01 33 00 – Submittals

.2 Section 01 78 00 – Closeout Submittals

.3 Section 01 91 13 – Commissioning Requirements

.4 Section 26 05 00 – Common Work Requirements Electrical

.5 Section 26 90 00 – Wiring of Equipment Supplied by Others

1.2 SUBMITTALS

.1 Submit the following in accordance with 01 33 00 – Submittal Procedures:

.1 PDF shop drawings and product data.

.2 Descriptive System Document for all devices / wiring circuits to be installed in hazardous locations, in accordance with OESC rule 18-066 1) and Appendix F.

.3 Items as required in Section 26 05 00 – Common Work Requirements Electrical.

.2 Submit verification test report in accordance with 01 78 00 – Closeout Submittals.

1.3 MAINTENANCE DATA

.1 Provide maintenance data for incorporation into Operating and Maintenance manual.

1.4 SCOPE OF WORK

.1 Supply, install MSA Gas Detectors or approved alternative, for the monitoring of Oxygen, Methane, Hydrogen Sulphide, Carbon Monoxide gas concentration.

.2 Supply and install horn/strobe units to annunciate zone and main gas detection alarms.

.3 Gas sensors units will initiate a horn/strobe combination in locally effected zones. Materials and installation for industrial control devices including pushbutton stations, control and relay panels.

PART 2 PRODUCTS

2.1 GAS DETECTION SENSORS

.1 Supply and install MSA Ultima X5000 sensor/transmitters or acceptable alternative for Oxygen, Methane, Hydrogen Sulphide, Carbon Monoxide detection as shown in Contract Drawings.

.1 Certified to UL and CSA requirements for Class 1, Div. 1 Group B, C, and D.

.2 Ranges to be 0-500 ppm of CO, 0-100ppm of H2S, 0-25% of O2, and 0-100% LEL of combustibles.

.3 Two alarm Levels

.4 Time Delays

.5 Integrated LCD Display

.6 LCD Display and keypad

.7 Audible and Visual Indicator

.8 Explosion-Proof Housings for devices installed in hazardous locations

.9 Microprocessor-based operating system

.10 Electrochemical Cell for CO concentration and H2S, battery type for O2, and catalytic for combustibles.

2.2 HORN/STROBE (EXPLOSION PROOF)

.1 Supply and install Horn/Strobe unit or combination as shown in Contract Drawings.

.1 Operates with 24VAC

.2 Minimum 80dB, Max 100 dB

.3 80 flashes/min.

.4 Adjustable 15/75 candela

.5 Rated for Class 1, Div 2, Group D

.6 Wall mounted

.7 Amber strobe lens

.8 Strobe and horn to be distinguishable from fire alarm.

2.3 HORN/STROBE

.1 Supply and install Horn/Strobe unit or combination as shown in Contract Drawings.

.1 Operates with 24VAC

.2 Minimum 80dB, Max 100 dB

.3 80 flashes/min.

.4 Adjustable 15/75 candela

.5 Rated for unclassified areas

.6 Wall mounted

.7 Amber strobe lens

.8 Strobe and horn to be distinguishable from fire alarm.

2.4 120/24V AC TRANSFORMER

.1 Supply and install 120/24VAC, 300VA transformer to be used for power supply as show in Contract Drawings.

PART 3 EXECUTION

3.1 INSTALLATION

.1 Follow manufacturers installation directions/requirements and drawings.

.2 Commissioning to be performed by authorized technician.

.3 Provide calibration sheets and technicians inspection report to engineer.

3.2 OPERATING SEQUENCE

.1 Activate external, zone horn/strobe units with contacts from each individual sensor, in the event of a low alarm, according to logic and levels found in Contract Drawings. Groups of sensors in a common zone will activate a single, external horn/strobe unit within the zone.

END OF SECTION

DIVISION 28 INDEX

DIVISION 31 INDEX

AGGREGATE MATERIALS

PART 1 GENERAL

1.1 RELATED SECTIONS

.1 Section 01 33 00 - Submittal Procedures.

.2 Section 31 23 33 – Excavating, Trenching and Backfilling.

.3 Section 32 11 16 – Granular Sub-Base

.4 Section 32 11 23 – Aggregate Base Courses.

1.2 REFERENCES

.1 American Society for Testing and Materials (ASTM International).

.1 ASTM D4791, Standard Test Method for Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate.

.2 Ontario Provincial Standard Specifications (OPSS):

.1 OPSS MUNI 1002 – Material Specification for Aggregates – Concrete

.2 OPSS MUNI 1004 – Material Specification for Aggregates – Miscellaneous

.3 OPSS MUNI 1010 – Material Specification for Aggregates – Base, Subbase, Select Subgrade, and Backfill Material

1.3 SOURCE QUALITY CONTROL

.1 Source of materials to be incorporated into work or stockpiles requires approval.

.2 Inform Contract Administrator of proposed source of aggregates and provide access for sampling at least 4 weeks prior to commencing production.

.3 If, in opinion of Contract Administrator, materials from proposed source do not meet, or cannot reasonably be processed to meet, specified requirements, locate an alternative source or demonstrate that material from source in question can be processed to meet specified requirements.

.4 Should a change of material source be proposed, advise Contract Administrator 4 weeks in advance of proposed change to allow sampling and testing.

.5 Acceptance of material at source does not preclude future rejection if it is subsequently found to lack uniformity, or if its field performance is found to be satisfactory.

1.4 SAMPLES

.1 Aggregate will be subject to continual sampling by Contract Administrator during production.

.2 Provide Contract Administrator with access to source and processed material for sampling and testing.

.3 Bear the cost of sampling and testing of aggregates which fail to meet specified requirements.

PART 2 PRODUCTS

2.1 MATERIALS

.1 Aggregate quality: sound, hard, durable material free from soft, thin, elongated or laminated particles, organic material, clay lumps or minerals, or other substances that would act in deleterious manner for use intended.

.2 Flat and elongated particles of coarse aggregate: to ASTM D4791.

.1 Greatest dimension to exceed five times least dimension.

.3 Fine aggregates satisfying requirements of applicable section to be one, or blend of following:

.1 Natural sand.
.2 Manufactured sand.
.3 Screenings produced in crushing of quarried rock, boulders, gravel or slag.

.4 Coarse aggregates satisfying requirements of applicable section to be one of or blend of following:

.1 Crushed rock or slag.
.2 Gravel and crushed gravel composed of naturally formed particles of stone.

.5 Granular ‘A’ as per OPSS MUNI 1010.

.6 Granular ‘B’ Type II as per OPSS MUNI 1010.

.7 19mm Clear Stone Type II to OPSS MUNI 1004.

.8 Rip Rap as per OPSS MUNI 1004

PART 3 EXECUTION

3.1 DEVELOPMENT OF AGGREGATE SOURCE

.1 Contractor to produce aggregates off site.

.2 Contractor to develop aggregate source to prevent contamination of aggregates stockpiled.

3.2 PROCESSING

.1 Process aggregate uniformly using methods that prevent contamination, segregation and degradation.

.2 Blend aggregates, if required, to obtain gradation requirements, percentage of crushed particles, or particle shapes, as specified. Use methods and equipment approved by Contract Administrator.

.3 Wash aggregates, if required to meet specifications. Use only equipment approved by Contract Administrator.

.4 When operating in stratified deposits use excavation equipment and methods that produce uniform, homogeneous aggregate.

3.3 HANDLING

.1 Handle and transport aggregates to avoid segregation, contamination and degradation.

3.4 STOCKPILING

.1 Stockpile aggregates on site in locations as indicated unless directed otherwise by Contract Administrator. Do not stockpile on completed pavement surfaces.

.2 Stockpile aggregates in sufficient quantities to meet Project schedules.

.3 Stockpiling sites to be level, well drained, and of adequate bearing capacity and stability to support stockpiled materials and handling equipment.

.4 Except where stockpiled on acceptably stabilized areas, provide compacted sand base not less than 300 mm in depth to prevent contamination of aggregate. Stockpile aggregates on ground but do not incorporate bottom 300 mm of pile into work.

.5 Separate different aggregates by strong, full depth bulkheads, or stockpile far enough apart to prevent intermixing.

.6 Do not use intermixed or contaminated materials. Remove and dispose of rejected materials as directed by Contract Administrator within two (2) working days of rejection.

.7 Stockpile materials in uniform layers of thickness as follows:

- .1 Max 1.0 m for coarse aggregate and base course materials.
- .2 Max 2.0 m for fine aggregate and sub-base materials.
- .3 Max 1.5 m for other materials.

.8 Complete each layer over entire stockpile area before beginning next layer.

.9 Uniformly spot-dump aggregates delivered to stockpile in trucks and build up stockpile as specified.

.10 Do not cone piles or spill material over edges of piles.

.11 Do not use conveying stackers.

.12 During winter operations, prevent ice and snow from becoming mixed into stockpile or in material being removed from stockpile.

3.5 CLEANING

.1 Leave aggregate stockpile site in tidy, well drained condition, free of standing surface water.

.2 Leave any unused aggregates in neat compact stockpiles as directed by Contract Administrator.

END OF SECTION

CLEARING AND GRUBBING

PART 1 GENERAL

1.1 RELATED SECTIONS

.1 Section 01 35 43 - Environmental Procedures.

.2 Section 31 23 16.26 - Rock Removal.

.3 Section 31 23 33.01 - Excavation, Trenching and Backfilling.

.4 Section 8 – Natural Heritage Report

1.2 DEFINITIONS

.1 Clearing consists of cutting off trees and brush vegetative growth to not more than a specified height above ground and disposing of felled trees, previously uprooted trees and stumps, and surface debris.

.2 Close-cut clearing consists of cutting off standing trees, brush, scrub, roots, stumps and embedded logs, removing at, or close to, existing grade and disposing of fallen timber and surface debris.

.3 Clearing isolated trees consists of cutting off to not more than specified height above ground of designated trees, and disposing of felled trees and debris.

.4 Underbrush clearing consists of removal from treed areas of undergrowth, deadwood, and trees smaller than 50 mm trunk diameter and disposing of all fallen timber and surface debris.

.5 Grubbing consists of excavation and disposal of stumps and roots boulders and rock fragments of specified size to not less than a specified depth below existing ground surface.

1.3 QUALITY ASSURANCE

.1 Safety Requirements: worker protection.

.1 Workers must wear gloves, dust masks, eye protection, protective clothing, when applying herbicide materials.

.2 Workers must not eat, drink or smoke while applying herbicide material.

.3 Clean up spills of preservative materials immediately with absorbent material and safely discard to landfill.

1.4 STORAGE AND PROTECTION

.1 Prevent damage to fencing, trees, landscaping, natural features, bench marks, existing buildings, existing pavement, utility lines, site appurtenances, water courses, root systems of trees which are to remain.

.2 Repair any damaged items to approval of Contract Administrator. Replace any trees designated to remain, if damaged, as directed by Engineer /Architect.

1.5 WASTE MANAGEMENT AND DISPOSAL

.1 Consider felled timber from which saw logs, pulpwood, posts, poles, ties, or fuel wood can be produced as saleable timber.

.2 Trim limbs and tops, and saw into saleable lengths. Stockpile adjacent to site.

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION

3.1 PREPARATION

.1 Inspect site and verify with Contract Administrator, items designated to remain.

.2 Locate and protect utility lines. Preserve in operating condition active utilities traversing site:

.1 Notify Contract Administrator immediately of damage to or when unknown existing utility lines are encountered.

.2 When utility lines which are to be removed are encountered within area of operations, notify Contract Administrator in ample time to minimize interruption of service.

.3 Notify utility authorities before starting clearing and grubbing.

.4 Keep roads and walks free of dirt and debris.

3.2 CLEARING

.1 Clearing includes felling, trimming and cutting of trees into sections and satisfactory disposal of trees and other vegetation designated for removal, including downed timber, snags brush and rubbish occurring within cleared areas.

.2 Clear as directed by Contract Administrator, by cutting at a height of not more than 300 mm above ground. In areas to be subsequently grubbed, height of stumps left from clearing operations to be not more than 1000 mm above ground surface.

.3 Cut off branches and cut down trees overhanging area cleared as directed by Contract Administrator.

.4 Cut off unsound branches on trees designated to remain as directed by Contract Administrator.

3.3 CLOSE CUT CLEARING

.1 Close cut clearing to ground level.

.2 Cut off branches down trees overhanging area cleared as directed by Contract Administrator.

.3 Cut off unsound branches on trees designated to remain as directed by Contract Administrator.

3.4 ISOLATED TREES

.1 Cut off isolated trees as directed by Contract Administrator at height of not more than 300mm above ground surface.

.2 Grub out isolated tree stumps.

.3 Prune individual trees as indicated.

.4 Cut limbs and branches to be trimmed close to bole of tree and main branches.

.5 Paint cuts more than 3 cm in diameter with approved tree wound paint.

3.5 UNDERBRUSH CLEARING

.1 Clear underbrush from areas as indicated at ground level.

3.6 GRUBBING

.1 Remove and dispose of roots larger than 7.5 cm in diameter, matted roots and designated stumps from indicated grubbing area.

.2 Grub out stumps and roots to not less than 200 mm below ground surface.

.3 Grub out visible rock fragments and boulders, greater than 300 mm in greatest dimension, but less than 0.25 m^3.

.4 Fill depressions made by grubbing with suitable material and to make new surface conform with existing adjacent surface of ground.

3.7 REMOVAL AND DISPOSAL

.1 Remove cleared and grubbed materials off site.

.2 Cut timber greater than 125 mm diameter to 3000mm lengths and stockpile as indicated. Unless otherwise notified, stockpiled timber becomes property of the Owner.

.3 Dispose of cleared and grubbed materials off site.

.4 Remove diseased trees identified by Contract Administrator and dispose of this material to approval of Contract Administrator.

3.8 FINISHED SURFACE

.1 Leave ground surface in condition suitable for immediate grading operations stripping of topsoil to approval of Contract Administrator.

3.9 CLEANING

.1 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

ROUGH GRADING

PART 1 GENERAL

1.1 RELATED SECTIONS

.1 Section 31 11 00 - Clearing and Grubbing.

.2 Section 31 23 16 - Rock Removal.

.3 Section 31 23 33 - Excavation, Trenching and Backfilling.

1.2 REFERENCES

.1 American Society for Testing and Materials (ASTM)

.1 ASTM D698, Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (600kN-m/m^3),

1.3 EXISTING CONDITIONS

.1 Examine subsurface investigation report which is available for inspection from Contract Administrator.

.2 Known underground and surface utility lines and buried objects are as indicated on site plan. Contractor to verify all utilities prior to commencing construction.

.3 Refer to dewatering in Section 31 23 33.01 - Excavating Trenching and Backfilling.

1.4 PROTECTION

.1 Protect and/or transplant existing fencing trees, landscaping, natural features, bench marks, buildings, pavement, surface or underground utility lines which are to remain as directed by Contract Administrator. If damaged, restore to original or better condition unless directed otherwise.

.2 Maintain access roads to prevent accumulation of construction related debris on roads.

PART 2 PRODUCTS

2.1 MATERIALS

.1 Fill material: Select subgrade material or granular material as per Type 3 in accordance with of Section 31 23 33 - Excavating, Trenching and Backfilling.

.2 Excavated or graded material existing on site may be suitable to use as fill for grading work if approved by Contract Administrator.

PART 3 EXECUTION

3.1 STRIPPING OF TOPSOIL

.1 Do not handle topsoil while in wet or frozen condition or in any manner in which soil structure is adversely affected as determined by Contract Administrator.

.2 Commence topsoil stripping of areas as indicated after area has been cleared of brush, weeds and grasses and removed from site.

.3 Strip topsoil to depths as indicated. Avoid mixing topsoil with subsoil.

.4 Stockpile in locations as directed by Contract Administrator. Stockpile height not to exceed 2 m.

.5 Dispose of unused topsoil as directed by Contract Administrator.

.6 Contain all soil piles with erosion control measures, mitigate all soil erosion.

3.2 GRADING

.1 Rough grade to levels, profiles, and contours allowing for surface treatment as indicated.

.2 Rough grade to following depths below finish grades:

.1 250mm for concrete slabs and walks precast paving units.

.3 Slope rough grade away from building 1:50 minimum.

.4 Grade ditches to depth as indicated.

.5 Prior to placing fill over existing ground, scarify surface to depth of 150 mm. Maintain fill and existing surface at approximately same moisture content to facilitate bonding.

.6 Compact filled and disturbed areas to corrected maximum dry density to ASTM D698, as follows:

.1 95% SPD under landscaped areas.

.2 100% SPD under paved and walk areas.

.7 Do not disturb soil within branch spread of trees or shrubs to remain.

3.3 TESTING

.1 Inspection and testing of soil compaction will be carried out by testing laboratory designated by Contract Administrator. Refer to Sections 01 29 83 - Payment Procedures for Testing Laboratory Services and 01 45 00 – Quality Control.

.2 Submit testing procedure, frequency of tests, to Contract Administrator for approval.

3.4 SURPLUS MATERIAL

.1 Contractor shall manage excess materials in accordance with On-Site and Excess Soil Management, O.Reg. 406/19. Remove surplus material and material unsuitable for fill, grading or landscaping off site.

END OF SECTION

ROCK REMOVAL

PART 1 GENERAL

1.1 RELATED SECTIONS

.1 Section 01 33 00 - Submittal Procedure.

.2 Section 01 35 43 – Environmental Protection

.3 Section 01 56 00 - Temporary Barriers and Enclosures.

.4 Section 01 35 29.06 - Health and Safety Requirements.

.5 Section 02 23 40 – Vibration Monitoring.

.6 Section 31 23 33.01 - Excavating, Trenching and Backfilling.

1.2 DEFINITION

.1 Rock: any solid material in excess of 2.0m^3 and which cannot be removed by means of mechanical excavating equipment having 1.95m^3 bucket. Frozen material not classified as rock.

1.3 MEASUREMENT PROCEDURES

.1 Rock removal quantities for building excavation, trench excavation, etc. will be considered inclusive to the work and will not be measured for any other purpose other than documenting as-built conditions.

.1 Contractors shall provide all survey equipment needed and provide assistance to Owner's Representative in taking cross sections. Sections shall be taken at 5 m intervals for mass and trench rock excavation. Sections will be submitted to contractor's site representative for verification. Additional sections shall be taken at points or significant change in elevation or at any other locations as determined by Owner's Representative. Contractor to schedule work to allow sufficient time for Owner's Representative to take necessary sections.

1.4 SUBMITTALS

.1 Submit to Owner's Representative and local authorities having jurisdiction for approval, written proposal of operations for removal of rock by mechanical means, blasting will not be accepted.

1.5 VIBRATION CONTROL

.1 Reduce ground vibrations to avoid damage to structures or remaining rock mass.

.2 Vibration monitoring shall be as per Specification 02 23 40.

PART 2 PRODUCTS [NOT USED]

PART 3 EXECUTION

3.1 PROTECTION

.1 Prevent damage to surroundings and injury to persons in accordance with Section 01 56 00 - Temporary Barriers and Enclosures. Sound warnings and display signs when blasting to take place.

.2 Monitor and repair any/all damage to surrounding infrastructure. Monitoring impacts as indicated in Vibration Monitoring section 01 35 43.

3.2 ROCK REMOVAL

.1 Co-ordinate this Section with Section 01 35 29.06 - Health and Safety Requirements.

.2 Remove rock to alignments, profiles, and cross sections in order to install work as indicated.

.3 Explosive blasting is not permitted.

.4 Use rock removal procedures to produce uniform and stable excavation surfaces. Minimize overbreak, and to avoid damage to adjacent structures.

.5 Excavate rock to horizontal surfaces.

.6 Scale, pressure wash and broom clean rock surfaces which are to bond to concrete.

.7 Excavate trenches to lines and grades to minimum of 300 mm below pipe invert indicated. Provide recesses for bell and spigot pipe to ensure bearing will occur uniformly along barrel of pipe.

.8 Cut trenches to widths as indicated.

.9 Remove boulders and fragments which may slide or roll into excavated areas.

.10 Correct unauthorized rock removal at no extra cost, in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.

3.3 DAMAGE

.1 Upon completion of blasting or immediately following the receipt of a complaint, a site condition survey shall be performed to determine if any damage has resulted. The Contractor shall record all incidents of any damage or injury, which shall be reported immediately in writing to the Contract Administrator. All other complaints shall be reported to the Contract Administrator in writing within 24

hours of receipt. Each complaint report shall include the name and address of the complainant, time received, and description of the circumstances that led to the complaint.

.2 The contractor shall be responsible for any and all damage caused by their choice of rock removal.

3.4 ROCK DISPOSAL

.1 Dispose of surplus removed rock off site. Dispose in locations acceptable to authorities having jurisdiction and Contract Administrator. The Contractor may be permitted to crush rock on site for use as Granular A or Granular B material if crushed material conforms to Section 31 05 16.

.2 Do not dispose removed rock into landfill. Material must be sent to appropriate location as approved by the Contract Administrator.

END OF SECTION

DEWATERING

PART 1 GENERAL

1.1 SUMMARY

.1 Comply with Division 1 – General Requirements.

.2 Section Includes:

.1 Control of groundwater and surface water.

.2 Monitoring of groundwater levels at the site.

.3 Monitoring water levels in existing neighbouring domestic water wells located within one kilometre of the site. Where required, supply water to affected wells at the City's expense.

.4 Monitoring for movement of existing structures.

.5 Discharge of drainage water from the site.

.6 Coordinating dewatering work with requirements of other trades and units of work affected by dewatering operations.

1.2 DESCRIPTION

.1 This section specifies requirements for dewatering procedures to stabilize ground and/or keep excavations dry during the construction of the works.

1.3 RELATED SECTIONS

.1 Section 01 33 00 - Submittals

.2 Section 31 23 33 – Excavating, Trenching and Backfilling

.3 Section 31 32 25 – Erosion and Sedimentation Control

.4 Section 31 62 16 – Shoring

.5 Section 33 05 13 – Manholes, Catchbasins, and Precast Structures

.6 Section 33 31 13 – Sanitary Sewers and Forcemains

1.4 DEFINITIONS

.1 Subgrade: Surface to which excavations are made for the purpose of construction of the Work in accordance with the Contract Documents. Subgrade as defined does not include additional depths of excavation that may be required or ordered to obtain suitable foundation conditions.

.2 Dewatering: Removal of water, groundwater as well as surface water, to facilitate construction of the specified works under dry conditions on a stable subgrade.

1.5 REFERENCES

.1 Geotechnical Design Report – Revision 1, Napanee Water Pollution Control Plant Expansion & Upgrade, 300 Water Street West, Napanee, ON, Thurber Engineering Ltd., June 5, 2024

.2 Draft Hydrogeological Report – Revision 1, Napanee Water Pollution Control Plant Expansion & Upgrade, 300 Water Street West, Napanee, ON, Thurber Engineering Ltd., July 24, 2024

.3 Draft Preliminary Geotechnical Design Report, Napanee Water Pollution Control Plant Expansion & Upgrade, Napanee, ON, Thurber Engineering Ltd., July 16, 2021

.4 Interim Draft, Hydrogeological Report, Napanee Water Pollution Control Plant Upgrades, Napanee, ON, Thurber Engineering Ltd., August 18, 2021

.5 Geotechnical Investigation, Upgrades to Wastewater Treatment Plant, 300 Water Street West, Napanee, ON, GHD, June 21, 2018

.6 Stage 2 Contract Soil Investigation, Town of Napanee Water Pollution Control Plant, J.D. Lee Engineering Ltd., October 1977

1.6 DEFINITIONS

.1 Dewatering: Removal of water, groundwater as well as surface water, to facilitate construction of the specified works under dry conditions on a stable subgrade.

1.7 PERMITS

.1 An application for a Permit To Take Water (PTTW) from the Ministry of the Environment, Conservation and Parks (MECP) has been submitted. The anticipated groundwater conditions and pumping rates are identified in the Hydrogeological Report (2025) the volumes are expected to exceed 400,000 L/day.

.2 The submitted Permit to Take Water application has been included in the Appendix to the Contract Documents for reference.

1.8 SUBMITTALS

.1 Submit detailed shop drawings of the proposed primary dewatering system in accordance with Section 01300, including but not limited to the locations and depths of the primary dewatering units, location and depth of piezometers (observation wells), details of pumping, discharge points, chemical analysis of the water as it pertains to:

.1 Relationship between dewatering equipment, new and existing structures, the excavation plan and excavation shoring systems.

.2 Location and dimensions of siltation ponds.

.3 Details of screens and filter media.

.4 Details of the recharge system.

.5 Location of monitoring points, frequency, data to be recorded, volumes pumped, etc.

.6 Shop drawings are to bear the seal and signature of a professional engineer licensed in the Province of Ontario.

.2 The Contractor cannot change the proposed dewatering system without the approval of the Contract Administrator.

.3 All design and shop drawings shall bear the signature and stamp of a Licensed Professional Engineer in the Province of Ontario with a demonstrated competence in this type of work.

1.9 PROTECTION AND DAMAGES

.1 Geotechnical investigations have been completed for the site and are attached to the Contract Documents. The Owner and Contract Administrator accept no responsibility for the accuracy of this information. Claims arising from the interpretation of available information will not be considered.

.2 The Contractor shall take full responsibility for the interpretation of available soils information for planning and execution of the dewatering work.

.3 Prevent damage to pipes, maintenance holes, other structures, ground cover and grades within and in the immediate vicinity of the area of work. Make good any damage.

.4 Rectify any and all damage caused to the excavated base and/or pipe bedding and other adjacent structures and slopes due to improper and/or inadequate dewatering to the satisfaction of the Contract Administrator and at no cost to the Owner.

.5 Prior to commencing the Work, the Contractor shall provide a precondition survey report using a specialized firm to checking adjacent structures and basements of residents, and provide a chemical analysis of nearby private wells. A report shall be submitted in accordance with Submittals 01 33 00.

.6 The Contractor shall submit a Dewatering contingency plan, which includes the supply of nearby residents with water wells potentially impacted by the Work with water, as well as any other mitigation measures.

1.10 QUALITY ASSURANCE

.1 Qualifications

.1 Due to the quantity of dewatering on site, the Contractor shall engage the services of a specialist dewatering subcontractor who has a minimum of 10 years experience in the design and construction of dewatering systems for projects of similar size and complexity.

1.11 SYSTEM DESCRIPTION

.1 Design and Performance Requirements

.1 The Contractor shall review the recommendations of the hydrogeologist's report and Permit to Take Water application in the Appendix to the Contract Documents for developing the Work of this Section.

.2 Engage a professional engineer with demonstrated competence to design, and to supervise construction, operation and maintenance of a dewatering system.

.3 Design, construct, operate, and maintain a dewatering system, to control groundwater. Consider also the lateral tracking of groundwater underneath existing structures.

.4 Co-ordinate with design and construction of excavation shoring systems, excavation and backfilling operations.

.5 Prevent surface run-off from entering excavations. Construct ditches, berms, and similar items as required to lead water away from excavation as shown on the drawings or as necessary. Do not allow silt laden run-off water to enter watercourses. Direct run-off flows to existing storm sewers, siltation ponds or catchment areas.

.6 Maintain groundwater level a minimum of 300 mm below subgrade level, or lower as may be required to permit placing geotextiles, subdrains, granular construction working surface, concrete, underground services and similar items on a firm dry undisturbed subgrade.

.7 Maintain groundwater at required level until:

.1 Structure/pipes are completely built where designed self-weight of structure resists the buoyancy forces.
.2 Backfilling to final grade is complete.

.8 Prevent destabilization, heaving, or shear failure of the sides and bottom of excavation.

.9 Prevent damage to, or displacement of, structures from groundwater pressures.

.10 Obtain the Contract Administrator's written consent prior to allowing a rise in groundwater level or prior to shutting down the dewatering operation.

.11 Repair or replace any structure or Works damaged due to dewatering at no expense to the Owner.

.2 Dewatering Discharge Requirements

.1 Provide appropriate filter screens so that no soil or foundation material is removed, and solids concentration of less than 5 ppm in the discharge water is achieved. Do not exceed solids concentration of 10 ppm at any time.

.2 Provide siltation controls at discharge locations to prevent excess sediment from leaving the construction site.

.3 Maintain siltation controls during construction period by removing silt build up from time to time to keep siltation controls functional.

.4 The Owner will carry out physical analysis of drainage water to establish conformance with local by-laws and provincial regulations. If directed by the Contract Administrator, treat the drainage water before discharging into existing storm sewer systems or watercourses.

.5 Provide discharge siltation ponds of the required size to allow for sufficient detention time so that the decanted water will meet all applicable Provincial regulations. Discharge all water from surface water collection and dewatering operations to the siltation ponds as required. This shall include all trench sump pump discharge water.

.6 Maintain the siltation ponds including the removal of sediment during the construction period, as necessary.

.7 Discharge drainage water to existing drainage outlet(s)/swale(s). Prevent erosion of existing outlets/swales by energy absorption devices, such as rock check dams.

1.12 SYSTEM REQUIREMENTS

.1 The Contractor is to determine, based on the geotechnical/hydrogeological report, the design of a primary dewatering system (wellpoints or eductors). The primary dewatering system must maintain the groundwater level at least 300 mm below the invert of the excavation or trench so that the excavation, pipe laying, construction of foundations, placement and compaction of bedding and backfill, etc. can be performed in the dry and in such a way as not to disturb or soften the foundation, native soils or fills already placed, and prevent uplift of any structure or underground service during, and after, construction.

.2 Maintain dewatering systems of sufficient capacity to keep the bottom of the excavation or trench dry and free of water at all times until the installation of the services has been completed.

.3 Install a secondary dewatering system consisting of perimeter ditches and/or ground contouring to prevent flow of surface runoff water into the excavation. As part of secondary dewatering system, provide also for pumping from sumps located within excavations to handle any surface run off or subsurface water entering the excavation, in spite of the primary and secondary dewatering systems in place.

.4 In all cases maintain a duplicate system of equal or greater capacity as emergency equipment, in case of breakdown of the dewatering systems in place.

.5 The dewatering system design will be the responsibility of the Contractor based on the soil information contained in their geotechnical/hydrogeological reports as well as the results of test pits.

PART 2 PRODUCTS

2.1 DEWATERING EQUIPMENT

.1 Pipes, wells, deep wells, well-points, pumps, electrical generators and other equipment as required.

.2 Standby pumps and generator with effective muffling devices to keep noise levels at or below background noise levels. In any event, do not exceed a noise level of 55 dB at adjacent structures at property lines.

PART 3 EXECUTION

3.1 FIELD PUMP TEST

.1 Perform a field pumping test prior to any excavation to ensure the adequacy of the primary dewatering system as proposed and as installed, to establish the rate of pumping to be used during various construction activities, and the rate of recharge when the primary dewatering system is shut off.

3.2 INSTALLATION AND MAINTENANCE

.1 Install and maintain the primary and secondary dewatering systems, and piezometers (observation wells).

.2 Install dewatering equipment and continuously dewater to the required level before proceeding to excavate.

.3 Take corrective measures as required to maintain groundwater at a sufficiently low level to meet the performance requirements.

.4 Flotation of Structures

.1 Maintain groundwater at a sufficiently low level to prevent damage to, or displacement of, structures by groundwater pressures.

.2 Protect completed structures or parts of completed structures that could suffer displacement or other damage as a result of dewatering equipment failure by providing:

.1 Standby dewatering equipment, connected directly to electrical generators, engaging automatically in the case of a power failure.

.2 A positive means by which the structures may be flooded with water to neutralize exterior hydraulic pressures.

.3 A combination of the two alternatives above.

.5 Design and Operate Dewatering Systems:

.1 To prevent the loss of ground as water is removed.
.2 To avoid inducing settlement or damage to existing facilities, completed Work, or adjacent property.
.3 To relieve artesian pressures and any resultant uplift of the bottom of the excavation.

.6 Standby power and equipment:

.1 Provide sufficient redundancy in each system to keep excavations free of water in the event of component failure.

.2 Provide 100 percent emergency power backup with automatic start-up and switchover in the event of electrical power failure.

.7 Maintain the dewatering systems in operation until a written authorization is given by the Engineer that the dewatering systems could be shut off.

.8 During the entire work, observe and record the elevation of the water levels in all observation wells daily. Submit the water level records to the Engineer each day.

.9 Do not remove any observation well except on written permission of the Engineer. Replace observation wells, which were damaged or destroyed within 24 hours.

.10 Conduct an assessment of the potential for dewatering induced settlement. Provide and operate devices or systems, including, but not limited to, reinjection wells, infiltration trenches and cut-off walls, as necessary in order to prevent damage to existing facilities, completed Work, and adjacent property.

.11 Securely support existing facilities, completed Work, and adjacent property which may be vulnerable to settlement due to dewatering operations. Support shall include, but not be limited to, bracing, underpinning, or compaction grouting.

.12 Install dewatering equipment and continuously dewater to allow for work.

.13 Take corrective measures as required to maintain groundwater at a sufficiently low level to allow for work.

3.3 DISPOSAL OF WATER

.1 Dispose of water from the excavation into a temporary sediment trap either in portable container and/or as per OPSD 219.180.

.2 Dispose of water removed from the excavation in such a way so that it will not be injurious to public health, private property or to any operation of the work completed or under construction under this contract or by others.

.3 Water from the dewatering system is not to be discharged to the sanitary sewer.

.4 Flow of water shall not be directed across or over pavements or sidewalks, except through approved pipes or properly designed and constructed methods.

.5 Water from the dewatering system may also be discharged directly to the existing Napanee WPCP provided all measures indicated in the Permit to take Water

application have been implemented, and approval from the Owner has been received.

3.4 REMOVAL OF PRIMARY DEWATERING SYSTEM

.1 Maintain the primary dewatering system until the excavation has been completely backfilled and compacted. Remove the primary dewatering system only on receipt of written authorization from the Contract Administrator to do so.

.2 Remove the primary dewatering system in stages to allow the groundwater level to rise at a controlled rate.

3.5 FIELD QUALITY CONTROL

.1 Monitor Groundwater Level

.1 Take readings of groundwater level twice a day for the duration of the dewatering period. Keep a written record of groundwater levels.

.2 Dewatering Discharge Volumes

.3 Take readings of daily flow rates due to dewatering for the duration of the dewatering period. Keep a written record of flow rates on site. Provide recorded flow rates to the Contract Administrator on a weekly basis.

.2 The Contractor shall be responsible to maintain all records as required by the Permit to Take Water.

END OF SECTION

EXCAVATION, TRENCHING AND BACKFILLING

PART 1 GENERAL

1.1 RELATED SECTIONS

.1 Section 31 05 16 – Aggregate Materials

.2 Section 31 23 19 – Dewatering

.3 Section 31 32 25 – Erosion and Sedimentation Control

.4 Section 33 05 13 – Precast Structures

.5 Section 33 31 13 – Sanitary Sewers and Forcemains

1.2 REFERENCES

.1 American Society for Testing and Materials (ASTM).

.1 ASTM C117, Standard Test Method for Material Finer Than 0.075 mm (No. 200) Sieve in Mineral Aggregates by Washing.

.2 ASTM C136, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.

.3 ASTM D422, Standard Test Method for Particle-Size Analysis of Soils.

.4 ASTM D698, Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3) (600 kN-m/m3).

.5 ASTM D1557, Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3) (2,700 kN-m/m3).

.6 ASTM D4318, Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

.2 Canadian General Standards Board (CGSB).

.1 CA/CGSB-8.2, Sieves, Testing, Woven Wire, Metric

.3 Canadian Standards Association (CSA)

.1 CAN/CSA-A3000, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).

.1 CSA-A3001, Cementitious Materials for Use in Concrete.

.2 CSA-A23.1/A23.2, Concrete Materials and Methods of Concrete Construction/ Methods of Test and Standard Practices for Concrete.

.4 Ontario Provincial Standard Specifications (OPSS) and Drawings (OPSD)

.5 O. Reg. 406/19: On-Site and Excess Soil Management made under the Environmental Protection Act, R.S.O. 1990, c. E.19

.6 Geotechnical Investigation – Refer to Section 7 of Tender Documents

1.3 DEFINITIONS

.1 Excavation classes: two classes of excavation will be recognized; common excavation and rock excavation.

.1 Rock excavation: excavation of material from solid masses of igneous, sedimentary or metamorphic rock which, prior to its removal, was integral with its parent mass, and boulders or rock fragments having individual volume in excess of 2 m^3. Frozen material not classified as rock. There shall be no compensation for boulder removal for boulders which can be removed by mechanical means with a 1.95 m^3 bucket.

.2 Common excavation: excavation of materials of whatever nature, which are not included under definitions of rock excavation.

.2 Unclassified excavation: excavation of deposits of whatever character encountered in work.

.3 Topsoil: material capable of supporting good vegetative growth and suitable for use in top dressing, landscaping and seeding.

.4 Waste material: excavated material unsuitable for use in work or surplus to requirements.

.5 Borrow material: material obtained from locations outside area to be graded, and required for construction of fill areas or for other portions of work.

.6 Unsuitable materials:

.1 Weak and compressible materials under excavated areas.

.2 Frost susceptible materials under excavated areas.

.3 Frost susceptible materials:

.1 Fine grained soils with plasticity index less than 10 when tested to ASTM D4318, and gradation within limits specified when tested to ASTM D422 and ASTM C136: Sieve sizes to CAN/CGSB-8.1.

Sieve Designation	%Passing
2.00 mm	100
0.10 mm	45-100
0.02 mm	10-80
0.005 mm	0-45

.2 Coarse grained soils containing more than 20% by mass passing 0.075 mm sieve.

1.4 SUBMITTALS

.1 Inform Contract Administrator at least 4 weeks prior to commencing work, of proposed source of fill materials and provide access for sampling.

.2 Submit 70 kg samples of type of fill specified including representative samples of excavated material.

.3 Ship samples as directed by Contract Administrator in tightly closed containers to prevent contamination.

1.5 QUALITY ASSURANCE

.1 Submit design and supporting data at least 2 weeks prior to commencing work.

.2 Design and supporting data submitted to bear stamp and signature of qualified professional engineer registered or licensed in the Province of Ontario.

.3 Keep design and supporting data on site.

.4 Do not use soil material until written report of soil test results are reviewed and approved by Contract Administrator.

1.6 EXISTING CONDITIONS

.1 Buried services:

.1 Before commencing work verify location of buried services on and adjacent to site.

.2 Arrange with appropriate authority for relocation of buried services that interfere with execution of work: pay costs of relocating services.

.3 Remove obsolete buried services within 2 m of foundations: cap cut-offs.

.4 Size, depth and location of existing utilities and structures as indicated are for guidance only. Completeness and accuracy are not guaranteed.

.5 Prior to commencing excavation work, notify applicable Owner or authorities having jurisdiction, establish location and state of use of buried utilities and structures. Owners or authorities having jurisdiction to clearly mark such locations to prevent disturbance during work.

.6 Confirm locations of buried utilities by careful test excavations.

.7 Maintain and protect from damage, water, sewer, gas, electric, telephone and other utilities and structures encountered as indicated.

.8 Where utility lines or structures exist in area of excavation, obtain direction of Contract Administrator before removing or re-routing.

.9 Record location of maintained, re-routed and abandoned underground lines.

.10 Confirm locations of recent excavations adjacent to area of excavation.

.2 Existing buildings and surface features:

.1 Conduct, with Contract Administrator condition survey of existing buildings, trees and other plants, lawns, fencing, service poles, wires, rail tracks, pavement, survey benchmarks and monuments which may be affected by work.

.2 Protect existing buildings and surface features from damage while work is in progress. In event of damage, immediately make repair to approval of Contract Administrator.

.3 Where required for excavation, cut roots or branches as approved by Contract Administrator.

PART 2 PRODUCTS

2.1 MATERIALS

.1 Type 1 fill: Granular 'A' as per OPSS 1010 and Section 31 05 16 - Aggregate Materials.

.2 Type 2 fill: Granular 'B' Type II as per OPSS.MUNI 1010 and Section 31 05 16 – Aggregate Materials.

.3 Type 3 fill: select subgrade material as per OPSS.MUNI 1010 from excavation or other sources, approved by Contract Administrator for use intended, unfrozen and free from rocks larger than 75 mm, cinders, ashes, sods, refuse or other deleterious materials.

.4 Geotextile: Type II Non-woven as per OPSS 1860.

.5 Clear stone per OPSS.MUNI 1010.

.6 Sand: Mortar sand or uniformly graded sand as per OPSS 1004.

.7 Unshrinkable fill: proportioned and mixed to provide:

.1 Maximum compressive strength of 0.4 MPa at 28 days.

.2 Maximum Portland cement content of 25 kg/m 3.

.3 Minimum strength of 0.07 MPa at 24 h.

.4 Concrete aggregates: to CSA-A23.1/A23.2,

.5 Cement: to CSA A3000, Type GU.

.6 Slump: 160 to 200 mm.

PART 3 EXECUTION

3.1 SITE PREPARATION

.1 Remove obstructions, ice and snow, from surfaces to be excavated within limits indicated.

3.2 PREPARATION/PROTECTION

.1 Keep excavations clean, free of standing water, and loose soil.

.2 Where soil is subject to significant volume change due to change in moisture content, cover and protect to Contract Administrator's approval.

.3 Protect natural and man-made features required to remain undisturbed. Unless otherwise indicated or located in an area to be occupied by new construction, protect existing trees from damage. Protect buried services that are required to remain undisturbed.

.4 Protect buried services that are required to remain undisturbed.

3.3 EROSION AND SEDIMENT CONTROL

.1 As per the requirements of Specification 31 32 25.

3.4 STRIPPING OF TOPSOIL

.1 Commence topsoil stripping of areas as indicated by Contract Administrator after area has been cleared of brush, weeds and grasses and removed from site.

.2 Strip topsoil to depths as indicated by Contract Administrator. Do not mix topsoil with subsoil.

.3 Stockpile in locations as directed by Contract Administrator. Stockpile height not to exceed 2 m.

.4 Dispose of unused topsoil off-site or as directed by Contract Administrator.

3.5 STOCKPILING

.1 Stockpile fill materials in areas designated by Contract Administrator. Stockpile granular materials in manner to prevent segregation.

.2 Protect fill materials from contamination.

3.6 COFFERDAMS, SHORING, BRACING AND UNDERPINNING

.1 Maintain side and slopes of excavations in safe condition by appropriate methods and in accordance with Occupational Health and Safety Act for the Province of Ontario.

.2 Design and construct temporary works to depths, heights and locations as required for new work.

.3 During backfill operation:

.1 Unless otherwise as indicated or as directed by Contract Administrator remove sheeting and shoring from excavations.

.2 Do not remove bracing until backfilling has reached respective levels of such bracing.

.3 Pull sheeting in increments that will ensure compacted backfill is maintained at an elevation at least 500 mm above toe of sheeting.

.4 When sheeting is required to remain in place, cut off tops at elevations as indicated.

.5 Upon completion of substructure construction:

.1 Remove cofferdams, shoring and bracing.

.2 Remove excess materials from site as indicated and as directed from Contract Administrator.

3.7 DEWATERING AND HEAVE PREVENTION

.1 Keep excavations free of water while work is in progress.

.2 Submit for Contract Administrator's review details of proposed dewatering or heave prevention methods, such as dikes, well points, and sheet pile cut-offs.

.3 Avoid excavation below groundwater table if quick condition or heave is likely to occur. Prevent piping or bottom heave of excavations by groundwater lowering, sheet pile cut-offs, or other means.

.4 Protect open excavations against flooding and damage due to surface run-off.

.5 Dispose of water in accordance with Section 01 35 43 - Environmental Procedures and in manner not detrimental to public and private property, or any portion of work completed or under construction.

.6 Provide flocculation tanks, settling basins, or other treatment facilities to remove suspended solids or other materials before discharging to storm sewers, water courses or drainage areas. Maximum allowable concentration of suspended solids in discharge shall be 25 mg/L TSS.

3.8 EXCAVATION

.1 Excavate to lines, grades, elevations and dimensions as indicated by Contract Administrator.

.2 Remove concrete, masonry, paving, walks, demolished foundations and rubble and other obstructions encountered during excavation. Dispose of material off site.

.3 Excavation must not interfere with bearing capacity of adjacent foundations.

.4 Do not disturb soil within branch spread of trees or shrubs that are to remain. If excavating through roots, excavate by hand and cut roots with sharp axe or saw.

.5 For trench excavation, unless otherwise authorized by Contract Administrator in writing, do not excavate more than 30 m of trench in advance of installation operations and do not leave open more than 15 m at end of day's operation.

.6 Keep excavated and stockpiled materials a safe distance away from edge of trench as directed by Contract Administrator.

.7 Restrict vehicle operations directly adjacent to open trenches.

.8 Dispose of surplus and unsuitable excavated material off site.

.9 Do not obstruct flow of surface drainage or natural watercourses.

.10 Earth bottoms of excavations to be undisturbed soil, level, free from loose, soft or organic matter.

.11 Notify Contract Administrator when bottom of excavation is reached.

.12 Obtain Contract Administrator approval of completed excavation.

.13 Remove unsuitable material from trench bottom to extent and depth as directed by Contract Administrator.

.14 Correct unauthorized over-excavation as follows:

.1 Fill under bearing surfaces and footings with concrete specified for footings.

.2 Fill under other areas with Type 2 fill compacted to not less than 95% of corrected maximum dry density.

.15 Hand trim, make firm and remove loose material and debris from excavations. Where material at bottom of excavation is disturbed, compact foundation soil to density at least equal to undisturbed soil. Clean out rock seams and fill with concrete mortar or grout to approval of Contract Administrator.

.16 Division 31 will complete all required trenching and backfilling required for work of Division 20, 26 and 44.

3.9 BUILDING SUBEXCAVATION

.1 Sub-excavate within entire footprint of the new building and beyond the footprint of the new building to a minimum geodetic elevation as shown on the drawings.

.2 Beyond the building footprint, sub-excavation shall extend a minimum of 500mm horizontally from the edge of the footing, and outwards as required to reach the existing grade at a slope as indicated in the geotechnical reports (Refer to Section 7).

3.10 FILL TYPES AND COMPACTION

.1 Use fill of types as indicated or specified below. Compaction densities are percentages of Standard Proctor Maximum Dry Densities (SPMDD) obtained from ASTM D698.

.1 Open excavation (basement) from demolition work or building sub-excavation:

.1 Type 2 fill, thickness as required, compacted to minimum 98% SPMDD, in maximum 300 mm thick lifts.

.2 New building sub excavation areas:

.1 Type 2 fill, thickness as required, compacted to minimum 98% SPMDD, in maximum 300 mm thick lifts.

.3 Slabs-on-grade for new structures:

.1 Type 2 fill, thickness as required to raise the floor subgrade, compacted to minimum 98% SPMDD, in maximum 300 mm thick lifts.

.2 Type 1 fill to underside of slab, minimum compacted thickness of 150 mm, compacted to minimum 98% SMPDD, in maximum 300 mm thick lifts.

.4 Footings founded on structural fill for new structures:

.1 Type 2 fill placed over undisturbed native soil, thickness as required to achieve design footing subgrade elevation (minimum compacted thickness of 200 mm), compacted to minimum 100% SPMDD, in maximum 300 mm thick lifts.

.2 Type 1 fill to underside of footing, minimum compacted thickness of 150 mm, compacted to minimum of 100% SPMDD, in maximum 300 mm thick lifts.

.5 Exterior side of perimeter walls for new structures:

.1 Type 2 fill for 1.0m beyond face of foundation wall, thickness as required to reach subgrade level, compacted to 95% SPMDD.

.2 Type 3 fill for other areas, thickness as required to reach subgrade level, compacted to 95% SPMDD.

.6 Subgrade:

.1 Compact existing subgrade under walkways, paving, and sidewalks to same compaction as fill above.

.7 Under grassed areas:

.1 Type 3 fill, thickness as required to reach underside of topsoil, compacted to 95% SPMDD.

.8 To correct over excavation in trenches:

.1 Type 2 fill to underside of Granular “A” bedding, compacted to 95% SPMDD.

3.11 BEDDING AND SURROUND OF UNDERGROUND SERVICES

.1 Place and compact granular material for bedding and surround of underground services as indicated.

.2 Place bedding and surround material in unfrozen condition.

3.12 BACKFILLING

.1 Vibratory compaction equipment: approved by Contract Administrator.

.2 Do not proceed with backfilling operations until Contract Administrator has inspected and approved installations.

.1 Areas to be backfilled to be free from debris, snow, ice, water and frozen ground.

.3 Do not use backfill material which is frozen or contains ice, snow or debris.

.4 Place backfill material in uniform layers not exceeding 150 mm compacted thickness up to grades indicated. Compact each layer before placing succeeding layer.

.5 Backfill around installations.

.1 Place bedding and surround material as specified elsewhere.

.2 Do not backfill around or over cast-in-place concrete within 24 hours after placing of concrete.

.3 Place layers simultaneously on both sides of installed work to equalize loading. Difference not to exceed 600 mm.

.4 Where temporary unbalanced earth pressures are liable to develop on walls or other structures.

.1 Permit concrete to cure for minimum 14 days or until it has sufficient strength to withstand earth and compaction pressure, and approval obtained from Contract Administrator, or

.2 If approved by Contract Administrator, erect bracing or shoring to counteract unbalance, and leave in place until removal is approved by Contract Administrator.

.6 Division 31 will perform required excavation, trenching and backfilling required for all Divisions. General Contractor to coordinate details of all Divisions to determine the extent of work to be provided.

3.13 RESTORATION

.1 Upon completion of work, remove waste materials and debris, trim slopes, and correct defects as directed by Contract Administrator.

.2 Replace topsoil as indicated by Contract Administrator.

.3 Reinstate lawns to elevation which existed before excavation.

.4 Reinstate pavement and sidewalks distributed by excavation to thickness, structure, and elevation which existed before excavation.

.5 Clean and reinstate areas affected by work as directed by Contract Administrator.

.6 Use temporary plating to support traffic loads over unshrinkable fill for initial 24 h.

.7 Protect newly graded areas from traffic and erosion and maintain free of trash and debris.

.8 Dispose of surplus material and material unsuitable for fill grading or landscaping off site.

3.14 FIELD QUALITY CONTROL

.1 Testing of materials and compaction of backfill and fill will be carried out by testing laboratory designated by Owner.

.2 Do not begin backfilling or filling operations until material has been approved for use by Contract Administrator.

.3 Not later than 48 hours before backfilling or filling with approved material, notify Contract Administrator to allow compaction tests to be carried out by testing agency designated by Owner.

3.15 SOIL MANAGEMENT AND EXCESS SOIL QUALITY

.1 Contractor shall manage excess materials in accordance with On-Site and Excess Soil Management, O. Reg. 406/19. All excess materials (including bituminous pavement, concrete, fabricated metal and plastic products, wood, masonry, pipes surplus or unsuitable excavated earth and rock, and other wastes not otherwise designated for salvage or Reuse by the Owner) shall be removed from the project area and properly transported and re-used or disposed of offsite.

.2 The contractor shall retain the services of a Qualified Person (QP) to complete in-situ or ex-situ soil characterization for the proposed excavation area by means of stock piling, and sampling to generate a soil characterization report in accordance with O. Reg. 406/19.

.3 Sampling shall include field screening of the soil samples for visual and olfactory evidence of impacts and for the presence of petroleum/volatile organic compound (VOC) – derived vapours using a combustible gas indicator (CGI) calibrated to hexane and a photo-ionization detector (PID) calibrated to isobutylene or equivalent. Use a combination of visual and olfactory observations and CGI/PID organic vapour readings to identify the most apparent worst-case samples for lab analysis.

.4 Submit apparent “worst-case” soil samples from each stockpile for bulk chemical analysis of petroleum hydrocarbons (PHCs) in the F1 to F4 fraction ranges, metals (including Hydrides), electrical conductivity (EC) and sodium adsorption ratio (SAR). Samples to be sent to a laboratory accredited by the Standards of Council of Canada and the Canadian Association for Laboratory Accreditation.

.5 Submit two representative soil samples for laboratory analysis of pH;

.6 The Contractor shall be responsible for the On-Site and Off-Site deposit of Excess Soils from the Project Area and will be responsible for executing the requirements of the Reuse Site in relation to import of Excess Soils originating from another site. This shall include all necessary sampling, documentation, and reporting to support placement of material at the Reuse Site(s) including the identified submittals. If required, the Contractor will be responsible to supply the necessary planning documents for a notice on the Registry as identified in O.Reg. 406/19, to be prepared by the contractor’s Qualified Person (QP).

.7 All excess material shall be transported to the Reuse Site(s) to be identified by the Contractor and approved by the QP. The contract administrator shall review and accept the proposed Reuse Site(s) in advance of any excavation work. The Contractor shall obtain written consent from the operator/owner of the Off-Site Reuse Site(s) at which the Excess Soils will be deposited prior to the initiation of construction operations.

.8 The Contractor shall develop and submit a plan for the transportation, disposal and tracking of Excess Soils. The plan shall list all carriers who will haul the soil to the Reuse Site(s) to be identified by the Contractor and approved by the QP. The contract administrator shall review the plan and list of carriers in advance of any excavation work. The plan shall also include details to meet the tracking requirements identified under O.Reg. 406/19.

.9 The Contractor shall comply with the requirements outlined in a Fill Management Plan, should it exist for the Reuse Site, Excess Soil Destination Assessment Report and/or site-specific Instrument of the Reuse Site where Excess Soil will be placed, as applicable.

.10 The Contractor shall determine the consistency, quality, and quantity of excavated material generated as a result of construction activities. Unless otherwise designated, the QP shall undertake any required additional sampling and testing of the excavated materials supplemental to the previous environmental sampling and to evaluate the suitability for Reuse either within the Project Area or at an Off-Site Reuse Site.

END OF SECTION

BRACING AND SHORING

PART 1 GENERAL

1.1 SCOPE

.1 This specification covers the requirements for the design, supply, placement, maintenance, and removal or abandonment of temporary support systems required to permit the excavation and backfilling of trenches or excavations for the installation of underground utilities and any other specified subsurface construction.

.2 This specification also covers the requirements for the design, placement, maintenance, and removal or abandonment of temporary support systems required to permit the construction of below grade structures and/or foundations for building structures.

.3 Shoring is mandatory where indicated and, in all areas, where excavation will potentially undermine existing structures, pipes, conduits, utilities or roadways.

.4 Subject to paragraph 1.1.3, it will be the Contractor's decision whether to carry out general excavation in open cut or to use shoring system to conserve space and/or control groundwater infiltration.

1.2 RELATED SECTIONS

.1 Division 1 – General Requirements

.2 Section 02 23 40 – Vibration Monitoring

.3 Section 03 30 00 – Cast-in Place Concrete

.4 Section 31 23 19 – Dewatering

.5 Section 31 23 33 – Excavating, Trenching and Backfilling

1.3 REFERENCES

.1 Occupational Health and Safety Act, R.S.O. 1990, c.O.1, as amended.

.2 Ontario Regulation 213/91 – Regulations for Construction Projects, as amended.

.3 OPSS 404 – Construction Specification for Support Systems.

.4 OPSS 539 – Construction Specification for Temporary Protection Systems.

.5 CSA G30.18-21 - Carbon Steel Bars for Concrete Reinforcement -

.6 CSA G40.20-13/G40.21-13 (R2018) - General requirements for rolled or welded structural quality steel / Structural quality steel.

.7 CSA A23.1/A32.2-19 - Concrete Materials and Methods of Concrete Construction / Test Methods and Standard Practices for Concrete

.8 CSA W59-18 – Welded Steel Construction (Metal Arc Welding)

1.4 RESPONSIBILITY FOR SHORING SYSTEM

.1 Engage a professional engineer, registered in the Province of Ontario, who has demonstrated competence in shoring and underpinning work, to design and supervise construction of temporary structures required to execute construction of permanent Works.

.2 Take full responsibility for design, supply, placement, installation, maintenance and where applicable removal of shoring system.

.3 Comply with all safety requirements of The Occupational Health and Safety Regulations and Ontario Building Code.

1.5 DESIGN OF SHORING SYSTEM

.1 Design excavation shoring and/or underpinning systems based on recognized geotechnical and structural theories and principles and site conditions encountered. Undertake additional geotechnical site investigation for design of the shoring system and/or underpinning at no extra cost to the Owner.

.2 Design shoring system for all applicable lateral pressures from soil and groundwater, including unsymmetrical surcharge loads from construction operations and frost action on retained soil.

.3 Design shoring system such that intermediate bracing members, walers or struts will not interfere with permanent structure. All below grade structures are to be complete with ground level slabs, and other bracing elements prior to backfill.

.4 Design bracing to be fully effective at all stages of construction. Pre-stress bracing, if required, to control deflection.

.5 Design underpinning and temporary supports for existing structures and/or utilities to safely resist all loads including loads which may be imposed as a result of construction operations.

.6 Where shoring system retains materials which provides support for foundations at a higher level, design to limit deflections so that foundation materials are not disturbed or weakened. Design lateral pressures to be determined based on at-rest soil pressures. Limit total deflection to 20 mm horizontally.

.7 Co-ordinate design of shoring system with design of dewatering system to meet performance requirements specified herein.

.8 Locate all yard piping, services, conduit, structures, etc., in the area of the excavation. Assume all items found are live and are to be kept live unless specifically noted otherwise. Take precautions necessary to ensure that there is no damage to existing buried services, piping, conduit, structure, etc., during the shoring and excavation work.

1.6 METHOD STATEMENT

.1 Submit method statements for the construction sequence and duration of all main activities including any ground treatment that may be required to construct without the use of active dewatering at least fifteen (15) days prior to the commencement of the Works.

1.7 COORDINATION

.1 Coordinate design of temporary shoring system with the design of dewatering system in Section 31 23 19 – Dewatering.

1.8 SHORING PERFORMANCE REQUIREMENTS

.1 General Requirements

.1 Construct substantially watertight excavation shoring systems suitable for geotechnical conditions encountered and which will meet all requirements of these performance specifications. Prevent destabilization of subgrade, migration of soil fines, damage to any structure and/or works. Prevent disturbance, displacement or damage, to sides and bottom of excavation, to new and existing structures, pipelines, utilities, roads, embankments, etc. at any stage of construction of works. Prevent destabilization or failure of bottom of excavation from shear, heave, piping and boiling, groundwater pressure or any other cause.

.2 Review Utilities drawings and Site Survey, available from the Engineer showing site information and configuration of existing buildings and services.

.3 Prior to beginning work on the site, confirm location of all underground services and structures, and arrange work to prevent damage to any services or structures.

.4 Provide adequate space for access for installation of formwork and inspection.

.2 Watertightness

.1 Shoring system to be watertight to the extent that any dewatering required inside the excavation shall not lower the water table on outer side of the shoring system.

.3 Tolerances

.1 Install shoring so that, exclusive of temporary walers or bracings, no part of temporary structure to be left in place above the bottom of the

excavation in its deflected position will reduce the concrete wall thicknesses to below the dimensions indicated.

.2 If the shoring installation does not satisfy these requirements, alter it, at no extra cost to Owner, until it meets the requirements.

.3 The maximum permitted deviation of the finished pile from the vertical at any level is 1 in 200.

.4 Lateral deflection limit

.1 Performance of temporary shoring systems shall be performance level 1a as described in OPSS 539.

.5 Monitoring Deflection

.1 The contractor shall hire a monitoring contractor with at least five years' experience in precision survey monitoring that can demonstrate having performed at least 10 projects of similar scope, magnitude and complexity to develop and execute a precision survey program for monitoring movement at the top of the shoring wall. The system shall achieve an accuracy of plus/minus 2 mm at each measurement point.

.2 The monitoring contractor is responsible for developing the system to meet 2 mm accuracy but the system at a minimum meet the following criteria:

.1 Monitoring points are to be spaced no more than 3 m apart and at all critical locations.

.2 Movement in the x, y and z direction must be measured at each point.

.3 The surveying instrument shall be a Leica TCA 1800 or equal. The manufacturer's published accuracy must be at least one second angular resolution with plus minus 1 mm electronic distance measurement at 100 m distance.

.3 Readings shall be recorded twice weekly until the excavation is no longer open.

.4 Reports shall show movement in both at a tabulated and graphical format. The owner's representative to approve the reporting format prior to start of the work.

.5 Data is to be reported weekly, but immediately if any unusual movements occur.

1.9 SUBMITTALS

.1 Submit shop drawings at least fifteen (15) days before commencement of shoring Works for temporary structures including both shoring and bracing systems. Shop drawing to bear seal and signature of a Professional Engineer, registered in the Province of Ontario, who has carried out the design and who will provide construction supervision of temporary structures.

.2 Indicate on shop drawings the following:

.1 Dimensions and elevations

.2 Relationship to new and existing structures and utilities

.3 Material designations, grades, sizes, mix design, etc.

.4 Temporary struts and walers etc., their relationship to permanent structure and schedule for removal3

.5 Permanent tie backs locations, size and embedment.

.6 Deflections of shoring members when deflection limitations have been specified in this Section.

.7 Design loads, design assumptions, surcharge loads and all loading restrictions.

.8 Identification of Shoring Engineer of record who will be responsible for design calculations, checking of shop drawings, inspection and supervision of fabrication and installation, and filing of reports with the appropriate authorities and the Owner.

.9 Complete field instructions required during installation and any other pertinent information.

.10 Schedule for removal of temporary struts and walers.

.3 Submittal of shop drawings for such temporary structures is for record purposes. The Engineer will not review or check such shop drawings for structural adequacy. Take the full responsibility for design, supplying, placing installation and maintenance.

1.10 QUALITY CONTROL

.1 Provide a system of quality control to ensure that the minimum standards specified herein are attained.

.2 Bring to the attention of Engineer any defects in the work or departures from the Contract Documents which may occur during construction. The Engineer will decide upon corrective action and state recommendations in writing.

.3 The Engineer’s general review during construction and inspection and testing by Independent Inspection and Testing Companies reporting to the Engineer are both undertaken to inform the Owner of the Contractor’s performance and shall in no way augment the Contractor’s quality control or relieve him of contractual responsibility.

1.11 QUALITY ASSURANCE

.1 Engage a Professional Engineer, licensed in Ontario, to design, supervise installation of, and inspect all temporary structures for the duration of construction.

.2 Utilize only personnel with demonstrated competence and experience to install temporary structures.

.3 Welder: CSA W47.1 certified.

PART 2 PRODUCTS

2.1 MATERIALS

.1 Concrete Mixes and materials

.1 CSA A23.1/A23.2

.2 Reinforcing Steel

.1 CSA G30.18

.3 Steel Liner Plates

.1 Corrugated proprietary steel liner plates with bolted joints and grouting nipples supplied on a sufficient number of plates to provide grouting connections at 3 m maximum around the circumference and every second ring of plates.

.4 Steel Casings

.1 Temporary casings shall be thin-walled mild steel cylindrical casing, spirally welded or other similar construction. The dimensions and quality of the casing shall be adequate to withstand without damage or distortion all handling, construction and ground stresses to which they will be subjected, including preventing concrete from within the pile from displacing soft soil or soil squeezing in and displacing fresh concrete.

.5 Structural Steel Members

.1 CSA G40.20/G40.21 Grade 300W for walers, bracing and soldiers piles.

.6 Welding

.1 CSA W59 Welded Steel Construction

.7 Steel Sheet Piling:

.1 Per CAN/CSA G40.20/G40.21 interlocking type. Selection properties to suit design.

.8 Lumber

.1 Graded lumber, sound, straight, free from cracks, shakes, large or loose knots. Use planks for sheeting, tongued and grooved, or grooved and splined as required.

.9 Drypack Concrete Fill Behind Lagging

.1 Concrete in accordance with Section 03 30 00 – Cast-in Place Concrete suitable for filling all voids behind lagging with a 28-day compressive strength of 20 MPa.

PART 3 EXECUTION

3.1 GENERAL

.1 Before work begins, inspect conditions upon which work depends. Inform the Engineer, in writing, of conditions not identified.

.2 Protect adjacent structures, utilities, pipelines, or other foundations on or below grade from damage and/or displacement.

.3 Monitor and control vibration of existing structures in accordance with Section 02 23 40 – Vibration Monitoring.

.4 Monitor settlements of existing structures.

3.2 COLD WEATHER PROTECTION

.1 Between the 15th of October of any year and the 15th of April of the following year, provide on hand and ready for use all equipment necessary for adequate cold weather protection.

.2 Provide sufficient insulation, and heat as necessary, to prevent freezing of frost susceptible soil behind temporary shoring works.

.3 When providing heat, do not dry out sensitive soils such as clays.

3.3 PLACEMENT - GENERAL

.1 Retain Professional Engineer responsible for design and supervision of construction of temporary/permanent retaining structures to verify that Work is carried out in conformance with the design. Retained engineer to provide written acceptance of “As Constructed” shoring before excavation is occupied.

.2 Prior to commencing excavation in any area protected by temporary shoring, the shoring engineer shall provide written certification that the shoring has been constructed in accordance with the approved drawings as amended by field instruction. This requirement will not apply to trench boxes.

.3 Do not place any part of shoring and bracing systems until permission by the Engineer has been given to proceed.

.4 Have shoring systems installed by personnel with demonstrated competence and experience in this type of work.

.5 Provide and set all excavation, shoring and bracing necessary to prevent cave-in of banks and excavations.

.6 For installation of sheets, select driving hammer equipment suitable for the soil conditions. The driving equipment shall not exceed the vibration limits transmitted to adjacent structures established in Section 02 23 40 – Vibration Monitoring.

.7 Install shoring so that there is no loose material or voids between shoring and sound undisturbed soil.

.8 Set all shoring to a true vertical and to dimensions and elevations indicated on shop drawings.

.9 Do not encase any part of temporary structure in the structural concrete of the permanent structure without written permission from the Engineer.

.10 If bracing members, such as walers, etc., are to be removed during construction, timing and procedure for removal shall not induce stresses in permanent structures. Submit removals plan to Engineer for review.

3.4 SECANT PILE WALLS

.1 Excavation and construction methods shall result in minimum disturbance of surrounding material. The Contractor shall be required to drill through any boulders and rock encountered in the excavation boring.

.2 The sides of all borehole shall be kept intact and no loose material shall be permitted to fall into the bottom of the boreholes. The Contractor's boring equipment shall be able to sink a steel casing to support the sides of all boring.

.3 The Contractor shall be responsible for the program and sequence of construction which is dependent on the rate of gain of strength of primary piles affects the time within which secondary piles can be formed. The concrete mix may include additives to control the rate of gain of strength, particularly the primary piles. Where the Contractor considers that alternative proposals for the concrete mix are required then evidence of trial mixes should be provided.

.4 Concrete to be placed under high groundwater table shall be using a tremie method of concreting in accordance with CSA A23.1/A23.2.

.5 The caissons shall be socketed with a minimum of 1000mm below the sound bedrock elevation.

3.5 SOLDIER PILES AND LAGGING

.1 Install soldier piles to dimensions and elevations indicated on shop drawings. If soldier piles are installed in predrilled holes, fill void around piles with a lean concrete mix before commencing excavation.

.2 Install walers and/or ringwalers, struts and bracing for soldier piles as excavation proceeds and follow behind as closely as possible with lagging installation. Install lagging to bottom of excavation at the end of each day's work.

.3 Wedge lagging tightly against firm soil at all points. Prevent migration of soil particles through joints in lagging.

.4 If soil has been loosened, remove it and fill void with dry pack concrete rammed tightly between the lagging and firm soil.

.5 Fill all voids between lagging and firm soil with dry pack rammed tightly in place.

.6 If bracing members, such as walers, etc., are to be removed during construction, timing and procedure for removal shall not induce stresses in permanent structures or bracing members in excess of those allowed by applicable codes.

3.6 LINER PLATES

.1 Excavate to depth of one (1) ring and place liner plates, set first ring true to circle and vertical position.

.2 Excavate for next ring and place liner plates. Do not excavate further ahead of liner in place than the width of one ring.

.3 Grout voids between liner plates and ground, by means of a grout pump. Frequency of grouting to suit conditions but not less frequent than after every second ring has been placed. Do not leave any ring ungrouted overnight.

.4 Do not leave the sides of the excavation exposed below the liner plates at the end of the day's work.

.5 Provide reinforcing at openings as required by the design.

3.7 STEEL SHEET PILING

.1 Provide temporary guide frames and bracing to hold sheet piles in proper alignment during setting and driving. Install piling to dimensions and elevations indicated on shop drawings.

.2 Install walers and bracings so not to interfere with reinforcing bars or other parts of permanent structures.

.3 Splices in walers shall develop full strength of member in bending, shear and axial compression.

.4 If bracing members, such as walers, etc., are to be removed during construction, timing and procedure for removal shall not induce stresses in permanent structures or in steel sheet piling or bracing members in excess of those allowed by applicable codes.

.5 Leave sheeting in place unless otherwise specified.

3.8 CLOSED SHEETING FOR TRENCHES

.1 Provide and install braced closed sheeting where required for trench construction.

.2 Sheeting system shall be adequate for all loading and pressures and for surcharge effects due to construction equipment and materials in accordance with the provision of The Occupational Health and Safety Act, and The Ontario Building Code.

.3 Where sheeting is to be left in place, the top shall be cut off 1.2 m below grade or as directed.

3.9 MONITORING DEFLECTION/SETTLEMENT OF EXISTING INFRASTRUCTURE

.1 Monitor deflection of shoring systems that retain materials providing support for adjacent foundations at higher levels at least daily. Verify that measured deflections are within design tolerances.

.2 Monitor deflection/settlements at each corner and center of existing structures daily. Report to the Engineer immediately if specified settlement limits are exceeded. Monitor and control vibration.

.3 Monitor the following structures:

.1 Existing Digester Complex

.4 Submit written records of settlement and deflection result to the Engineer weekly.

3.10 SHORING REMOVALS

.1 When footings, walls, slabs and other foundations are in place and backfilling near completion to existing grade, cut down and remove the tops of piles and lagging to a minimum of 1200 mm below finished grade.

.2 Remove shoring as shown on the drawings where necessary to construct new foundation.

3.11 NOTIFICATION

.1 Give the Engineer advance notice of shop fabrication, field installation and other phases of the work to allow the Engineer reasonable opportunity to inspect the work for compliance with contract requirements. Failure to meet this requirement may be a cause for the Engineer to classify the work as defective.

3.12 DEFECTIVE MATERIALS AND WORK

.1 Where factual evidence exists that defective work has occurred or that work has been carried out incorporating defective materials, the Engineer may have tests, inspections or surveys performed, analytical calculations of structural strength made, and the like, in order to help determine whether the work must be replaced. Tests, inspections or surveys or calculations carried out under these circumstances will be made at the Contractor’s expense, regardless of their

results, which may be such that, in the Engineer's opinion, the work may be acceptable.

.2 All testing shall be conducted in accordance with the requirements of the Ontario Building Code and in accordance with the standards given by the Engineer.

.3 Materials or work which fail to meet specified requirements may be rejected by the Engineer whenever found at any time prior to final acceptance of the work regardless of previous inspection. If rejected, defective materials or work incorporating defective materials or work shall be promptly removed and replaced or repaired to the satisfaction of the Engineer, at no expense to the Owner.

END OF SECTION

GEOTEXTILES

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

.1 Section 31 05 16 – Aggregate Materials

.2 Section 31 23 19 – Dewatering

.3 Section 31 32 25 – Erosion and Sedimentation Control

1.2 SECTION INCLUDES

.1 Supply and placement of geotextile fabric to be used for rip-rap, subdrains, slope protection and silt fences as required.

.2 All geotextiles are to conform to Ontario Provincial Standard Specification (OPSS) 1860.

1.3 REFERENCE STANDARDS

.1 CAN/CSA-G40.21-04, Structural Quality Steel.

.2 CAN/CSA-G164-M92(R2003), Hot Dip Galvanizing of Irregularly Shaped Articles.

.3 CAN/CGSB-4.2 No. 11.1-94, Textile Test Methods - Bursting Strength - Diaphragm Pressure Test

.4 CAN/CGSB-4.2 No. 14-2005, Textile Test Methods - Quantitative Analysis of Fibre Mixtures

.5 CAN/CGSB-148.1-M (Complete Set), Methods of Testing Geosynthetics.

.6 OPSS 577-2006, Construction Specification for Temporary Erosion and Sediment Control Measures.

.7 OPSS 1860-2004, Material Specification for Geotextiles.

.8 ASTM D4491-99a(2004)e1, Standard Test Methods for Water Permeability of Geotextiles by Permittivity.

.9 ASTM D4595-05, Standard Test Method for Tensile Properties of Geotextiles by the Wide-Width Strip Method

.10 ASTM D4751-04, Standard Test Method for Determining Apparent Opening Size of a Geotextile.

1.4 DELIVERY AND STORAGE

.1 Protect geotextiles during delivery and storage at the site from direct sunlight, ultraviolet rays, excessive heat, mud, dirt, dust, debris and rodents at all times.

PART 2 PRODUCTS

2.1 MATERIAL

.1 Geotextile: synthetic fibre fabric, supplied in rolls.

.1 Composed of: minimum 85% by mass of polypropylene, polyester, or polyethylene with inhibitors added to base plastic to resist deterioration by ultra-violet and heat exposure.

.2 Meet Owner requirements and Engineer approval.

.2 Geotextile for use with rip-rap

.1 Non-woven Type II.

.2 Thickness: to CAN/CGSB-148.1, No. 3, minimum 2.3 mm.

.3 Mass per unit area: to CAN/CGSB-148.1 No. 2, minimum 180 g/m².

.4 Grab tensile strength and elongation: to CAN/CGSB-148.1, No. 7.3.

.1 Breaking force: minimum 660 N, wet condition.
.2 Elongation at failure: minimum 15%.

.5 Bursting strength: to CAN/CGSB-148.1, No. 6.1 minimum 2.2 MPa, dry condition.

.6 Apparent opening size (AOS): to ASTM D4751, 50 to 100 micrometers.

.7 Permeability: to CAN/CGSB-4.2, No. 11.1, 2.7 x 10 cm/s.

.3 Geotextile for use in subdrains:

.1 Non-woven Type II.

.2 Mass per unit area: to CAN/CGSB-148.1 No. 2, minimum 180 g/m².

.3 Tensile strength and elongation (in any principal direction):

.1 Grab tensile strength; to CAN/CGSB-148.1 No. 7.3-92; minimum 440 N, wet condition.
.2 Elongation at break; minimum 70%.
.3 Seam strength; equal to or greater than tensile strength of fabric.
.4 Mullen burst strength: to CAN/CGSB-4.2 No. 11.1; minimum 1.4 MPa
.5 Filtration opening size (FOS); to ASTM D4751, 50-150 micrometers.
.6 Permeability; to CAN/CGSB - 4.2 No. 11.1: 2.0 x 10 cm/s.

.4 Geotextile for use in silt fences:

.1 Physical properties; to OPSS 577 and 1860, Class I, woven, FOS 105-210 micrometers.

.2 Bursting strength; to CAN/CGSB-148.1, No. 6.1, minimum 1.8 MPa.

.3 Slurry flow rate; maximum 25 L/min/m².

.4 Sediment retention efficiency; 75% minimum.

.5 Geotextile for slope protection:

.1 Open web; non-woven type polymer web.

.2 Cell area; 1000 cm².

.3 Cell height; 100 mm

.4 Weight; 350 g/m² minimum.

.5 Thickness; 1.9 mm minimum.

.6 Tensile strength; to ASTM D4595, 1.9 kN/100 mm minimum.

.7 Elongation break; to ASTM D4595, 30% minimum.

.8 Color; green or black, ultraviolet resistant.

.6 Securing pins and washers: to CAN/CSA-G40.21, Grade 300W, hot-dipped galvanized with minimum zinc coating of 600g/m² to CAN/CSA-G164.

.7 Wood posts for light duty Silt Fences: spruce, size 50 mm x 100 mm x 2200 mm long, pointed on one end for driving into ground.

.8 Staples for wood posts of Silt Fences:

.1 Crown width; 25 mm.

.2 Leg; 25 mm.

.3 Gauge; 1.25 mm.

.9 Steel posts for heavy duty Silt Fences: light weight galvanized steel T-Bar section not less than 37.5 mm x 37.5 mm x 2200 mm long.

.10 Tie Wire Fasteners for steel posts: vinyl coated, single strand, aluminum coated on galvanized steel wire, 5 mm diameter or other tie wire or strap approved by Engineer.

.11 Stretching wire for Silt Fences: not less than 3.4 mm diameter (9 gauge), galvanized wire.

PART 3 EXECUTION

3.1 INSTALLATION

.1 Place geotextile material by unrolling onto graded surface in orientation, manner and at locations required in accordance with manufacturers instructions.

.2 Place geotextile material smooth and free of tension, stress, folds, wrinkles and creases.

.3 Place geotextile material on sloping surfaces in one continuous length from toe of slope to upper extent of geotextile.

.4 Overlap each successive strip of geotextile 500 mm over previously laid strip.

.5 For use with rip-rap, pin successive strips of geotextile with securing pins at 300 mm interval at mid-point of lap.

.6 Protect installed geotextile material from displacement, damage or deterioration before, during, and after placement of material layers.

.7 After installation, cover with overlying layer within four (4) hours of placement.

.8 Replace damaged or deteriorated geotextile to Contact Administrator's approval.

3.2 PROTECTION

.1 No vehicles permitted directly on geotextile.

3.3 INSTALLATION OF SILT FENCES/EXCLUSION FENCING

.1 Install silt fences to manufacturer's installation instructions and in accordance with OPSD 219.130 or as directed.

.2 Fences are to fully surround construction area to prevent silt migration to adjacent areas, or as directed.

.3 Fence posts:

.1 Install wood posts for fences for use in construction to be completed during one year or season after which fence is intended to be removed, as directed.

.2 Install steel posts for fences for use in construction to be completed over multiple seasons or years and where fences are required to remain in place during this extended period.

.4 Drive wood or steel posts into ground to a depth of 1200 mm as shown. Provide adequate protection in order that wood posts do not splinter during driving and that steel posts do not warp or get damaged.

.5 Spacing for fence stakes or posts:

.1 Intermediate stakes: Not more than 1500 mm on center.

.2 End Stakes and stakes at curves: Not more than 750 mm on center.

.6 Install geotextile fabric on side facing the flow and staple well taut to wood posts. Staples, not less than 4 per stake. Use not less than 4 tie wires for steel posts. Fabric to be embedded under ground and anchored in trench as shown. Trench to be well backfilled and compacted.

.7 Return the ends of the erosion control fencing with a J-Turn as indicated to complete the exclusionary function of the fence as indicated.

.8 Install stretch wire at the top of posts for the full length of fence and ensure that wire is well set in place to provide stability for fence. Wrap fabric around wire and tie at two points between posts.

.9 Construct an open silt collection swale, not less than 600 mm wide and 300 mm deep, on the side facing the flow and adjacent to the full extent of silt fence, as shown. Swale to be not less than 800 mm away from fence to permit removal of silt without disturbing or damaging fence.

.10 Silt fences are to be maintained for the full duration of the project and shall not be removed until all construction is completed on site.

.11 Maintain silt fences as specified in the Erosion and Sediment Control specification, Section 02370.

3.4 REMOVAL

.1 Remove silt fences including geotexiles and dispose of off-site when the project is complete and after receipt of approval from the Engineer.

END OF SECTION

EROSION AND SEDIMENTATION CONTROL

PART 1 GENERAL

1.1 OBJECTIVES

.1 Prevent the loss of soil from construction site resulting from storm water runoff, wind erosion and construction activities.

.2 Prevent the sedimentation of storm sewers and receiving waters.

.3 Prevent air pollution caused by dust and particulate matter.

.4 Prevent negative impacts on the Napanee River. The Napanee River is fish habitat and is not to be negatively impacted by construction operations.

1.2 DESCRIPTION OF WORK

.1 Implement the Erosion and Sedimentation Control (ESC) measures shown on the project drawings and described in these specifications.

.2 Install ESC products in accordance with contract drawings.

.3 Inspect ESC measures on a weekly basis and following all significant storm events. If deficiencies are found, make repairs within 24 hours of detection.

.4 Maintain an ESC inspection log to document observations, deficiencies and corrective actions.

1.3 RELATED REQUIREMENTS

.1 Section 31 05 16 – Aggregate Materials

.2 Section 31 23 19 – Dewatering

.3 Section 31 32 19 – Geotextiles

1.4 REFERENCES

.1 Contract Section 8: Natural Heritage Assessment Report provides requirements for the erosion and sediment control measures as well as the avoidance and mitigation measures to prevent contravention of the Endangered Species Act which shall be followed by the Contractor in execution of the Contract.

.2 MECP – Exclusion Fencing https://www.ontario.ca/page/reptile-and-amphibian-exclusion-fencing#:%7E:text=Concrete%2C%20metal%20or%20vinyl%20exclusion,concrete%20wall%20for%20complete%20exclusion

.3 U.S. Environmental Protection Agency, Office of Water. “Chapter 3: Sediment and Erosion Control” and Chapter 4: Other Controls”. Document No. EPA 832-R-92-005 Storm Water Management for Construction Activities.

.4 Canada Green Building Council. “Sustainable Sites Prerequisite 1: Erosion and Sedimentation Control”. Leadership in Energy and Environmental Design

Reference Package for New Construction and Major Renovations (LEED® Canada-NC) Version 1.0.

.5 Ontario Provincial Standard Specifications/Drawings (OPSS/D)

1.5 SUBMITTALS

.1 Inspection Checklist – Schedule A procedures

.1 Prepare the checklist to include all measures shown on the drawings and described in the specifications.

.2 Complete a new checklist with each inspection and keep completed checklists with the weekly inspection log documentation.

.2 Weekly Inspection Log – Schedule B

.1 Complete the log on a weekly basis and keep all documentation on-site and available for review by the Owner's Representative.

.2 The inspection log shall be completed for each inspection, and must document deficiencies for all measures indicated as "Not OK" on the inspection checklist.

.3 Each deficiency must be initialled and each log signed, only after all corrective measures have been completed and documented.

.4 Submit all ESC documentation (e.g.: inspection checklists and inspection log) to the Owner's Representative after final landscaping is completely installed.

.3 Photographs:

.1 A minimum of three (3) digital photographs shall be taken (from various viewpoints) of each ESC measure implemented on-site immediately following installation.

.2 A minimum of three (3) digital photographs shall be taken (from various viewpoints) of ESC measure implemented on-site at the end of construction or prior to dismantling, whichever comes first.

.3 Submit all digital photographs to Contract Administrator for documentation within seven (7) days of being taken.

PART 2 PRODUCTS

2.1 MATERIALS

.1 Geotextile: Type II Non-woven as per OPSS 1860

.2 Straw Bales and Silt Fencing as per OPSD 219.180 and 219.130.

.3 Rock Check Dams as per OPSD 219.210.

PART 3 EXECUTION

.1 General Practices:

.1 Stabilized Construction Entrance (SCE)

.1 Construct an SCE before construction begins at every point where traffic leaves the site and enters onto a public road and/or any unpaved entrance/exit location where there is a risk of transporting mud or sediment onto paved roads.

.2 The SCE must be at least 3.65 m wide, with room for two vehicles to pass at high traffic areas, and constructed from 50 mm diameter clear stone, 150 mm diamater rip rap, and filter fabric with the following characteristics:

.1	Grab Tensile Strength:	100 kgs
.2	Elongation Failure:	60%
.3	Mullen Burst Strength:	195 kgs
.4	Puncture Strength:	57 kgs
.5	Equivalent Opening:	Size 40-80 (US std sieve)

.2 Site Arrangement

.1 All construction trailers and equipment shall be positioned to reduce the disturbance of site. They shall be located close to the current phase of construction to minimize traffic damage to the site.

.3 Material Stockpiling

.1 If material in stockpile will not be used within 14 days, it must be stabilized using one of the following measures:

.1 Temporary Seeding
.2 Tarps
.3 Compaction
.4 Surface Roughening

.4 Install ESC products in accordance with manufacturer instructions and the prescribed installation procedures in the referenced EPA document.

.2 Stabilization Practices

.1 Preservation of Natural Vegetation

.1 Establish construction boundaries to limit site disturbance to 12m beyond the building perimeter, 1.5 m beyond primary roadway curbs, walkways and main utility branches and 7.6 m beyond parking areas. Refer the to attached Natural Heritage Report for separation distances to the natural environment along the southern property boundary.

.2 Stakes shall be used to indicate limits of construction, grading and disturbance. Trees shall be clearly marked to be preserved and protected from the ground disturbances around the base.

.2 Buffer Zones

.1 Incorporate vegetated strips of land on floodplains, next to wetlands, along stream banks and on steep, unstable slopes to decrease the velocity of storm water runoff, preventing soil erosion.

.2 May be an area of vegetation left undisturbed during construction, or it can be newly planted. New strips require establishment of permanent seeding and planting.

.3 Soil Retaining Measures

.1 Use skeleton sheeting, continuous sheeting or permanent retaining walls to hold in place loose or unstable soil where other soil retaining methods are not practical.

.4 Permanent Seeding

.1 Shall be applied to any graded or cleared area as specified on landscaping plan.

.2 Plant native species of grass, trees and shrubs during favourable growth conditions; for areas outside of construction activity preferably within 3 weeks of construction start.

.3 Species shall not require permanent irrigation after the first two years or fertilizers containing phosphorus. Species must not be invasive.

.4 Use topsoil on areas where topsoil has been removed, where soil is dense or impermeable, or where mulching and fertilizers alone cannot improve soil quality. Make topsoil layers at least 150 mm deep or similar to the existing topsoil depth.

.3 Structural Practices

.1 Silt Fence/ Exclusion Fencing

.1 Construct posts with filter fabric media to remove sediment from storm water volumes flowing through the fence as well as to create an exclusionary fence to isolated the work areas from amphibians.

.2 Provide J-returns at all terminal ends of the fencing.

.3 The lower edge of the fence is to be vertically trenched and covered by backfill.

.4 Filter fabric should be a pervious sheet of polypropylene, nylon, polyester, polyethylene or equivalent and have the following characteristics:

.1	Filtering Efficiency:	75%-85% (minimum)
.2	Tensile Strength at 20% kg/mm (max) Elongation kg/mm	Standard Strength – 0.54 Extra Strength – 0.89
.3	Slurry Flow Rate	15.0 L/m2/min (min)

.2 Outlet Protection

.1 Install stone, riprap, concrete aprons, paved sections or settling basins at all pipe, interceptor dike, swale or channel outlets where

the velocity of flow may cause erosion or pools at the outlets of an ESC measure.

.3 Inlet Protection

.1 Install stone, concrete masonry units and stone, filter fabric or slit fences around catch basins and manhole covers to prevent silting of inlets, storm drainage systems or receiving channels.

.4 Check Dams

.1 Install check dams in steeply sloped swales or in swales where adequate vegetation cannot be established, and only in small open channels which will not overflow once dams are constructed.

.2 Construct small, temporary or permanent dam of stone, straw bales, logs or pea gravel-filled sandbags across a drainage ditch, swale of channel to slow water flow and allow suspended sediment to settle.

.5 Drainage Swale

.1 Construct a channel with a lining of vegetation, riprap, asphalt, concrete or other material to convey runoff from the bottom or top of a slope.

.2 Intercepted runoff shall be diverted to an appropriate outlet with sediment trap if required; swale shall have a positive grade with no dips to collect water.

.3 Swale shall be lined using geotextiles, grass, sod, riprap, asphalt or concrete – based on the volume and velocity of the runoff.

.6 Gravel or Stone Filter Berm

.1 Construct a temporary ridge of loose gravel, stone or crushed rock to slow filter flow and divert it from exposed traffic in areas with gentle slopes and traffic.

.7 Sediment Trap

.1 Excavate a pond area or construct earthen embankments to allow for settling of sediment from storm water volumes.

.2 Incorporate temporary seeding, mulching and/or earth dike per installation procedures to reduce erosion of banks.

.3 Use a sediment trap for small drainage areas, no more than 2 hectares (5 acres).

.8 Temporary Sediment Basin

.1 Use sediment basins for areas larger than 2 hectares (5 acres).

.2 Construct a pond with a controlled water release structure to allow for settling of sediment from water volumes.

.3 Construction shall occur before any clearing and grading occurs, and must not be built on an embankment in an active stream.

.4 Incorporate temporary seeding, mulching and/or earth dike per installation procedures to reduce erosion of banks.

.5 Outlet pipe and spill way shall be designed by Owner's Representative based on an analysis of the expected runoff flow rates from the site.

.9 Subsurface Drains

.1 Place a perforated pipe or conduit beneath the surface of the ground at a designed depth and grade to drain an area with high water table.

.2 Use relief drains in a gridiron, herringbone or random pattern to dewater an area where the water table is high.

.3 Place interceptor drains, as single pipes, to remove water where sloping soils are excessively wet or subject to slippage.

.4 Backfill with open granular, highly permeable soil immediately after pipe is placed.

.5 Stabilize outlet and ensure sediment-laden storm water runoff is directed to a sediment trapping measure.

3.2 INSPECTIONS AND MAINTENANCE

.1 Inspection procedures specified below summarize the EPA document and shall be followed in conjunction with details, drawings and manufacturer requirements.

.2 Inspect all control measures at least once each week (unless otherwise noted) and following any significant storm (13 mm of precipitation or greater). Complete the inspection log for each inspection, and keep in an accessible location on site until all corrective measures have been documented. Submit each completed log to the Owner's Representative for review.

.3 Maintain all measures in good working order. If a repair is necessary, initiate within 24 hours of report.

.4 Stabilized Construction Entrance: Apply additional gravel as required, remove sediments and other materials from all areas to minimize clogging. Keep adjacent public roadway(s) free from sediment.

.5 Site Arrangement: Verify that movement of construction equipment to appropriate area occurs at the same time as movement of construction activities.

.6 Material Stockpile: Inspect for effective prevention of runoff and erosion. Remove built-up sediment from silt fence when it has reached 1/3 the height of the filter fabric.

.7 Preservation of Natural Vegetation: Routine maintenance shall include mowing, fertilizing, liming, irrigating, pruning and weed and pest control, depending on the specific species and environmental conditions. Remove any debris and ensure area is protected from traffic.

.8 Buffer Zones: Routine maintenance shall include mowing, fertilizing, liming, irrigating, pruning and weed and pest control, depending on the specific species and environmental conditions. Remove any debris and ensure area is protected from traffic.

.9 Soil Retaining Measures: Inspect for structural damage and repair as required.

.10 Permanent Seeding: Inspect for sufficient growth and water conditions. Replant areas if cover does not provide erosion control.

.11 Silt Fence: Silt fence to be inspected for depth of sediment, tears, loose fabric attachment at fence posts, channel erosion beneath fence, sagging or collapse, and to ensure the fence posts are firmly in the ground. Built-up sediment is to be removed from silt fence when it has reached 1/3 the height of the fence. Repair such that fence is in original installation condition.

.12 Outlet Protection: Inspect for erosion and pooling of water. Necessary repairs to be made as required to reduce exit velocity of runoff. If a riprap apron is used, inspect for riprap displacement and damage to filter fabric.

.13 Inlet Protection: Inspect that measures are in original installed condition. Ensure measures are effectively trapping sediment. Remove accumulated sediment and debris when it reaches ½ the design depth of the trap. Repair protection measures as required.

.14 Check Dams: Inspect for sediment and debris accumulation and erosion of sides. Sediment should be removed when it reaches ½ the original dam height. Repair dam as required.

.15 Drainage Swale: Inspect for dips or low points along the swale where water is pooling and ensure that runoff is being directed to sediment-trapping measure used onsite.

.16 Gravel or Stone Filter Berm: Inspect for breach in structure caused by vehicles, and accumulated sediment. Replace filter material if needed and remove and properly dispose of accumulated sediment.

.17 Temporary Sediment Basin/ Sediment Trap: Remove sediment when it reaches 300 mm in depth. If outlet becomes clogged with sediment it must be cleaned to restore flow capacity. Maintain until site area is permanently stabilized and/or permanent structures are in place. Ensure bank is sufficiently compacted and stabilized such that erosion into basin does not occur.

.18 Subsurface Drains: Inspect pipe for breaks or clogging by sediment or debris. Remove blockage immediately, replace any broken sections and restabilize the surface. Check inlets and outlets for sediment or debris, and remove and dispose of these materials properly.

3.3 REMOVAL OF PRODUCTS

.1 ESC measures shall not be removed and shall be fully inspected and maintained until final landscaping is complete.

Inspection Checklist – Schedule A

Project Name: _____

Completed By: _____

Date: _____

During Construction: Contractor to complete this Inspection Checklist ***once a week*** as per the ESC Specification. For each measure, check the "OK" box if there are no repairs or maintenance required; check the "Not OK" box if attention is required as per the inspection/maintenance procedures in the ESC specification.

For all measures marked as "Not OK", the Inspection Log must be completed. List the measures that are deficient in the "Deficiencies" column on the Inspection Log, and record the maintenance performed. Submit both the Inspection Checklist and Inspection Log to the Contract Administrator after all maintenance activities have been completed and recorded.

OK	Not OK	Location on Site	Measure

Inspection Log – Schedule B

Erosion & Sedimentation Control Weekly Inspection Log

Log Start Date: _____

Log End Date: _____

Log Completed By: _____

Company: _____

Telephone No.: _____

Inspection Date	General Observations (ie: seasonal conditions)	Location & Deficiency of ESC Measure	Corrective Measures	Initials

I hereby certify that the information provided is complete, correct and complies with the requirements of EPA Best Management Practices.

Signature	Title	Date

END OF SECTION

RIGID INCLUSION COLUMN GROUND IMPROVEMENT

PART 1 GENERAL

1.1 SCOPE OF WORK

.1 Provide all labour, equipment, material, and supervision to design and install a Rigid Inclusion Column (RIC) Ground Improvement System to support the raft slab foundation of the proposed structures presented in the Contract Drawings.

.2 Design shall rely on subsurface information presented in the project geotechnical and hydrogeological reports.

.3 RIC designer is responsible for designing an engineered pad system referred to as Load Transfer Platform (LTP) necessary to transfer loads between the improved soil and the underside of the raft foundation and/or any other structural elements requiring support.

.4 General contractor is responsible for site layout of control points and elevation benchmarks, construction and maintenance of LTP, footing excavation, subgrade preparation and disposal of spoils generated from the installation of the Rigid Inclusion Column Ground Improvement System.

1.2 RELATED SECTIONS

.1 DIVISION 1 – GENERAL REQUIREMENTS

.2 31 05 16 – Aggregate Materials

.3 Section 31 23 33 - Excavating, Trenching and Backfilling

.4 Section 02 23 40 – Vibration Monitoring

1.3 REFERENCES

.1 ASTM D422-63 (2007) – Standard Test Method for Particle-size Analysis of Soils

.2 ASTM D1143/D1143M-20 - Standard Test Methods for Deep Foundations Under Static Axial Compressive Load

.3 ASTM D1241-15, - Standard Specification for Materials for Soil-Aggregate Subbase, Base, and Surface Courses.

.4 Canadian Foundation Engineering Manual, 5th Edition, 2023.

.5 CSA A23.1/A23.2-19 - Concrete Materials and Methods of Concrete Construction / Test Methods and Standard Practices for Concrete.

.6 Ontario Building Code 2012 w/ latest amendments.

1.4 PAYMENT PROCEDURES

.1 This is a lump sum Contract, and payment will be made for work completed during the payment period.

1.5 GEOTECHNICAL AND HYDROGEOLOGICAL INVESTIGATIONS

.1 Geotechnical and Hydrogeological investigations of the site have been made and is provided as part of the Bid Documents.

.2 This information is given solely as a guide. No responsibility is accepted by the Owner or Consultant for its correctness, nor shall its accuracy affect the provisions of the contract.

1.6 SUBMITTALS

.1 Submit the following documentation for review at least three (3) weeks prior to the beginning of RIC construction.

.1 Reference projects as required in clause **Error! Reference source not found.**.

.2 installer's and designer's qualifications as required in clause **Error! Reference source not found.**.

.3 Drawings: General arrangement and detail drawings showing layout, location and number of each RIC element including corresponding depths below cut grade. These shall be prepared and sealed by a Professional Engineer, licensed in the Province of Ontario.

.4 Calculations: All computer-generated calculations and hand calculations shall be prepared and sealed by a Professional Engineer, licensed in the Province of Ontario.

.5 Concrete and Grout: Submit the concrete and grout mix design selected by the RIC Designer.

.6 Installation Work Plan: Complete description of the methods to install the RIC system including excavation procedures, sequence, liners, working elevations, concrete placement, improvement techniques, equipment to be used and spoils disposal. Do not proceed with work until methods have been reviewed by the Consultant.

.7 Quality Control Plan: The quality control test program for the RIC system, meeting the design requirements.

.8 Load Transfer Platform / Drill Rig Work Platform Engineering Report: Engineering report with drawings stating where the drill rig will travel and sit, its weight, the soils it sits on are stable and the requirements and construction of working pads under the drill rig. The report shall be by a Professional Engineer, licensed in the Province of Ontario.

.2 Submit the following during RIC construction:

.1 Daily RIC Progress Reports: The General Contractor shall have available a complete and accurate record of RIC installation prepared by the RIC

installer. The record shall indicate the location, length and volume of concrete used during installation, and final elevations or depths of the base and top of elements. The record shall also indicate the type and size of the installation equipment used, and the type of concrete used. The installer shall immediately report any unusual conditions encountered during installation to the RIC Designer, Owner, General Contractor and Consultant.

.2 Certification that the RIC system has been designed and installed in general conformance with the Contract Documents. All submitted certification and letters shall be stamped by a Professional Engineer, licensed in the Province of Ontario.

.3 Sacrificial load test reports.

.4 Concrete testing results.

.3 As-built drawings: As-built drawings showing the final locations and depth of the rigid inclusion elements geolocated with northings and eastings sealed by a Professional Engineer licensed in the Province of Ontario.

1.7 QUALIFICATIONS REQUIREMENTS

.1 The RIC Installer shall have at least 10 years' experience with the rigid inclusion column ground improvement being employed and shall have completed at least thirty (30) rigid inclusion projects in Canada and shall be able to demonstrate having completed projects in Ontario of similar scope in similar soil types using Ground Improvement.

.2 The RIC Designer shall have experience designing rigid inclusion column ground improvement for minimum of 10 years.

.3 Installers should have successfully completed a minimum of ten (10) WTP/WWTP Ground Improvement projects in Canada and have successfully completed on ground improvement projects in the Napanee Region. References to be provided at time of tender.

.4 The ground improvement Contractor shall provide three (3) references for projects for the method being employed, having a minimum total construction value of $5,000,000. The projects shall have the following:

.1 Similar types of soil conditions. Geotechnical reports to be included.

.2 Similar types of ground improvement systems supporting raft slab foundation.

.3 At least one example project that have been constructed in the Napanee Region.

1.8 QUALITY ASSURANCE

.1 The RIC installer shall have a full-time, on-site Quality Control Technician to verify and report all installation procedures. The Installer shall immediately report

any unusual conditions encountered during installation to the RIC Designer and to the General Contractor.

.2 Independent Inspection and Testing

.1 The Consultant will appoint the independent inspection and Testing Firm to make inspections or perform tests as the Consultant directs. The independent inspection and testing firm shall be responsible only to the Consultant and shall make only such inspections or tests as the Consultant may direct.

.2 When defects are revealed, the Owner is entitled to be provided with additional inspection or testing to ascertain the full extent of the defect, at the Contractor's expense.

.3 Load Test Requirements:

.1 A static load test(s) is performed on a sacrificial RIC element(s) to verify the design assumptions. The RIC designer shall provide a description of the installation equipment, installation records, complete test data, analysis of the test data and verification of the design parameter values. Static Load Test Procedures shall utilize appropriate sections of ASTM D1143-Quick Test. The report shall be prepared under direction of a Registered Professional Engineer in the Province of Ontario.

.2 In the event of unsuccessful tests, the RIC designer shall re-design the rigid inclusion foundation system and perform additional sacrificial tests until the design assumptions are verified. Re-design of the rigid inclusion column ground improvement system and additional load tests shall be included in the lump sum price of this section.

.4 Concrete Sampling and Testing:

.1 Concrete shall be sampled and tested. The sampling and testing are typically performed by an external certified technician retained by the Contractor. Each concrete truck load shall be tested for slump. For compressive strength testing, 4 cylinders shall be made per 115 cubic metres or once per day, whichever is more frequent. For every 250 RIC elements, a minimum of one set of 4 cylinders shall be tested to obtain 4, 7, 14, and 28 day strengths. For projects requiring less than 250 RIC elements, one set of 4 cylinders shall still be tested for 4, 7, 14, and 28 day strengths. The four-day break may be omitted at the RIC designer's discretion.

.2 Compressive test results shall be shared with the Consultant and the Owner.

1.9 DELIVERY, STORAGE, AND HANDLING

.1 Deliver and store materials on Site in accordance with CSA A23.1/A23.2

PART 2 PRODUCTS

2.1 DESIGN AND PERFORMANCE REQUIREMENTS

.1 Rigid Inclusion Column Design:

.1 The construction methods by which the ground improvement is achieved is the responsibility of the RIC Designer and is summarized in, but not limited to, the following points:

.1 The design of the rigid inclusion system shall be based on the service loads, and the allowable total and differential settlement criteria of all structural elements in accordance with generally accepted engineering practice and the methods.

.2 The RIC system shall be designed in accordance with engineering standards and the methods described in these Specifications. The design life of the structure shall be eighty (80) years.

.3 Design of an engineered granular pad, also referred to as Load Transfer Platform (LTP) for the equipment rig is to be included as part of the overall design of the ground improvement system. The LTP must extend at least 3.0 m from the extents of the foundation footprint.

.4 Design for the LTP shall consider point loads from vehicles, lifts, cranes, etc. and simplifying the point loads as uniformly distributed load is not acceptable.

.2 The design shall meet the following criteria:

Design Bearing Pressure for raft slab supported by RIC System	
Serviceability Limit States (SLS)	150 kPa
Ultimate Limit States (ULS)	225 kPa
Soil Subgrade Modulus	6,000 kPa/m
Estimated Total Long-Term Settlement	≤ 25 mm
Estimated Long-Term Differential Settlement:	≤ 12 mm
Loads from vehicles, lifts, cranes other construction equipment	Refer to Manufacturer's Literature

.3 The RIC elements shall be designed and installed so that they terminate on sound bedrock and do not terminate in any existing fill materials.

2.2 CONCRETE

.1 Concrete shall meet the requirements of CSA A23.1/A23.2.

.2 The mix design for concrete used by the RIC Installer for column construction shall be pre-approved by the RIC Designer.

2.3 ACCEPTABLE DESIGN AND INSTALLATION VENDORS FOR THESE WORKS ARE:

.1 Menard Canada

.2 GeoSolv Design/Build, Inc.

PART 3 EXECUTION

3.1 GENERAL

.1 Should any obstruction be encountered during RIC installation, the element shall be relocated or abandoned as determined by the RIC Designer at no additional expense to the Owner. Obstructions include, but are not limited to, boulders, timbers, concrete, bricks, utility lines, etc., which prevent placing the elements to the required depth, or shall cause the elements to drift from the required location.

.2 Dense natural rock or weathered rock layers or very dense natural soil shall not be deemed obstructions as determined by the RIC Designer, and piers may be terminated short of design lengths on such materials.

3.2 INSTALLATION PROCEDURES

.1 The following sections provide general criteria for the construction of the RIC elements. Unless otherwise approved by the RIC Designer, the installation method used for RIC construction shall be used in the construction of the successful load test.

.2 The RIC system is to be installed using displacement methods.

.3 The RIC system is to be installed using a method generating no vibrations.

3.3 PLAN LOCATION AND ELEVATION OF RIC ELEMENTS

.1 The as-built center of each pier shall be within 150 mm of the locations indicated on the plans. Piers installed outside of the above tolerances are deemed not acceptable, shall be rebuilt at no additional expense to the Owner.

3.4 REJECTED RIGID INCLUSION COLUMNS

.1 RIC elements installed beyond the maximum allowable tolerances shall be abandoned and replaced with new columns, unless the RIC Designer approves the condition or provides other remedial measures. All material and labour required to replace rejected piers shall be provided at no additional cost to the Owner, unless the cause of rejection is due to an obstruction or mis-location and has been approved by the Owner.

3.5 RESPONSIBLITIES OF THE GENERAL CONTRACTOR

.1 Examination and Protection

.1 The General Contractor is responsible for any field visits necessary to familiarize with the site conditions. The Owner will not accept any claims for items the Contractor is deemed to have considered in submission of their bid.

.2 The General Contractor shall locate and protect underground and aboveground utilities and other structures from damage during installation of the RIC elements.

.3 The General Contractor shall provide site access to the Installer, after earthwork in the area has been completed. A suitable working surface shall be established and maintained by the General Contractor to provide positive drainage and wet weather protection of the subgrade and to provide access and stability for efficient operation of the rigid inclusion column installation.

.4 A firm, stable and free draining working surface, as required, shall be included for the installation of the RIC system at no additional cost to the Owner.

.5 Protect installed RIC from freezing temperatures.

.6 Do not disturb RIC surface by construction traffic.

.7 The management and removal of any spoils generated through the installation of the RIC system, is to be completed at no additional cost to the Owner. The General Contractor shall removal spoil from the rigid inclusion column work area in a timely manner to prevent interruption of rigid inclusion column installation.

.8 The General Contractor shall coordinate all excavations made post-RIC installations so that excavations do not encroach on the elements as shown in the RIC construction drawings. Protection of completed elements is the responsibility of the General Contractor. In case that utility excavations are required in close proximity to the installed RIC elements, the General Contractor must contact the RIC Designer immediately to develop construction solutions to minimize impacts on the installed elements.

.9 Site grades for rigid inclusion column installation shall be within 300 mm of the top of footing elevation or finished grade elevation to minimize rigid inclusion column installation depths or as agreed upon between the general contractor and installer. Ground elevations and bottom of footing elevations shall be provided to the rigid inclusion column Installer in sufficient detail to estimate installation depth elevations to within 75 mm.

.2 Load Transfer Platform

.1 The Load Transfer Platform (LTP), as designed by the RIC designer shall be placed by the General Contractor between the tops of the rigid inclusion columns and the bottom of raft slab. A minimum thickness of

300 mm shall be used unless otherwise specified by the designer to be thicker.

.2 The LTP should be constructed as specified by the RIC Designer, and may include geogrid reinforcement, Cement Treated Aggregate, or other special construction techniques.

.3 The LTP material shall consist of a well-graded, crushed aggregate base material. If compaction of this material is problematic, open-graded, 19 mm diameter crushed stone may be substituted provided it is approved by the designer. Geofabrics and geogrids may be used at the discretion of the Geotechnical Engineer of Record (GER) as a compaction aid so that the gravel pad is compacted to a minimum dry density of 98% of the Standard Proctor Maximum Dry Density (SPMDD) value.

.3 Excavation of Footing Bottom

.1 Excavation and surface compaction of all footings is required.

.2 Foundation excavations to expose the tops of RIC elements shall be made in a workman-like manner, and shall be protected until concrete placement, with procedures and equipment best suited to:

.1 Avoid exposure to water,

.2 Prevent softening of the matrix soil between and around the RIC elements before pouring structural concrete, and

.3 Achieve direct and firm contact between the dense, undisturbed RIC elements and the concrete footing.

.3 All excavations for footing bottoms supported by RIC foundations shall be prepared in the following manner. Recommended procedures for achieving these goals are to:

.1 Limit over-excavation below the bottom of the footing to 75 mm (smooth-bucket recommended).

.2 Compaction of surface soil prior to construction of the granular pad shall be prepared using a motorized impact compactor "Jumping Jack," or similar (plate tampers shall only be used in granular soils and when approved by the RIC Designer). Loose or soft surficial soil over the entire footing bottom shall be recompacted or removed, respectively. If excessively soft subgrade soil is present (peat, organic silt) and preventing adequate compaction of the granular layer, a geogrid or other means of stabilizing the subgrade should be used as per direction of the RIC Designer prior to granular pad construction.

.3 Construct granular pad immediately after footing excavation is made and approved, preferably the same day as the excavation. If same day placement of the granular pad is not possible, open excavations shall be protected from surface water accumulation by means of a lean concrete mud-mat. Other methods must be pre-approved by the RIC Designer.

.4 The following criteria shall apply, and a written inspection report sealed by the Independent Testing Agency shall be furnished to the Installer to confirm:

.1 Water (which may soften the unconfined matrix soil between and around the RIC elements and may have detrimental effects on the supporting capability of the RIC reinforced subgrade) has not been allowed to pond in the footing excavation at any time.

.2 All RIC elements designed for each structural element have been exposed in the excavation.

.3 No excavations or drilled shafts have been made after installation of RIC elements within the excavation limits described in the RIC construction drawings, without the written consent of the Installer or RIC Designer.

END OF SECTION

DIVISION 32 INDEX

GRANULAR SUB-BASE

PART 1 GENERAL

1.1 RELATED SECTIONS

.1 Section 31 05 16 - Aggregate Materials.

.2 Section 32 11 16 – Granular Sub-Base

1.2 REFERENCES

.1 American Society for Testing and Materials (ASTM).

.1 ASTM C117, Standard Test Method for Material Finer Than 0.075 mm Sieve in Mineral Aggregates by Washing.

.2 ASTM C136, Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.

.3 ASTM D136, Standard Test Method for Sieve Analysis of Fine and Course Aggregated.

.4 ASTM D698, Stand Test Methods for Laboratory Compaction Characteristics of Soil Using standard Effort (12,400 ft-lbf/ft3)(600 N m/m3).

.5 ASTM D1557, Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3) (2,700 kN-m/m3).

.6 ASTM D4318, Standard Test Methods for Liquid Unit, Plastic Unit and Plasticity Index of Soils.

.7 Ontario Provincial Standard Specifications (OPSS) Division 10.

.2 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-8.2-, Sieves, Testing, Woven Wire, Metric.

.3 Ontario Provincial Standard Specifications (OPSS)

.1 OPSS MUNI 1010 – Material Specifications for Aggregates – Base, Subbase, Select Subgrade, and Backfill Material

1.3 DELIVERY, STORAGE, AND HANDLING

.1 Deliver and stockpile aggregates in accordance with Section 31 05 16 – Aggregate Materials.

PART 2 PRODUCTS

2.1 MATERIALS

.1 Granular base: material to Section 31 05 16- Aggregate Materials and the following requirements:

.1 Granular ‘B’ Type II to OPSS MUNI 1010

.2 Granular 'A' Type II to OPSS.MUNI 1010

2.2 SEQUENCE OF OPERATION

.1 Place granular base after granular sub-base surface is inspected and approved by Contract Administrator.

.1 Construct granular base to depth and grade in areas indicated.

.2 Ensure no frozen material is placed.

.3 Place material only on clean unfrozen surface, free from snow and ice.

.4 Place material using methods which do not lead to segregation or degradation of aggregate.

.5 Place material to full width in uniform layers not exceeding 150 mm compacted thickness.

.6 Shape each layer to smooth contour and compact to specified density before succeeding layer is placed.

.7 Remove and replace that portion of layer in which material becomes segregated during spreading.

.2 Compaction Equipment

.1 Compaction equipment to be capable of obtaining required material densities.

.3 Compacting

.1 Compact to no less than 100% of standard proctor maximum dry density (SPMDD).

.2 Shape and roll alternately to obtain smooth, even and uniformly compacted base.

.3 Apply water as necessary during compacting to obtain specified density.

.4 In areas not accessible to rolling equipment, compact to specified density with mechanical tampers approved by Contract Administrator.

.5 Correct surface irregularities by loosening and adding or removing material until surface is within specified tolerance.

2.3 SITE TOLERANCES

.1 Finished base surface to be within plus or minus 10 mm of established grade and cross section but not uniformly high or low.

2.4 PROTECTION

.1 Maintain finished base in condition conforming to this section until succeeding material is applied or until acceptance by Contract Administrator.

END OF SECTION

AGGREGATE BASE COURSE

PART 1 GENERAL

1.1 RELATED SECTIONS

.1 Section 31 05 16 - Aggregate Materials.

.2 Section 32 11 16 – Granular Sub-Base

1.2 REFERENCES

.1 American Society for Testing and Materials (ASTM).

.1 ASTM C117, Standard Test Method for Material Finer Than 0.075 mm Sieve in Mineral Aggregates by Washing.

.2 ASTM C136, Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.

.3 ASTM D136, Standard Test Method for Sieve Analysis of Fine and Course Aggregated.

.4 ASTM D698, Stand Test Methods for Laboratory Compaction Characteristics of Soil Using standard Effort (12,400 ft-lbf/ft3)(600 N m/m3).

.5 ASTM D1557, Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3) (2,700 kN-m/m3).

.6 ASTM D4318, Standard Test Methods for Liquid Unit, Plastic Unit and Plasticity Index of Soils.

.7 Ontario Provincial Standard Specifications (OPSS) Division 10.

.2 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-8.2-, Sieves, Testing, Woven Wire, Metric.

.3 Ontario Provincial Standard Specifications (OPSS)

.1 OPSS MUNI 1010 – Material Specifications for Aggregates – Base, Subbase, Select Subgrade, and Backfill Material

1.3 DELIVERY, STORAGE, AND HANDLING

.1 Deliver and stockpile aggregates in accordance with Section 31 05 16 – Aggregate Materials.

PART 2 PRODUCTS

2.1 MATERIALS

.1 Granular base: material to Section 31 05 16- Aggregate Materials and the following requirements:

.1 Granular ‘A’ to OPSS.MUNI 1010

AGGREGATE BASE COURSE

2.2 SEQUENCE OF OPERATION

.1 Place granular base after granular sub-base surface is inspected and approved by Contract Administrator.

.1 Construct granular base to depth and grade in areas indicated.

.2 Ensure no frozen material is placed.

.3 Place material only on clean unfrozen surface, free from snow and ice.

.4 Place material using methods which do not lead to segregation or degradation of aggregate.

.5 Place material to full width in uniform layers not exceeding 150 mm compacted thickness.

.6 Shape each layer to smooth contour and compact to specified density before succeeding layer is placed.

.7 Remove and replace that portion of layer in which material becomes segregated during spreading.

.2 Compaction Equipment

.1 Compaction equipment to be capable of obtaining required material densities.

.3 Compacting

.1 Compact to no less than 100% of standard proctor maximum dry density (SPMDD).

.2 Shape and roll alternately to obtain smooth, even and uniformly compacted base.

.3 Apply water as necessary during compacting to obtain specified density.

.4 In areas not accessible to rolling equipment, compact to specified density with mechanical tampers approved by Contract Administrator.

.5 Correct surface irregularities by loosening and adding or removing material until surface is within specified tolerance.

2.3 SITE TOLERANCES

.1 Finished base surface to be within plus or minus 10 mm of established grade and cross section but not uniformly high or low.

2.4 PROTECTION

.1 Maintain finished base in condition conforming to this section until succeeding material is applied or until acceptance by Contract Administrator.

END OF SECTION

ASPHALT PAVEMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

.1 Materials and installation for asphalt pavement for areas identified on the Contract Drawings.

1.2 RELATED SECTIONS

.1 Section 31 05 16 – Aggregate Materials.

.2 Section 31 23 33 – Excavating, Trenching and Backfilling.

.3 Section 32 11 23 – Aggregate Base Course.

.4 Section 32 16 15 – Concrete Walks, Curbs and Gutters.

.5 Section 32 17 28 – Pavement Marking.

1.3 REFERENCES

.1 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-8.2, Sieves Testing, Woven Wire, Metric.

.2 CAN/CGSB-16.1, Cutback Asphalts for Road Purposes.

.2 American Association of State Highway and Transportation Officials (AASHTO)

.1 AASHTO M320 - Standard Specification for Performance Grade Asphalt Binder.

.3 American Society for Testing and Materials International, (ASTM)

.1 ASTM C88, Standard Test Method for Soundness of Aggregates by Use of Sodium Sulphate or Magnesium Sulphate.

.2 ASTM C117, Standard Test Method for Material Finer Than 0.075 mm (No. 200) Sieve in Mineral Aggregates by Washing.

.3 ASTM C123, Standard Test Method for Lightweight Particles in Aggregate.

.4 ASTM C127, Standard Test Method for Density, Relative Density (Specific Gravity), and Absorption of Coarse Aggregate.

.5 ASTM C128, Standard Test Method for Density, Relative Density (Specific Gravity), and Absorption of Fine Aggregate.

.6 ASTM C131, Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.

.7 ASTM C136, Standard Method for Sieve Analysis of Fine and Coarse Aggregates.

.8 ASTM D698, Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3) (600 kN-m/m^3).

.9 ASTM D977 – Standard Specification for Emulsified Asphalt.

.10 ASTM D995, Standard Specification for Requirements Mixing Plants for Hot-Mixed, Hot-Laid Bituminous Paving Mixtures.

.11 ASTM D2419, Standard Test Method for Sand Equivalent Value of Soils and Fine Aggregate.

.12 ASTM D3203, Standard Test Method for Percent Air Voids in Compacted Dense and Open Bituminous Paving Mixtures.

.4 Asphalt Institute (AI)

.1 Asphalt Institute MS-2-1993 Sixth Edition, Mix Design Methods for Asphalt Concrete.

.5 Ontario Provincial Standard Specifications (OPSS).

1.4 SUBMITTALS

.1 Submit asphalt concrete mix design to Contract Administrator for approval.

.2 Materials to be tested by testing laboratory approved by Contract Administrator.

.3 Submit test certificates showing suitability of materials at least 4 weeks prior to commencing work.

.4 Inform Contract Administrator of proposed source of aggregates and provide access for sampling at least 4 weeks prior to commencing work.

PART 2 PRODUCTS

2.1 MATERIALS

.1 Granular base and sub-base material: to Section 31 05 16 – Aggregate Materials, Section 32 11 16 Granular Sub-Base and Section 31 11 23 Aggregate Base Courses.

.2 HL-3 and HL-8 hot mix asphalt, compacted thickness as indicated on drawings, PGAC 58-34, per OPSS 1001, 1003, 1101 and 1150.

.3 Asphalt cement: to AASHTO M320.

.4 Aggregates per Section 31 05 16 – Aggregate Materials; gradation per OPSS 1003.

.5 Asphalt tack coat: to SS-1 or RS-1 as per OPSS 1103, depending on weather at the time of asphalt paving operations.

2.2 MIX DESIGN

.1 Job mix formula to be approved by Contract Administrator.

.2 Do not change job-mix without prior approval of Contract Administrator. When change in material source proposed, new job-mix formula to be approved by Contract Administrator.

.3 Return plant dust collected during processing to mix in quantities acceptable to Contract Administrator.

2.3 EQUIPMENT

.1 Pavers: mechanical grade controlled self-powered pavers capable of spreading mix within specified tolerances, true to line, grade and crown indicated.

.2 Rollers: sufficient number of rollers of type and weight to obtain specified density of compacted mix. Roller combination shall be as per OPSS 310 for a production rate of 120 t/hr.

.3 Vibratory rollers for parking lots and driveway:

.1 Minimum drum diameter: 750mm.

.2 Maximum amplitude of vibration (machine setting): 0.5mm for lifts less than 40mm thick.

.4 Haul trucks: of sufficient number and of adequate size, speed and condition to ensure orderly and continuous operation and as follows:

.1 Boxes with tight metal bottoms.

.2 Covers of sufficient size and weight to completely cover and protect asphalt mix when truck fully loaded.

.3 In cool weather or for long hauls, insulate entire contact area of each truck box.

.5 Suitable hand tools

PART 3 EXECUTION

3.1 PREPARATION

.1 Fine grade aggregate base course, add/remove aggregate as required.

.2 Re-compact aggregate base course to achieve 100% Standard Proctor Maximum Dry Density (SPMDD) as required.

.3 Install tack coat on all milled surfaces and on all vertical surfaces abutting new asphalt.

3.2 ASPHALT PAVING

.1 Obtain approval of primer from Contract Administrator before placing asphalt mix.

.2 Place asphalt mix only when base or previous course is dry and air temperature is above 7°C and rising.

.3 When temperature of surface on which the material is to be placed falls below 10° C, provide extra rollers as necessary to obtain required compaction before cooling.

.4 Place asphalt concrete in compacted layers as indicated on construction drawings but not exceeding 50 mm.

.5 Minimum 120°C mix temperature required when spreading.

.6 Maximum 160°C mix temperature permitted at any time.

.7 Compact each course with roller as soon as it can support roller weight without undue cracking or displacement.

.8 Compact asphalt concrete to density not less than 92 % of Maximum Relative Density (MRD) obtained with Marshall specimens prepared in accordance with ASTM D1559, from samples of mix being used. Roll until roller marks are eliminated.

.9 Keep roller speed slow enough to avoid mix displacement and do not stop roller on fresh pavement.

.10 Moisten roller wheels with water to prevent pick up of material.

.11 Compact mix with hot tampers or other equipment approved by Contract Administrator in areas inaccessible to roller.

.12 Finish surface to be within 5 mm of design elevation and with no irregularities greater than 10 mm in 4.5 m.

.13 Repair areas showing checking, rippling or segregation as directed by Contract Administrator.

3.3 JOINTS

.1 Remove surplus material from surface of previously laid strip. Do not deposit on surface of freshly laid strip. Complete joints to existing asphalt as indicated on contract drawings.

.2 Paint contact surfaces of existing structures such as manholes, curbs or gutters with tack coat prior to placing adjacent pavement.

.3 For cold joints, cut back to full depth vertical face and tack face with tack coat.

.4 For longitudinal joints, overlap previously laid strip with spreader by 150 mm.

.5 Carefully place and compact hot asphaltic material against joints.

.6 Mill existing asphalt and step connect to existing asphalt as per Contract Drawings where existing asphalt thickness is equal to or greater than 80 mm. Tack coat vertical and horizontal surfaces.

3.4 PROTECTION

.1 Keep vehicular traffic off newly paved areas until paving surface temperature has cooled below 38°C. Do not permit stationary loads on pavement until 24 hours after placement.

.2 Provide access to buildings as required. Arrange paving schedule so as not to interfere with normal use of premises.

END OF SECTION

CONCRETE WALKS, CURBS, AND GUTTERS

PART 1 GENERAL

1.1 RELATED SECTIONS

.1 Section 03 30 00 – Cast-In-Place Concrete

.2 Section 31 23 33 - Excavating, Trenching and Backfilling.

.3 Section 32 11 23 – Aggregate Base Courses.

1.2 REFERENCES

.1 Canadian Standards Association (CSA).

.1 CAN/CSA-A23.1/A23.2, Concrete Materials and Methods of Concrete Construction/Methods of Test for Concrete.

.2 American Society for Testing and Materials (ASTM).

.1 ASTM D698, Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400ft-lbf/ft^3) (600kN-m/m^3).

.2 ASTMD2628, Standard Specification for Performed Polychloroprene Elastomeric Joint Seals for concrete Pavements.

.3 Ontario Provincial Standard Specifications (OPSS) and Drawings (OPSD)

1.3 TESTING

.1 Testing of concrete to CAN3-A23.1.

1.4 ENVIRONMENTAL CONDITIONS

.1 If temperature is below 5°C or if Contract Administrator anticipates a temperature drop below this value within the next 24 hours, take all necessary measures to protect concrete from freezing.

.2 Do not place concrete on frozen base.

PART 2 PRODUCTS

2.1 MATERIALS

.1 Concrete mixes and materials: according to Section 03 30 00 – Cast-in-Place Concrete.

.2 Granular base: Granular “A” to OPSS.MUNI 1010, to Section 32 11 23 – Aggregate Base Courses and to Section 31 23 33 - Excavating, Trenching and Backfilling.

.3 Non-staining mineral type form release agent: chemically active release agents containing compounds that react with free lime to provide water soluble soap.

.4 Curing blankets shall be burlap.

.5 Expansion joints to be 12mm thick bituminous fibre per OPSS 1308.

.6 Formwork shall be as per OPSS 919.

.7 Tactile walking surface indicator plates (TWSI) shall be made from gray cast iron conforming to ASTM A 48M, Class 35B and shall be bare and not coated with paint or other coatings. TWSI plates shall be parallel with the curb radius where applicable, which will require the use of radius plates in some locations.

PART 3 EXECUTION

3.1 GRADE PREPARATION

.1 Do grade preparation work in accordance with Section 31 23 33 - Excavating, Trenching and Backfilling.

.2 Construct embankments using excavated material free from organic matter or other objectionable materials. Dispose of surplus and unsuitable excavated material off site.

.3 Place fill in maximum 150 mm layers and compact to at least 95% of Standard Proctor Maximum Dry Density (SPMDD) to ASTM D698.

.4 Ensure that Sub Grade and Granular Base preparation has been inspected and approved by Contract Administrator before commencing work.

3.2 GRANULAR BASE

.1 Obtain Contract Administrator approval of subgrade before placing granular base.

.2 Place granular base material to lines, widths, and depths as indicated.

.3 Compact granular sub base to at least 100% of Standard Proctor Maximum Dry Density (SPMDD) to ASTM D698.

3.3 FORMING

.1 Form vertical surfaces to full depth using forming material that will not deform under loading by plastic concrete.

.2 Securely position forms to required lines and grades.

.3 Coat forms with form release agent.

.4 Obtain approval of forms before placing concrete.

.5 Install metal fabrication as required.

.6 Install rigid insulation at all barrier free doors.

.7 Monolithic curb and sidewalk will not be allowed.

3.4 CONCRETE

.1 Obtain Contract Administrator approval of granular base and reinforcing steel prior to placing concrete.

.2 Do concrete work in accordance with OPSS 351 and OPSS.MUNI 353.

.3 Finish exposed surface to a smooth, uniform finish, free of open texturing and exposed aggregate. Do not work more mortar to the surface than required. Do not use neat cement as a dryer to facilitate finishing.

.4 Immediately after floating, give sidewalk surface uniform finish to produce regular corrugations not exceeding 2 mm deep, by drawing broom in direction normal to centre line.

.5 Provide edging as indicated with 10 mm radius edging tool.

.6 Cure and protect concrete in accordance with OPSS 904.

.7 No water may be added to the concrete on site or in transit. Concrete which is unworkable or that is too stiff to produce a satisfactory product shall be discarded.

3.5 TOLERANCES

.1 Finish surfaces to within 3mm in 3m as measured with 3m straightedge placed on surface.

3.6 EXPANSION AND CONTRACTION JOINTS

.1 Install tooled transverse contraction joints after floating, when concrete is stiff, but still plastic, at intervals of 1.5 m.

.2 Install expansion joints at intervals of 6 m.

.3 Install expansion joints around manholes and catch basins and along length adjacent to concrete curbs, catch basins, buildings, or permanent structure.

.4 When sidewalk is adjacent to curb, make joints of curb, gutters and sidewalk coincide.

3.7 ISOLATION JOINTS

.1 Install isolation joints around manholes and catch basins and along length adjacent to concrete curbs, catch basins, buildings, or permanent structure.

.2 Install joint filler in isolation joints as indicated.

3.8 CURING

.1 When the air temperature is less than 25 C, two layers of burlap shall be carefully laid on the surface of the concrete. Strips shall overlap by 75 mm and shall be held down as required against displacement. The burlap shall be maintained in place and kept thoroughly wet for a minimum of 24 hours.

.2 If the air temperature exceeds 25 °C, two layers of burlap shall be used as a curing agent and shall be placed upon the concrete setting up, shall be then wetted and kept in a wet condition for 96 hours after the pour.

.3 During hot weather, the Contractor must cool down the forms and aggregate as outlined in OPSS.MUNI 904.

3.9 BACKFILL

.1 Allow concrete to cure for 7 days prior to backfilling.

.2 Backfill to designated elevations with material approved by Contract Administrator. Compact and shape to required contours as indicated or as directed by Contract Administrator.

END OF SECTION

PAVEMENT MARKINGS

PART 1 GENERAL

1.1 RELATED SECTIONS

.1 Section 32 12 16 – Asphalt Paving

1.2 REFERENCES

.1 Master Painters Institute (MPI)

.1 Architectural Painting Specification Manual, MPI #32 Traffic Markings Paint, Alkyd.

.2 Canadian General Standards Board (CGSB)

.1 CAN/CGB -1.5-M91, Low Flash Petroleum Spirits thinner.

.2 CGSB 1-GP-12c-68, Standard Paint Colours.

.3 CGSB 1-GP-71-83, Method of Testing Paints and Pigments.

.3 Ontario Provincial Standard Specifications (OPSS).

1.3 SUBMITTALS

.1 Submit to Contract Administrator product data sheets for pavement markings and include product characteristics, performance of criteria, physical size, finish and limitations.

PART 2 PRODUCTS

2.1 MATERIALS

.1 Paint and Markings:

.1 Water borne traffic paint as per OPSS 1716.

.2 Colour: yellow matching the yellow paint chip of the Ontario Ministry of Transportation.

.3 Glass beads are not required.

.4 In accordance with MPI recommendation for surface conditions.

.2 Thinner: to MPI listed manufacturer.

PART 3 EXECUTION

3.1 EQUIPMENT REQUIREMENTS

.1 Paint applicator to be an approved pressure type mobile distributor capable of applying paint in single, double and dashed lines. Applicator to be capable of applying marking components uniformly, at rates specified, and to dimensions as indicated, and to have positive shut-off.

3.2 CONDITION OF SURFACES

.1 Pavement surface to be dry, free from ponded water, frost, ice, dust, oil, grease and other foreign materials.

3.3 APPLICATION

.1 Lay out pavement markings as indicated on drawings.

.2 Unless otherwise approved by Contract Administrator, apply paint only when air temperature is above 10°C, wind speed is less than 60km/h and no rain is forecast within next 4h.

.3 Apply traffic paint evenly at rate of 3m2/L.

.4 Do not thin paint unless approved by Contract Administrator.

.5 Symbols and letters to conform to dimensions indicated.

.6 Paint lines to be of uniform colour and density with sharp edges.

.7 Thoroughly clean distributor tank before refilling with paint of different colour.

3.4 TOLERANCE

.1 Paint markings to be within plus or minus 12mm of dimensions indicated.

.2 Remove incorrect markings.

3.5 PROTECTION OF COMPLETED WORK

.1 Protect pavement markings until dry.

END OF SECTION

CHAIN LINK FENCES AND GATES

PART 1 GENERAL

1.1 RELATED SECTIONS

.1 Section 01 33 00 - Submittal Procedures.

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

.3 Section 09 91 13 - Exterior Painting.

1.2 REFERENCES

.1 American Society for Testing and Materials (ASTM).

.1 ASTM A53/A53M, Standard Specification for Pipe, Steel, Black and Hot-dipped, Zinc-Coated Welded and Seamless.

.2 ASTM A90/A90M, Standard Test Method for Weight Mass of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings.

.3 ASTM A116, Standard Specification for Metallic-Coated, Steel-Woven Wire Fence Fabric.

.4 ASTM A121, Standard Specification for Zinc-Coated (Galvanized) Steel Barbed Wire.

.5 ASTM A123/A123M, Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel.

.6 ASTM A641/A641M, Standard Specification for Zinc-coated (Galvanized) Carbon Steel Wire.

.7 A653/A653M, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvanized) by the Hot-Dip Process.

.2 Canadian General Standards Board (CGSB).

.1 CAN/CGSB-138.1, Fabric for Chain Link Fence.

.2 CAN/CGSB-138.2, Steel Framework for Chain Link Fence.

.3 CAN/CGSB-138.3, Installation of Chain Link Fence.

.4 CAN/CGSB-138.4,Gates for Chain Link Fence.

.5 CAN/CGSB-1.181, Ready-Mixed Organic Zinc-Rich Coating.

.3 Canadian Standards Association (CSA).

.1 CSA-A23.1/A23.2, Concrete Materials and Methods of Concrete Construction/Methods of Test for Concrete.

.2 CAN/CSA-G164, Hot Dip Galvanizing of Irregularly Shaped Articles.

.3 CAN/CSA-A3000, Cementitious Materials Compendium. Includes:

.4 Ontario Provincial Standard Specifications (OPSS):

.1 OPSS 541 – Construction Specification for Chain-Link Fence

1.3 SUBMITTALS

.1 Submit WHMIS MSDS – Material Safety Data Sheets.

.2 Submit manufacturer's data sheets including:

.1 Fence fabric gauge and finish.
.2 Post and rail dimension and finish.
.3 Gate frame dimension and finish.
.4 Required fittings and hardware.

PART 2 PRODUCTS

2.1 MATERIALS

.1 Concrete mixes and materials: in accordance with Section 03 30 00- Cast-in-Place Concrete.

.1 Nominal coarse aggregate size: 20 mm.
.2 Compressive strength: 20 MPa minimum at 28 days.

.2 Chain-link fence fabric: to CAN/CGSB-138.1.

.1 Type 1, Class A, medium style.
.2 Height of fabric: as indicated.

.3 Posts, braces and rails: to CAN/CGSB-138.2, galvanized steel pipe. Dimensions as indicated.

.4 Bottom tension wire: to CAN/CGSB-138.1, Table 2 single strand, galvanized steel wire, 5 mm diameter.

.5 Tie wire fasteners: to CAN/CGSB-138.1, Table 2 (steel wire), single strand, galvanized steel wire confirming to requirements of fence fabric, 5 mm diameter.

.6 Tension bar: to A653/A653M, 5 x 20 mm minimum galvanized steel.

.7 Tension bar brands: 3 x 20 mm minimum galvanized steel or 5 x 20 mm minimum aluminum.

.8 Gates: to CAN/CGSB-138.4.

.9 Gate frames: to ASTM A53/A53M, galvanized steel pipe, standard weight 45 mm outside diameter pipe for outside frame, 35mm outside diameter pipe for interior bracing.

.1 Fabricate gates as indicated with electrically welded joints, and hot-dip galvanized after welding.

.2 Fasten fence fabric to gate with twisted selvage at top.

.3 Furnish gates with galvanized malleable iron hinges, latch and latch catch with provision for padlock which can be attached and operated from either side of installed gate.

.4 Furnish double gates with chain hook to hold gates open and centre rest with drop bolt for closed position.

.10 Fittings and hardware: to CAN/CGSB-138.2, cast aluminum alloy, galvanized steel or malleable or ductile cast iron.

.1 Tension bar bands: 3 x 20 mm minimum galvanized steel or 5 x 20 mm minimum aluminum.

.2 Post caps to provide waterproof fit, to fasten securely over posts and to carry top rail.

.3 Overhang tops to provide waterproof fit, to hold top rails and an outward inward projection to hold barbed wire overhang.

.4 Provide projection with clips or recesses to hold 3 strands of barbed wire spaced 100 mm apart.

.5 Projection of approximately 300 mm long to project from fence at 45° above horizontal.

.6 Turnbuckles to be drop forged.

.11 Organic zinc rich coating: to CAN/CGSB-1.181.

.12 Barbed wire : 2.5 mm diameter galvanized steel wire to ASTM A121, 4 point barbs 125 mm spacing.

.13 Grounding rod: 16 mm diameter copper well rod, 3 m long.

2.2 FINISHES

.1 Galvanizing:

.1 For chain link fabric: to CAN/CGSB-138.1, Grade2.

.2 For pipe: 550 g/m^2 minimum to ASTM A90.

.3 For barbed wire: to ASTM A121, Class 2.

.4 For other fittings: to CAN/CSA-G164.

PART 3 EXECUTION

3.1 GRADING

.1 Remove debris and correct ground undulations along fence line to obtain smooth uniform gradient between posts.

.1 Provide clearance between bottom of fence and ground surface of 30 mm to 50 mm.

3.2 ERECTION OF FENCE

.1 Erect fence along lines as indicated and as directed by Contract Administrator and in accordance with CAN/CGSB-138.3.

.2 Excavate post holes 1200 mm depth x 300 mm diameter by methods approved by Contract Administrator.

.3 Space line posts 3 m apart, measured parallel to ground surface.

.4 Space straining posts at equal intervals not exceeding 150 m if distance between end or corner posts on straight continuous lengths of fence over reasonably smooth grade is greater than 150 m.

.5 Install additional straining posts at sharp changes in grade and where directed by Contract Administrator.

.6 Install corner post where change in alignment exceeds 10˚.

.7 Install end posts at end of fence and at buildings. Install gate posts on both sides of gate openings.

.8 Place concrete in sonotube forms for posts required to be set in concrete then embed posts into concrete to minimum 1200 mm depth.

.1 Extend concrete 50 mm above ground level and slope to drain away from posts.

.2 Brace to hold posts in plumb position and true to alignment and elevation until concrete has set.

.9 Do not install fence fabric until concrete has cured minimum of 5 days.

.10 Install brace between end and gate posts and nearest line post, placed in centre of panel and parallel to ground surface.

.1 Install braces on both sides of corner and straining posts in similar manner.

.11 Install overhang tops and caps.

.12 Install top rail between posts and fasten securely to posts and secure waterproof caps and overhang tops.

.13 Install bottom tension wire, stretch tightly and fasten securely to end, corner, gate and straining posts with turnbuckles and tension bar bands.

.14 Lay out fence fabric. Stretch tightly to tension recommended by manufacturer and fasten to end, corner, gate and straining posts with tension bar secured to post with tension bar bands spaced at 300 mm intervals.

.1 Knuckled selvedge at bottom.

.2 Twisted selvedge at top.

.15 Secure fabric to top rails, line posts and bottom tension wire with tie wires at 450 mm intervals.

.1 Give tie wires minimum two twists.

.16 Install barbed wire strands and clip securely to lugs of each projection.

.17 Install grounding rods as indicated.

3.3 INSTALLATION OF GATES

.1 Install gates in locations as indicated.

.2 Level ground between gate posts and set gate bottom approximately 40 mm above ground surface.

.3 Determine position of centre gate rest for double gate. Cast gate rest in concrete as directed. Dome concrete above ground level to shed water.

.4 Install gate stops where indicated.

3.4 TOUCH UP

.1 Clean damaged surfaces with wire brush removing loose and cracked coatings. Apply two coats of organic zinc-rich paint to damaged areas in accordance with Section 09 91 13 – Exterior Painting or as approved by the Contract Administrator. Pre-treat damaged surfaces according to manufacturers' instructions for zinc-rich paint.

3.5 CLEANING

.1 Clean and trim areas disturbed by operations. Dispose of surplus material as directed by Contract Administrator.

END OF SECTION

BLOCK RETAINING WALLS

PART 1 GENERAL

1.1 SCOPE

.1 This specification covers the requirements for the design, supply, placement, and finishing of the pre-cast concrete block retaining walls identified in the design.

.2 This specification also covers the requirements for the foundation preparation, and accessories required for a complete installation of the retaining walls.

.3 The design indicates the basic requirements of the retaining wall system, the contractor will complete the design, supply and installation as per the suppliers design requirements..

1.2 RELATED SECTIONS

.1 Division 1 – General Requirements

.2 Section 31 05 16 – Aggregate Materials

.3 Section 31 23 19 – Dewatering

.4 Section 31 32 19 – Geotextiles

.5 Section 31 23 33 – Excavating, Trenching and Backfilling

.6 Section 32 11 16 – Granular Sub-Base

.7 Section 32 16 15 – Concrete Walks, Curbs and Gutters

1.3 REFERENCES

.1 Occupational Health and Safety Act, R.S.O. 1990, c.O.1, as amended.

.2 Canadian Standards Association (CSA International)

- .1 CSA-G30.3-M1983(R1998), Cold-Drawn Steel Wire for Concrete Reinforcement.
- .2 CSA-G30.5-M1983(R1998), Welded Steel Wire Fabric for Concrete Reinforcement.
- .3 CAN/CSA-A3000-23, Cementitious Materials Compendium. Includes:
  - .1 CAN/CSA-A23.5-98, Supplementary Cementing Materials
- .4 ASTM C94/C94M-23 Ready-Mixed Concrete.
- .5 ASTM C1372-17 Segmental Retaining Wall Units.

.3 All references as amended.

1.4 DESIGN CRITERIA

.1 Engage a professional engineer, registered in the Province of Ontario, who has demonstrated competence in retaining wall design, to design and supervise construction of the retaining walls to execute construction of permanent Works.

.2 Take full responsibility for design, supply, placement, installation of the retaining wall system.

.3 Comply with all safety requirements of The Occupational Health and Safety Regulations and Ontario Building Code.

.4 Consider both internal and external stability of wall system in design. External stability to include safety against sliding, overturning, bearing failure and slip circle failure.

1.5 STORAGE AND HANDLING

.1 Follow storage and handling instructions of supplier of Redi Rock retaining wall system.

.2 Prevent chipping and cracking of precast concrete facing blocks and damage to embedded connectors for reinforcing elements. Replace damaged blocks as directed by Contract Administrator

.3 Contractor shall prevent excessive mud, wet cement and like materials from coming in contact with units.

1.6 SUBMITTALS

.1 Submit shop drawings as per the requirements of Specification 01 33 00 Submittals. Shop drawing to bear seal and signature of a Professional Engineer, registered in the Province of Ontario, who has carried out the design and who will provide construction supervision of permanent installation.

.2 Indicate on shop drawings the following:

.1 Dimensions and elevations

.2 Relationship to new and existing structures and utilities

.3 Material designations, grades, sizes, mix design, etc.

.4 Permanent tie backs locations, size and embedment.

.5 Design loads, design assumptions, surcharge loads and all loading restrictions.

.6 Identification of the design Engineer of record who will be responsible for design calculations, checking of shop drawings, inspection and supervision of fabrication and installation.

.7 Complete field instructions required during installation and any other pertinent information..

PART 2 PRODUCTS

2.1 WALL SYSTEMS

.1 Only proprietary wall systems are acceptable.

.2 Acceptable systems: Redi-Rock International segmental retaining wall system. Main wall shall consist of a combination of 28", 41", and 60" Series Blocks.

.3 All pre-cast concrete shall provide a minimum 35 Mpa strength.

.4 The precast product shall provide a Limestone type face finish.

2.2 SUBDRAINS

.1 Subdrain is to be 100mm diameter perforated polyethylene pipe covered with a knitted geotextile sock as per OPSS 1860. Subdrain outlet to be 2.5m long, 150mm diameter galvanized CSP c/w rodent grate. Coordinate the sub-drain outlet(s) with the Civil design drawings.

2.3 GRANULAR MATERIALS

.1 All granular materials will be as per Specification 31 05 16 – Aggregate Materials.

.1 Granulars: OPSS 1010.

.1 Granular A Type II

.2 Granular B Type II

.3 19mm Clear Stone.

2.4 GEOTEXTILE

.1 All granular materials will be as per Specification 31 32 19 – Geotextiles.

.1 Class II Non-woven geotextile as per OPSS 1860.

PART 3 EXECUTION

3.1 INSTALLATION

.1 Arrange for technical representative of supplier of to be on site for initial stage of wall construction to ensure correct installation procedures. Arrange for subsequent visits as directed by Contract Administrator.

.2 Excavate, remove and dispose of materials of all types and descriptions, including rock and concrete encountered during the installation of the block wall and dispose of any material not useable for backfill off site.

.3 Supply, place and compact minimum 300mm thick by 2400mm wide Granular B and 150mm thick by 2400mm wide Granular A bedding material compacted to

100% SPD. Granular bedding shall be placed on undisturbed native soils or suitable replacement fill. This bedding shall be the minimum founding platform for the retaining walls. The founding granulars shall be underlain by geotextile.

.4 At all locations where the retaining walls abut the building structures, the contractor shall place, at a minimum, two layers of expansion joint materials, as per the material specifications of Section 32 16 15.

.5 Supply, place and compact Granular B backfill material a min. thickness 300mm lifts behind/in front of, block to 100% SPD in maximum 200mm lifts.

.6 Supply, place and compact select subgrade backfill material and compact to 100% SPD in maximum 200mm lifts.

.7 Place non-woven geotextile between granular backfill material and select subgrade or native material to maintain separation of dissimilar materials.

.8 Install block as per manufacturer's recommendations.

.9 Supply and place 100mm perforated polyethylene pipe c/w knitted geotextile sock as indicated on drawings. Slope perforated pipe at a min. 1% to outlet; min. 2m beyond end of new block wall. Supply and place a 150mm CSP outlet pipe; 2.5m long complete with a galvanized rodent screen at location of the subdrain outlet.

.10 Backfill material behind block wall is to be compacted with a plate packer. No wheeled loads will be permitted to travel over backfill behind block wall. Backfill shall be placed and compacted to the top of each block course upon the placement of each successive course.

.11 The first course of wall units shall be placed on the granular bedding with the aesthetic surface facing out and the front edges

END OF SECTION

TOPSOIL PLACEMENT AND GRADING

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

.1 Section 31 23 33 – Excavating, Trenching and Backfilling

.2 Section 32 92 19.16 – Hydraulic Seeding

1.2 REFERENCES

.1 Agriculture and Agri-Food Canada

.1 The Canadian System of Soil Classification, Third Edition, 1998.

.2 Canadian Council of Ministers of the Environment

.1 PN1340-2005, Guidelines for Compost Quality.

.3 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.

1.3 DEFINITIONS

.1 Compost:

.1 Mixture of soil and decomposing organic matter used as fertilizer, mulch, or soil conditioner.

.2 Compost is processed organic matter containing 40% or more organic matter as determined by Walkley-Black or Loss on Ignition (LOI) test.

.3 Product must be sufficiently decomposed (i.e. stable) so that any further decomposition does not adversely affect plant growth (C:N ratio below (25) (50)) and contains no toxic or growth inhibiting contaminates.

.4 Composed bio-solids to: CCME Guidelines for Compost Quality, Category (A) (B).

1.4 WASTE MANAGEMENT AND DISPOSAL

.1 Separate waste materials for reuse and recycling.

.2 Divert unused soil amendments from landfill to official hazardous material collections site approved by Consultant.

.3 Do not dispose of unused soil amendments into sewer systems, into lakes, streams, onto ground or in locations where it will pose health or environmental hazard.

PART 2 PRODUCTS

2.1 TOPSOIL

.1 Topsoil: imported screened or native screened topsoil with a mixture of particulates, microorganisms and organic matter which provides suitable medium for supporting intended plant growth.

.1 Soil texture based on The Canadian System of Soil Classification, to consist of 20 to 70 % sand, minimum 7 % clay, and contain 2 to 10 % organic matter by weight.

.2 Contain no toxic elements or growth inhibiting materials.

.3 Finished surface free from:

.1 Debris and stones over 25 mm diameter.

.2 Course vegetative material, 10 mm diameter and 100 mm length, occupying more than 2% of soil volume.

.4 Consistence: friable when moist.

2.2 SOIL AMENDMENTS

.1 Fertilizer:

.1 Fertility: major soil nutrients present in following amounts:

.2 Nitrogen (N): 20 to 40 micrograms of available N per gram of topsoil.

.3 Phosphorus (P): 40 to 50 micrograms of phosphate per gram of topsoil.

.4 Potassium (K): 75 to 110 micrograms of potassium per gram of topsoil.

.5 Calcium, magnesium, sulfur, and micro-nutrients present in balanced ratios to support germination and/or establishment of intended vegetation.

.6 Ph value: 6.5 to 8.0.

.2 Peatmoss:

.1 Derived from partially decomposed species of Sphagnum Mosses.

.2 Elastic and homogeneous, brown in colour.

.3 Free of wood and deleterious material which could prohibit growth.

.4 Shredded particle minimum size: 5 mm.

.3 Sand: washed coarse silica sand, medium to course textured.

.4 Organic matter: compost Category A in accordance with CCME PN1340, unprocessed organic matter, such as rotted manure, hay, straw, bark residue or sawdust, meeting the organic matter, stability, and contaminant requirements.

.5 Fertilizer: industry accepted standard medium containing nitrogen, phosphorous, potassium and other micro-nutrients suitable to specific plant species or application or defined by soil test.

2.3 SOURCE QUALITY CONTROL

.1 Advise Consultant of sources of topsoil and manufactured topsoil to be utilized with sufficient lead time for testing.

.2 Contractor is responsible for amendments to supply topsoil as specified.

.3 Soil testing by recognized testing facility for PH, P and K, and organic matter.

.4 Testing of topsoil will be carried out by testing laboratory designated by Consultant.

.1 Soil sampling, testing and analysis to be in accordance with Provincial standards.

PART 3 EXECUTION

3.1 TEMPORARY EROSION AND SEDIMENTATION CONTROL

.1 Provide temporary erosion and sedimentation control measures as per Section 31 32 25 – Erosion and Sedimentation Control.

3.2 PREPARATION OF EXISTING GRADE

.1 Verify that grades are correct.

.1 If discrepancies occur, notify Consultant and do not commence work until instructed by Consultant.

.2 Grade soil, eliminating uneven areas and low spots, ensuring positive drainage.

.3 Remove debris, roots, branches, stones in excess of 50 mm diameter and other deleterious materials.

.1 Remove soil contaminated with calcium chloride, toxic materials, and petroleum products.

.2 Remove debris which protrudes above surface.

.3 Dispose of removed material off site.

.4 Cultivate entire area which is to receive topsoil to minimum depth of 100 mm.

.1 Cross cultivate those areas where equipment used for hauling and spreading has compacted soil.

3.3 PLACING AND SPREADING OF TOPSOIL/PLANTING SOIL

.1 Place topsoil after Consultant has accepted subgrade.

.2 Spread topsoil in uniform layers not exceeding 150 mm.

.3 For sodded areas keep topsoil 15 mm below finished grade.

.4 Spread topsoil as indicated to following minimum depths after settlement.

.1 100 mm for seeded areas.

.2 100 mm for sodded areas.

.3 300 mm for flower beds.

.4 500 mm for shrub beds.

.5 Manually spread topsoil/planting soil around trees, shrubs, and obstacles.

3.4 FINISH GRADING

.1 Grade to eliminate rough spots and low areas and ensure positive drainage.

.1 Prepare loose friable bed by means of cultivation and subsequent raking.

.2 Consolidate topsoil to required bulk density using equipment approved by Consultant.

.1 Leave surfaces smooth, uniform, and firm against deep foot printing.

3.5 ACCEPTANCE

.1 Consultant will inspect and test topsoil in place and determine acceptance of material, depth of topsoil and finish grading.

3.6 SURPLUS MATERIAL

.1 Dispose of all surplus materials offsite.

3.7 CLEANING

.1 Leave Work area clean at the end of each day.

.2 Upon completion of installation, remove surplus materials, rubbish, tools, and equipment.

END OF SECTION

HYDRAULIC SEEDING

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

.1 Section 31 23 33 – Excavating, Trenching and Backfilling

.2 Section 32 91 19.13 – Topsoil Placement and Grading

1.2 REFERENCES

.1 Ontario Provincial Standard Specifications (OPSS) by the Ontario Ministry of Transportation:

.1 OPSS.MUNI 804 – Construction Specification for Seed and Cover, November 2014.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00 - Submittals.

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for seed, mulch, tackifier, fertilizer, liquid soil amendments and micronutrients.

.2 Submit 2 copies of WHMIS MSDS in accordance with Section 01 35 30 - Safety Requirements.

.3 Submit in writing 7 days prior to commencing work:

.1 Volume capacity of hydraulic seeder in litres.

.2 Amount of material to be used per tank based on volume.

.3 Number of tank loads required per hectare to apply specified slurry mixture per hectare.

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

.5 Test Reports: submit certified test reports showing compliance with specified performance characteristics and physical properties.

1.4 QUALITY ASSURANCE

.1 Qualifications:

.1 Landscape Contractor: to be a Member in Good Standing of Horticultural Trades Association.

.2 Landscape Planting Supervisor: Landscape Industry Certified Technician with Softscape Installation designation.

.3 Landscape Maintenance Supervisor: Landscape Industry Certified Technician with Turf Maintenance designation.

1.5 WARRANTY

.1 For seeding, 12 months warranty period is extended to 24 months.

.2 Contractor hereby warrants that seeding will remain free of defects in accordance with General Conditions CCDC GC 12.3, but for 24 months.

.3 End-of-warranty inspection will be conducted by Consultant.

PART 2 PRODUCTS

2.1 MATERIALS

.1 Seed: "Canada pedigreed grade" in accordance with Government of Canada Seeds Act and Regulations.

.1 Grass mixture: "Certified", "Canada No. 1 Lawn Grass Mixture" in accordance with Government of Canada "Seeds Act" and "Seeds Regulations".

.1 Mixture composition:

.1 55% Creeping Red Fescue.

.2 27% Canada Blue Grass.

.3 15% Perennial Rye Grass.

.4 3% White Clover.

.2 Mulch: specially manufactured for use in hydraulic seeding equipment, non-toxic, water activated, green colouring, free of germination and growth inhibiting factors and as per OPSS.MUNI 804.

.3 Tackifier: as per OPSS.MUNI 804.

.4 Water: free of impurities that would inhibit germination and growth.

.5 Fertilizer: 8-32-16

PART 3 EXECUTION

3.1 PROTECTION OF EXISTING CONDITIONS

.1 Protect structures, signs, guide rails, fences, plant material, utilities and other surfaces not intended for spray.

.2 Immediately remove any material sprayed where not intended as directed by Consultant.

3.2 PREPARATION OF SURFACES

.1 Do not perform work under adverse field conditions such as wind speeds over 10 km/h, frozen ground or ground covered with snow, ice or standing water.

.2 Fine grade areas to be seeded free of humps and hollows.

.1 Ensure areas are free of deleterious and refuse materials.

.3 Cultivated areas identified as requiring cultivation to depth of 25 mm.

.4 Ensure areas to be seeded are moist to depth of 150 mm before seeding.

.5 Obtain Consultant's approval of grade and topsoil depth before starting to seed.

3.3 PREPARATION OF SLURRY

.1 Measure quantities of materials by weight or weight-calibrated volume measurement satisfactory to Consultant. Supply equipment required for this work.

.2 Charge required water into seeder. Add material into hydraulic seeder under agitation. Pulverize mulch and charge slowly into seeder.

.3 After materials are in seeder and well mixed, charge tackifier into seeder and mix thoroughly to complete slurry.

3.4 SLURRY APPLICATION

.1 Ensure seed is placed under supervision of certified Landscape Planting Supervisor.

.2 Hydraulic seeding equipment:

.1 Slurry tank.

.2 Agitation system for slurry to be capable of operating during charging of tank and during seeding, consisting of recirculation of slurry and/or mechanical agitation method.

.3 Capable of seeding by 50 m hand operated hoses and appropriate nozzles.

.4 Tank volume to be certified by certifying authority and identified by authorities "Volume Certification Plate".

.3 Apply slurry uniformly, at optimum angle of application for adherence to surfaces and germination of seed.

.1 Using correct nozzle for application.

.2 Using hoses for surfaces difficult to reach and to control application.

.4 Blend application 1,000 mm into adjacent grass areas or sodded areas previous applications to form uniform surfaces.

.5 Re-apply where application is not uniform.

.6 Remove slurry from items and areas not designated to be sprayed.

3.5 CLEANING

.1 Leave Work area clean at end of each day.

.2 Upon completion remove surplus materials, rubbish, tools, and equipment.

3.6 PROTECTION

.1 Protect seeded areas from trespass until plants are established.

.2 Remove protection devices as directed by Consultant.

3.7 MAINTENANCE DURING ESTABLISHMENT PERIOD

.1 Ensure maintenance is carried out under supervision of certified Landscape Maintenance Supervisor.

.2 Perform following operations from time of seed application until acceptance:

- .1 Repair and reseed dead or bare spots to allow establishment of seed prior to acceptance.
- .2 Mow grass to 40 mm whenever it reaches a height of 70 mm. Remove clippings which will smother grass.
- .3 Fertilize seeded areas after first cutting in accordance with fertilizing program. Spread half of required amount of fertilizer in one direction and remainder at right angles
- .4 Water seeded areas in sufficient quantities and at a frequency required to establish and maintain grass and optimum soil moisture condition. Control watering to prevent washouts.
- .5 Control weeds by mechanical means.
- .6 Install temporary barriers or signage where required to protect newly established seed.

3.8 ACCEPTANCE

.1 Seeded areas will be accepted by Consultant provided that:

- .1 Seeded areas are uniformly established.
- .2 Seeded areas are free of rutted, eroded, bare or dead spots.
- .3 Areas have been mown at least twice.
- .4 Areas have been fertilized.
- .5 No surface soil is visible from a height of 1500 mm when grass has been cut to height of 50 mm.

3.9 MAINTENANCE DURING WARRANTY PERIOD

.1 Perform following operations from time of acceptance until end of warranty period:

.1 Repair and reseed dead or bare spots to satisfaction of Consultant.

.2 Fertilize seeded areas in accordance with fertilizing program. Spread half of the required amount of fertilizer in one direction and the remainder at right angles.

.3 Water seeded areas as required to maintain continued growth of grass.

END OF SECTION

DIVISION 33 INDEX

MANHOLES, CATCHBASINS, AND PRECAST STRUCTURES

PART 1 GENERAL

1.1 SECTION INCLUDES

.1 Materials and installation for constructing new precast maintenance holes, precast wet well and precast metering chamber.

1.2 RELATED SECTIONS

.1 Section 00 31 13 – Construction Phasing

.2 Section 02 05 20 – Temporary By-Pass Pumping

.3 Section 31 05 16 - Aggregate Materials

.4 Section 31 23 19 - Dewatering

.5 Section 31 23 33 - Excavation, Trenching and Backfilling.

1.3 REFERENCES

.1 American Society for Testing and Materials (ASTM International).

.1 ASTM A48/A48M, Standard Specification for Gray Iron Castings.

.2 ASTM A123/A123M, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

.3 ASTM C478M, Specification for Precast Reinforced Concrete Manhole Sections Metric.

.4 ASTM D412, Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers-Tension.

.5 ASTM D2240, Standard Test Method for Rubber Property-Durometer Hardness.

.2 Canadian General Standards Board (CGSB).

.1 CAN/CGSB-8.2, Sieves, Testing, Woven Wire, Metric.

.3 Canadian Standards Association (CSA International).

.1 CSA-A23.1/A23.2, Concrete Materials and Methods of Concrete Construction/Methods of Test for Concrete.

.2 CSA G30.18, Carbon Steel Bars for Concrete Reinforcement.

.3 CSA A257.4, Precast Circular Concrete Manhole Sections, Catchbasins and Fittings.

.4 CAN/CSA-A165 Series, CSA Standards on Concrete Masonry Units (Consists of A165.1, A165.2 and A165.3).

.5 CSA A3000 “Cementitious Materials Compendium”.

.6 The Structural Manuals – Division 1

.4 Ontario Provincial Standard Specifications (OPSS) and Drawings (OPSD) by the Ontario Ministry of Transportation.

1.4 SUBMITTALS

.1 Submit manufacturer's test data and certification at least 4 weeks prior to beginning Work. Include manufacturer's drawings, information and shop drawings where pertinent.

.2 All shop drawings submittals must be stamped and signed by a professional engineer licensed in the Province of Ontario.

1.5 SCHEDULING OF WORK

.1 Schedule work to minimize interruptions to existing services and to maintain existing flow during construction.

.2 Submit schedule of expected interruptions for approval and adhere to approved schedule.

PART 2 PRODUCTS

2.1 MATERIALS

.1 Precast maintenance holes: to OPSD 701.010

.2 Precast wet well: to OPSD 1101.012

.3 Precast concrete wet-well and valve chambers: Leak free, pre-cast reinforced concrete with access openings, ladders, service platforms and designed for the following forces:

.1 Dead load of stations and components, dynamic and kinetic forces of rotating equipment.

.2 Dead load from soil over structure, superimposed live load of 12 kN/m2 or single whieel load of 54 kN over an area of 750 x 750mm.

.3 Hydrostatic uplift force, horizontal earth loadings and full hydrostatic pressure assuming water at ground elevation.

.4 Joints: to be made watertight using rubber rings, bituminous compound, epoxy resin cement or cement mortar.

.5 Mortar:

.1 Aggregate: to CSA A82.56.

.2 Cement: to CAN/CSA-A8.

.6 Ladder rungs: to OPSD 405.010.

.7 Adjusting rings: to OPSD 704.010 for maintenance holes outside roadway.

.8 Frames, gratings, covers to dimensions as indicated and following requirements:

.1 Sanitary maintenance holes in roadway: self leveling type as per CC-205

.2 Sanitary maintenance holes outside roadway: to OPSD 401.010.

.9 Granular bedding and backfill: Granular 'A' as per OPSS.MUNI 1010.

.10 Unshrinkable Fill: in accordance with Section 31 23 33 – Excavation, Trenching and Backfilling.

.11 Benching: 25 MPa concrete

.12 Waterproofing membrane – Blue skin WP 200.

.13 Aluminum Access Hatches:

.1 All hatches to be MSU Mississauga aluminum and/or stainless-steel access hatches complete with slam lock or approved alternate. For sizes and locations, refer to drawings.

.2 Covers: fabricate with minimum 6.4mm aluminum or stainless-steel tread plate, reinforced on underside to eliminate warpage, limit deflection to 1/150 of span. Design for a minimum live load of 14.4 kPa.

.3 CL-625-ONT Cover: The valve chamber covers shall be reinforced to support CAN/CSA S6 CL-625-ONT wheel load with an impact factor of 15% and a maximum deflection of $1/150^{th}$ of the span.

.4 Angle frames: fabricate from extruded aluminum or stainless-steel angles with a minimum thickness of 6.35 mm complete with welded 100 mm long strap anchors located at 250 mm on centre.

.5 Access Hatches: Provide MSU M-Style access hatches for exterior applications as noted on the drawings. Equip with the following:

.1 Recessed Stainless Steel butt hinges.

.2 90 deg. Hold Open Arm.

.3 Flush lift handle.

.4 All 304 Stainless Steel hardware.

.5 Perimeter sealing gasket.

.6 Aluminum removable sealing plug and opening tool.

.7 Gas-spring assist cylinder.

.8 Drain.

.9 Safety chain and pull up bars around opening when door leafs are in open position for all access hatches

.10 Lockable and removable key.

.14 Aluminum Access Ladders:

.1 All access ladders shall be: Model MSU Type "FB" aluminum access ladder, 406 Std. wide c/w aluminum Model 8120 ladder brackets bolt-on-style (for Hilti-Hit kit) and Dual Model 3100 by 'MSU' (Mississauga Ltd.) removable pull-up bars or approved equivalent.

.15 Landing and Handrails:

.1 Landings shall be of aluminum construction. Openings shall be complete with stainless steel hinges and be as per contract drawings.

.2 Landings shall be designed to a minimum uniform load of 9.6 kPa and have a maximum deflection of L/360 less than or equal to 6mm.

.3 Handrails: 49mm OD aluminum handrails, all welded construction. Provide posts at centres required to meet horizontal live loads. Construction to be fully welded and ground smooth design to applicable OBC standards.

.4 All handrails and guardrails to have clear anodized coating.

.16 Pumping Station Trash Basket

.1 All trash baskets shall be retractable, constructed of 316L SS 10mm diameter rod, 38 x 38 x 6mm angle and 6mm plate - MSU Type TB-SS as supplied by MSU Mississauga Ltd.

.2 Trash baskets to be constructed to the size and dimensions shown on the construction drawings and shall be supplied complete with all required components including sch 10 316L - 50mm guiderails, 5.6mm type 316L stainless steel chain, chain hook plate, and brackets.

.3 Trash baskets shall be constructed square, true, and accurate to require size, with joints closely fitted. Remove all burs and sharp edges.

.17 Pumping Station Vent Pipes

.1 Vent piping in pumping station wet-wells shall be fabricated using type 316 stainless steel schedule 10s pipe and shall be completed with bolt down flanges, goose neck and insect screen. Diameter as noted on construction drawings.

.2 Vent pipes to be supplied with 316 SS wall brackets and installed at 1000 mm O/C.

.3 Vent pipes shall be supplied by MSU Mississauga Ltd. or approved equivalent.

.18 Isolation Coating

.1 Isolate aluminum from concrete, mortar, or masonry and dissimilar metals with two coats of bituminous paint.

PART 3 EXECUTION

3.1 EXCAVATION AND BACKFILL

.1 Excavate and backfill in accordance with Section 31 23 33 - Excavating Trenching and Backfilling and as indicated.

.2 Obtain approval of Contract Administrator before installing manholes or ditch inlets.

3.2 INSTALLATION

.1 Construct units in accordance with details indicated, plumb and true to alignment and grade.

.2 Complete units as pipe laying progresses. Maximum of three units behind point of pipe laying will be allowed.

.3 Dewater excavation to approval of Contract Administrator and remove soft and foreign material before placing concrete base.

.4 Set precast concrete base on 150 mm minimum of granular bedding compacted to 100% corrected maximum dry density.

.5 All Precast units:

.1 Set bottom section of precast unit in bed of cement mortar and bond to concrete slab or base. Make each successive joint watertight with Contract Administrator approved rubber ring gaskets, bituminous compound, cement mortar, epoxy resin cement, or combination thereof.

.2 Clean surplus mortar and joint compounds from interior surface of unit as work progresses.

.3 Plug lifting holes with precast concrete plugs set in mortar or mastic compound.

.6 For precast concrete wet-wells and valve chambers:

.1 Prior to fabricating chamber covers, coordinate with hatch, lifting davit and fall arrest and retrieval davit suppliers to ensure all cast-in items shown on the construction drawings are properly integrated into the cover fabrication.

.2 Wrap each joint with blueskin membrane. Membrane to be 450 mm wide at each joint.

.7 Compact granular backfill to 100% Standard Proctor Maximum Dry Density (SMPDD). Granular backfill shall extend from the base of the structure to 300 mm above the inlet pipe obvert.

.8 Place unshrinkable backfill in accordance with Section 31 23 33 - Excavating, Trenching and Backfill.

.9 Set frame and cover to required elevation such that the distance from the top of manhole cover to the first ladder rung is less that 450 mm. If adjustment is required use concrete rings, parge and make smooth and watertight.

.10 Place frame and cover on top section to elevation as indicated prior to final lift of asphalt. If adjustment required use concrete ring.

.11 Clean units of debris and foreign materials. Remove fins and sharp projections. Prevent debris from entering system.

END OF SECTION

SITE WATER UTILITY DISTRIBUTION PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

.1 Materials and installation for water mains, services, yard hydrants, and valves.

.2 All watermain and appurtenances shall conform to Ontario Provincial Standard Specifications (OPSS) 514 and 701.

.3 All cathodic protection of watermains and appurtenances shall conform to Ontario Provincial Standard Specification (OPSS) 702.

1.2 RELATED SECTIONS

.1 Section 01 33 00 - Submittal Procedures.

.2 Section 01 78 00 - Closeout Submittals.

.3 Section 03 20 00 – Concrete Reinforcing.

.4 Section 03 30 00 – Cast-in-Place Concrete.

.5 Section 31 23 33 – Excavating, Trenching and Backfilling.

1.3 REFERENCES

.1 American National Standards Institute/American Water Works Association (ANSI/AWWA)

.1 ANSI/AWWA B301, Liquid Chlorine.

.2 ANSI/AWWA C104/A21.4, Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water.

.3 ANSI/AWWA C110/A21.10, Ductile-Iron and Gray Iron Fittings, 3 inch through 48 inch (75 mm through 1200 mm), for Water.

.4 ANSI/AWWA C111/A21.11, Rubber-Gasket Joints for Ductile-Iron and Gray Iron Pressure Pipe and Fittings.

.5 ANSI/AWWA C151/A21.51, Ductile-Iron Pipe, Centrifugally Cast, for Water.

.6 ANSI/AWWA C153/A21.53, Ductile-Iron Compact Fittings for Water Service.

.7 ANSI/AWWA C500, Metal-Seated Gate Valves for Water Supply Service (Includes Addendum C500a-95).

.8 ANSI/AWWA C600, Installation of Ductile-Iron Water Mains, and Their Appurtenances.

.9 ANSI/AWWA C651, Disinfecting Water Mains.

.2 American Society for Testing and Materials International, (ASTM)

.1 ASTM A307, Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile.

.2 ASTM C117, Standard Test Method for Material Finer Than 75 [MU] m (No. 200) Sieve in Mineral Aggregates by Washing.

.3 ASTM C136, Standard Method for Sieve Analysis of Fine and Coarse Aggregates.

.4 ASTM C478M, Standard Specification for Precast Reinforced Concrete Manhole Sections, Metric.

.5 ASTM D698, Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft (600 kN-m/m^3)).

.3 American Water Works Association (AWWA)/Manual of Practice

.1 AWWA M17, Installation, Field Testing, and Maintenance of Fire Hydrants.

.4 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-8.1, Sieves, Testing, Woven Wire, Inch Series.

.5 Canadian Standards Association (CSA International)

.1 CAN/CSA-A257 Series, Standards for Concrete Pipe.

.2 CSA A3000, Cementitious Materials Compendium

.3 CSA B137 Series, Thermoplastic Pressure Piping Compendium

.4 CAN/CSA-G30.18, Billet Steel Bars for Concrete Reinforcement.

.5 CAN/CSA-G164, Hot Dip Galvanizing of Irregularly Shaped Articles.

.6 Ontario Provincial Standard Specifications (OPSS)

.1 OPSS Muni 441 – Construction Specification for Watermain Installation in Open Cut

1.4 SUBMITTALS

.1 Submit complete shop drawings for all watermains and appurtenances for approval by the Contract Administrator as per the requirements of Specification 01 33 00 Submittals.

.2 Inform Contract Administrator of proposed source of bedding materials and provide access for sampling at least 4 weeks prior to commencing work.

.3 Submit manufacturer's test data and certification that pipe materials and appurtenances meet requirements of this section at least 4 weeks prior to beginning work. Include manufacturer's drawings, information and shop drawings where pertinent.

.4 Pipe certification to be on pipe.

1.5 CLOSEOUT SUBMITTALS

.1 Provide record drawings, including directions for operating valves, list of equipment required to operate valves, details of pipe material, location of air and vacuum release valves, hydrant details, maintenance and operating instructions.

.1 Include top of pipe, horizontal location of fittings and type, valves, valve boxes, valve chambers and hydrants.

1.6 DELIVERY, STORAGE AND HANDLING

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

1.7 SCHEDULING OF WORK

.1 Schedule Work to minimize interruptions to existing services.

.2 Submit schedule of expected interruptions to Contract Administrator for approval and adhere to interruption schedule as approved by Contract Administrator.

.3 Notify Contract Administrator, building occupants, superintendent minimum of two (2) working days in advance of interruption in service.

1.8 COLD WEATHER WORK

.1 Protect all work from freezing.

.2 Do not lay pipes on frozen soil.

.3 Do not place frozen bedding, cover or backfill materials.

1.9 PROTECT AGAINST FLOATATION

.1 Prevent damage to any pipeline due to hydrostatic uplift during construction and until the work is completed.

PART 2 PRODUCTS

2.1 PIPE, JOINTS AND FITTINGS

.1 Polyvinyl chloride pipe (PVC) to AWWA C900 and CSA – B137.3, class 235 DR18

.2 Fitting to conform to AWWA – C-110 P21.10.08 Ductile Iron Fittings lined as per AWWA C104

.3 Restrainer gland – uniflange series 1350 or approved equal with a full rated pressure of the pipe on which it is installed, with a minimum of 2:1 safety factor.

.4 Valves shall be to ANSI/AWWA C-509, Mueller, Canada Valve or Clow

.5 Restraint coupler Hymax Grip as per AWWA C-219, NSF61 certified

.6 Hydrant shall be Century EM", complete with 2-65 mm hose nozzle s and 1-100 mm nozzle with a storz fitting.

.7 Service Connections shall be cross-linked polyethylene (PEX) Blue 904 SDR9 to CSA B 137.5 and AWWAC904 and complete with tracer wire.

.8 Fittings, couplers and curb stops are to be Mueller Compression Style.

.9 Service boxes (Mueller A-714) shall be included at the curb stop complete with stainless steel valve extensions. Valve boxes and extensions shall be as per OPSD 1101.020. Valve boxes shall be a 130 mm diameter slide type box complete with a cast iron lid.

2.2 YARD HYDRANTS

.1 Yard hydrants to be exposed, non-freeze post hydrant with lift handle and lock option, complete with galvanized steel casing guard. All bronze seat and replaceable seat washer, and non-turning operating rod with free-floating compression closure valve with 25mm connection. Hydrant to be equipped with a tapped 3mm drain port in valve housing.

.2 Depth of bury of hydrant shall be 2.0m. Outlet connection shall be minimum 750mm above finished grade.

.3 Hydrants to be installed with concrete protective base, surround by granulars to allow for draining.

.4 Standard of Acceptance: Merrill R-6000 Galvanized Frost Proof Yard Hydrant 1" Inlet.

2.3 TRACING WIRE

.1 Tracing wire to be TWU or RWU, 10 guage, 7 strands or more, copper, 60°C or higher, 600 V, plastic coated or approved equivalent.

.2 C-tap to be approved by CSA and to be sized to connect two tracer wires as specified above.

.3 Tapes to be rugged, pressure-sensitive, PVC-based, minimum:

.1 1mm thickness. Tapes must protect against water, salts and sewage and be suitable for direct burial applications.

.4 All trace wire termination points must utilize an approved trace wire access box (above ground access box or grade level/in-ground access box as applicable), specifically manufactured for this purpose.

2.4 PIPE BEDDING AND SURROUND MATERIAL

.1 Type 1 in accordance with Section 31 05 16 - Aggregate Materials and following requirements:

2.5 BACKFILL MATERIAL

.1 Type 3, in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.

2.6 PIPE DISINFECTION

.1 Undertake disinfection of water mains in accordance with ANSI/AWWA C651.

.2 After watermain has been disinfected as described in AWWA C651, two consecutive sets of acceptable samples taken at least 24 hours apart shall be collected. Samples to be tested for Total Choloform, HPC and *E. Coli*. All testing will be conducted by the Contractor in the presence of the Contract Administrator, and paid for by the Contractor.

2.7 MECHANICAL JOINT RETAINER GLANDS

.1 Mechanical joint retainer glands shall be cast from ductile iron no less that grade 70-50-5 and shall comply with all application provisions of AWWA/ANSI C110/A21.10 and C111/A21.11. Set screws shall be 5/8" NC thread with torque-set head, or 5/8" square head bolts, with knurled cup-point, made of 4140 steel and shall be hardened to Rockwell "C" scale 45 – 47. The restraining devices shall have a working pressure rating to the full rated pressures of the installed pipe 1035 kPa with a minimum safety factor of 2:1. 16mm ø or greater threaded tie rods shall be used on blind flanges and elbows as indicated in contract drawings. A minimum of 3 rods shall be used for each connection unless otherwise noted.

2.8 CATHODIC PROTECTION

.1 Cathodic Protection must be to the OPSS 702 and OPSD 1109 Standards.

.2 The chemical composition of a zinc alloy anodes shall conform to the latest edition of ASTM B418 Type II.

.3 Zinc anodes, each must be labelled with their type as follows: "Z-24-48 Anode" as per OPSS 702 and OPSD 1109.

2.9 PIPE INSULATION

.1 Pipe shall be insulated where indicated on the drawings or as noted on the drawings. D.O.W HI-40 or Owens Corning Foamular 400 brand; 50mm thick extruded Polystyrene foam, minimum compressive strength 275kPa as per ASTM D 1621-73.

2.10 PIPE COATINGS

.1 Denso Glass Outerwrap 70.

2.11 TOOLS AND EQUIPMENT

.1 Provide Contract Administrator with following tools:

.1 One tee-handle operating keys for valves.

PART 3 EXECUTION

3.1 PREPARATION

.1 Clean pipes, fittings, valves, hydrants, and appurtenances of accumulated debris and water before installation. Carefully inspect materials for defects to approval of Contract Administrator. Remove defective materials from site as directed by Contract Administrator.

3.2 TRENCHING

.1 Do trenching work in accordance with Section 31 23 33.01 - Excavating Trenching and Backfilling.

.2 Trench depth to provide cover over pipe of not less than 2.0 m from finished grade or as indicated. Trench minimum width shall be as indicated in the contract drawings allowing for a minimum 300mm of bedding material.

.3 Trench alignment and depth require Contract Administrator approval prior to placing bedding material and pipe.

3.3 GRANULAR BEDDING

.1 Place granular bedding material in uniform layers not exceeding 150 mm compacted thickness to depth of 300 mm below bottom of pipe. Place Granular ‘A’ from 300mm below the watermain invert to 300mm above the watermain obvert.

.2 Do not place material in frozen condition.

.3 Shape bed true to grade to provide continuous uniform bearing surface for pipe.

.4 Shape transverse depressions in bedding as required to suit joints.

.5 Compact each layer full width of bed to at least 100% of corrected maximum dry density.

.6 Fill authorized or unauthorized excavation below design elevation of bottom of specified bedding in accordance with Section 31 23 33 - Excavating Trenching and Backfilling.

3.4 PIPE INSTALLATION

.1 Terminate building water service outside building wall opposite point of connection to main. Install flange adapter and or coupling necessary for connection to building plumbing. If plumbing is already installed, make connection; otherwise cap or seal end of pipe and place temporary marker to locate pipe end. Provide mechanical restraints as required and coordinate with Building Mechanical division.

.2 Lay pipes to ANSI/AWWA C-600-85, ANSI/AWWA C603, ANSI/AWWA Manual of Practice and manufacturer's standard instructions and specifications.

.3 Join pipes in accordance with ANSI/AWWA C-600, ANSI/AWWA C602/C206, ANSI/AWWA Manual of Practice and manufacturer's recommendations.

.4 Handle pipe by methods recommended by pipe manufacturer. Do not use chains or cables passed through pipe bore so that weight of pipe bears on pipe ends.

.5 Lay pipes on prepared bed, true to line and grade. Ensure barrel of each pipe is in contact with shaped bed throughout its full length. Take up and replace defective pipe. Correct pipe which is not in true alignment or grade or pipe which shows differential settlement after installation greater than 10 mm in 3 m.

.6 Face socket ends of pipe in direction of laying. For mains on a grade of 2% or greater, face socket ends up-grade.

.7 Do not exceed permissible deflection at joints as recommended by pipe manufacturer.

.8 Keep jointing materials and installed pipe free of dirt and water and other foreign materials. Whenever work is stopped, install a removable watertight bulkhead at open end of last pipe laid to prevent entry of foreign materials.

.9 Position and join pipes with equipment and methods approved by Contract Administrator.

.10 Cut pipes in approved manner as recommended by pipe manufacturer, without damaging pipe or its coating and to leave smooth end at right angles to axis of pipe.

.11 Align pipes before jointing.

.12 Apply sufficient pressure in making joints to ensure that joint is completed to manufacturer's recommendations.

.13 When stoppage of work occurs, block pipes in an approved manner to prevent creep during down time.

.14 Do not lay pipe on frozen bedding.

.15 Do hydrostatic and leakage test and have results approved by Contract Administrator before surrounding and covering joints and fittings with granular material. Hydrostatic and leakage testing to be completed in accordance with OPSS 441.

.16 Backfill remainder of trench.

3.5 VALVE INSTALLATION

.1 Install valves to manufacturer's recommendations at locations as indicated.

.2 Support valves located in valve boxes or valve chambers by means of concrete blocks, located between valve and solid ground. Valves not to be supported by pipe.

3.6 YARD HYDRANTS

.1 Install yard hydrants at locations as indicated.

.2 Install hydrants in accordance with AWWA M17.

.3 Install gate valve and cast iron valve box on hydrant services leads as indicated.

.4 Place concrete blocks as indicated and specified, ensuring that drain holes are unobstructed.

.5 Place appropriate sign on installed hydrants indicating whether or not they are in service during construction.

3.7 THRUST BLOCKS AND RESTRAINED JOINTS

.1 Do concrete work in accordance with Section 03 30 00 - Cast-in-Place Concrete.

.2 Place concrete thrust blocks between valves, tees, plugs, caps, bends, changes in pipe diameter, reducers, hydrants and fittings and undisturbed ground as indicated or as directed by Contract Administrator.

.3 Keep joints and couplings free of concrete.

.4 Do not backfill over concrete within 24 hours after placing.

.5 For restrained joints: only use restrained joints approved by Contract Administrator.

.6 Mechanical joint restraint glands to be used at all valves, tees, plugs, caps, bends, changes in pipe diameter, reducers, hydrants and fittings. Additionally, mechanical joint restraint glands to be used at all pipe joints within 6.0 m of the fittings listed above. These are to be installed as per manufacturer's specifications.

3.8 CATHODIC PROTECTION

.1 Cathodic protection shall be installed to the current standard of OPSS 442.

.2 Spacing of anodes shall be:

.1 100-300mmø DI fittings/valves Z-12-24 @ 1 per each.

3.9 TRACER WIRE

.1 Tracer wire shall be installed as per OPSS standards and shall be connected on all PVC pipe, fittings etc. to form a continuous loop.

.2 Test the loop of tracer wire and demonstrate to Consultant that it functions properly after the backfill has been completed.

3.10 HYDROSTATIC AND LEAKAGE TESTING

.1 Do tests in accordance with ANSI/AWWA C600, and OPSS 441.

.2 Provide labour, equipment and materials required to perform hydrostatic and leakage tests hereinafter described.

.3 Notify Contract Administrator at least two (2) working days in advance of proposed tests. Perform tests in presence of Contract Administrator.

.4 Where section of system is provided with concrete thrust blocks, conduct tests at least 5 days after placing concrete or 2 days if high early strength concrete is used.

.5 Test pipeline in sections not exceeding 365 m in length, unless otherwise authorized by Contract Administrator.

.6 Upon completion of pipe laying and after Contract Administrator has inspected work in place, surround and cover pipes between joints with approved granular material placed to dimensions indicated.

.7 Leave valves, joints and fittings exposed.

.8 When testing is done during freezing weather, protect hydrants, valves, joints and fittings from freezing.

.9 Strut and brace caps, bends, tees, and valves, to prevent movement when test pressure is applied.

.10 Open valves.

.11 Expel air from main by slowly filling main with potable water. Install corporation stops at high points in main where no air-vacuum release valves are installed. Remove stops after satisfactory completion of test and seal holes with plugs.

.12 Thoroughly examine exposed parts and correct for leakage as necessary.

.13 Apply hydrostatic test pressure of 1000 kPa based on elevation of lowest point in main and corrected to elevation of test gauge, for period of 1 hour.

.14 Examine exposed pipe, joints, fittings and appurtenances while system is under pressure.

.15 Remove joints, fittings and appurtenances found defective and replace with new sound material and make watertight.

.16 Repeat hydrostatic test until defects have been corrected.

.17 Define leakage as amount of water supplied from water storage tank in order to maintain test pressure for 2 h.

.18 Do not exceed allowable leakage of 0.03 L/mm diameter per 300 m of pipe, including lateral connections, per hour.

.19 Locate and repair defects if leakage is greater than amount specified.

.20 Repeat test until leakage is within specified allowance for full length of watermain.

.21 Co-ordinate test procedure with Contract Administrator and provide certification of test acceptance.

3.11 PIPE SURROUND

.1 Upon completion of pipe laying and after Contract Administrator has inspected work in place, surround and cover pipes as indicated.

.2 Hand place surround material in uniform layers not exceeding 150 mm compacted thickness as indicated. Do not dump material within 1.00 m of pipe.

.3 Place layers uniformly and simultaneously on each side of pipe.

.4 Do not place material in frozen condition.

.5 Compact each layer from pipe invert to mid height of pipe to at least 100% maximum density.

.6 Compact each layer from mid height of pipe to underside of backfill (300mm above pipe obvert, or as shown on drawings) to 100 % of corrected maximum density.

3.12 BACKFILL

.1 Place backfill material, above pipe surround, in uniform layers not exceeding 300 mm compacted thickness up to grades as indicated.

.2 Do not place backfill in frozen condition.

.3 Under footings, parking area and walks, compact backfill to at least 100% maximum density.

3.13 HYDRANT FLOW TESTS

.1 Conduct flow tests on every hydrant.

3.14 PAINTING OF HYDRANTS

.1 N/A

3.15 FLUSHING AND DISINFECTING

.1 Flushing and disinfecting operations shall be carried out by specialist contractor and witnessed by Contract Administrator. Notify Contract Administrator at least 4 days in advance of proposed date when disinfecting operations will commence.

.2 Flush water mains in accordance with AWWA C651.

.3 Flushing shall be through available outlets with a sufficient flow of potable water to produce velocity of 1.5 m/s, within pipe for minimum 10 minutes, or until foreign materials have been removed and flushed and water is clear.

.4 Flushing flows as follows: 38 L/s minimum.

.5 Provide connections and pumps for flushing as required.

.6 Open and close valves, hydrants and service connections to ensure thorough flushing.

.7 When flushing has been completed to satisfaction of Contract Administrator complete the disinfection procedure as per AWWA C651.

.8 Disinfect watermains.

.9 Rate of chlorine application to be proportional to rate of water entering pipe.

.10 Chlorine application to be close to point of filling water main and to occur at same time.

.11 Operate valves, hydrants and appurtenances while main contains chlorine solution.

.12 Flush line to remove chlorine solution after 24 hours.

.13 Measure chlorine residuals at extreme end of pipe-line being tested.

.14 Perform bacteriological tests on water main, after chlorine solution has been flushed out. Take samples daily for minimum of two days. Should contamination remain or recur during this period, repeat disinfecting procedure. Specialist contractor to submit certified copy of test results.

.15 Take water samples at hydrants and service connections, in suitable sequence, to test for chlorine residual.

.16 Co-ordinate flushing disinfection with Contract Administrator.

.17 Provide certification of test acceptance.

3.16 SURFACE RESTORATION

.1 After installing and backfilling over water mains, restore surface to original condition as directed by Contract Administrator.

3.17 QUALITY ASSURANCE

.1 Provide copies of all inspections and test results for Commissioning Manuals.

.2 Contractor shall supply to the Contract Administrator an As-Built drawing indicating the horizontal and vertical alignment of the watermain and appurtenances. All anodes, valves, bends, hydrants, tees, changes in material etc. shall be noted.

END OF SECTION

SANITARY AND STORM SEWERS, FORCEMAINS AND YARD PIPING

PART 1 GENERAL

1.1 RELATED WORK

.1 Section 00 31 13 – Construction Phasing

.2 Section 02 05 20 – Temporary By-Pass Pumping

.3 Section 31 05 16 - Aggregate Materials.

.4 Section 31 23 19 - Dewatering

.5 Section 31 23 33 - Excavating Trenching and Backfilling.

.6 Section 33 05 14 – Precast Structures

1.2 REFERENCES

.1 American Society for Testing and Materials International, (ASTM)

.1 ASTM B745/745M, Standard Specification of Corrugated Aluminum Pipes for Sewers and Drains.

.2 ASTM D3034, Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.

.3 ASTM D2774 – Standard Practice for Underground Installation of Thermoplastic Pressure Piping

.4 ASTM D3350-14 – Polyethylene Plastic Pipe and Fittings Material

.5 ASTM F1290 – Standard Practice for Electrofusion Joining Polyolefin Pipe and Fittings

.6 ASTM F2164 – Field Leak Testing of Polyethylene (PE) Pressure Piping Systems Using Hydrostatic Pressure

.7 ASTM F2206 – Fabricated Fittings for Butt-Fused Polyethylene Plastic Pipe

.8 ASTM F2620 – Standard Practice for Heat Fusion Joining of Polyethylene Pipe and Fittings

.2 Canadian General Standards Board (CGSB). CSA B137, Thermoplastic Pressure Piping Compendium.

.3 Canadian Standards Association (CSA International)

.1 CAN/CSA-A3000, Cementitious Materials Compendium (Consists of A5-98, A8-98, A23.5-98, A362-98, A363-98, A456.1-98, A456.2-98, A456.3-98).

.1 CAN/CSA-A5, Portland Cement.

.2 CSA B1800, Plastic Non-pressure Pipe Compendium - B1800 Series (Consists of B181.1, B181.2, B181.3, B181.5, B182.1, B182.2, B182.4, B182.6, B182.7, B182.8 and B182.11).

.1 CSA B182.2, PVC Sewer Pipe and Fittings (PSM Type).

.4 Ontario Provincial Standard Specifications (OPSS)

.1 OPSS Sections 401, 403, 405, 409, 410, 412, MUNI 1841

1.3 DEFINITIONS

.1 Pipe section is defined as length of pipe between successive manholes and/or between manhole and any other structure which is part of sewer system.

1.4 SUBMITTALS

.1 Submit shop drawings in accordance with Section 01 33 00 – Submittals.

.2 Inform Contract Administrator at least 4 weeks prior to beginning Work, of proposed source of bedding materials and provide access for sampling.

.3 Submit manufacturer's test data and certification at least 2 weeks prior to beginning Work.

.4 Ensure certification is marked on pipe.

1.5 DELIVERY, STORAGE AND HANDLING

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

1.6 SCHEDULING

.1 Schedule Work to minimize interruptions to existing services and maintain existing sewage flows during construction with temporary bypass pumping.

.2 Submit schedule of expected interruptions for approval and adhere to approved schedule.

.3 Notify Contract Administrator and plant superintendent two (2) working days in advance of any interruption in service.

PART 2 PRODUCTS

2.1 SANITARY AND STORM SEWERS

.1 Less than or equal to 450 mm ø:

.1 PVC SDR 35 as per ASTM A2412 and in compliance with CSA B182.2 and ASTM A3034. Pipe stiffness minimum 320 kPa. Pipe joints to be bell and spigot with rubber gaskets.

.2 Reinforced concrete Class 65-D (or greater, as required), to CSA A257.2.

2.2 FORCEMAINS

.1 Polyvinyl chloride (PVC) pipe, Class 165, DR 25, manufactured in accordance to AWWA C900 and shall have cast iron outside diameter.

.2 Fittings to AWWA C907 and certified to CSA B137.2. Ductile iron fittings may also be used. They shall be in accordance with ANSI/AWWA C153/A21.53. Mechanical joints shall conform to ANSI/AWWA C111/A21.11.

.3 High Density Polyethylene Materials

.1 All material must be produced from a PE 4710 resin listed in the Plastic Pipe Institute (PPI) TR-4. The resin material should comply with ASTM D 3350 with a minimum cell classification of 445474C. HDPE pipe and fittings must not contain any recycled compounds except that generated in the manufacturer's own facility from resin meeting the same specifications, sourced from the same raw material. HDPE products shall be homogeneous throughout and free of visible cracks, holes, foreign inclusions, voids, or other injurious defects.

.2 Pipe shall be made of HDPE material with a minimum material designation code of PE4710 and with a minimum Cell Classification of 445474C. The polyethylene compound shall be UV protected by means of carbon black of not less than 2 percent.

.3 Pipe sizes 4” – 63” shall be manufactured in accordance with ASTM F 714, while pipe sizes 3/4” – 3” shall be manufactured in accordance with ASTM D 3035. All HDPE pipes shall adhere to Sandale’s Inspection and Test Procedure (ITR-04).

.4 HDPE Fittings – Fittings shall be made of HDPE Material with a minimum designation code of PE 4710 & a minimum cell classification of 445474C. All fittings shall be manufactured by Sandale Utility Products, CRP or approved equal. Fittings shall have a minimum pressure rating equal to or greater than the pipe to which they are joined unless otherwise specified by the owner/engineer. All fittings shall meet the requirements of AWWA C901 or C906 and all applicable ASTM Standards.

.5 Fusion Equipment Requirements

.1 Butt fusion equipment must be in satisfactory working order and the hydraulic system must be leak free. Heater plates shall be free from scrapes, gouges, and have a consistent clean coated surface. The pressure gage and thermometer should be checked for accuracy. When requested by the owner, records showing a maintenance service/inspection within 3 months prior to use for this project shall be provided.

.2 Electrofusion Processors shall be maintained and calibrated per manufacturer’s requirements and recommendations.

.4 Transition coupling to AWWA C219, fusion bonded epoxy in accordance with AWWA C213 and supplied with stainless steel nuts, bolts, non-corrosive washers and rubber gaskets to AWWA/ANSI specifications C111/A21.11.

.5 Direct Bury Plug Valves shall be 100% port eccentric direct buried plug valves to AWWA C517-05 and sized to match pipe size noted or as noted on drawings. Valves shall be cast iron body, supplied with mechanical joint ends, Acrylonitrile-Butadiene V-type multiple V-Ring packing, Chloroprene plug facing, a gear actuator suitable for burial applications and supplied with an extended nut actuator and valve box. Valves shall be supplied with a two part epoxy and suitable for direct burial applications. Valves to be Dezurik PEF 100% port eccentric plug valve or approved equivalent.

.6 Valve boxes shall be a 130mm diameter slide type box complete with cast iron lid.

.7 Restrainers shall be Uniflange Series 1350 or approved equivalent. Concrete thrust blocks will not be allowed.

.8 Tracer wire:

.1 TWU or RWU, 10 gauge, 7 strands or more, 60 C or higher, 600 V, plastic coated or approved equivalent.

.2 C-tap to be CSA approved and to be sized to connect two tracers wires as specified above.

.3 Tapes to be rugged, pressure-sensitive, PVC-based, minimum 0.1mm thickness. Tapes must protect against waters, salts and be suitable for direct burial applications.

.9 Corrosion protection shall be as per OPSS 702 and OPSD 1109 and as follows:

.1 Z-12-24, 1x per metallic valve or fitting,

.2 Z-12-24, 1x per every 1,000m length of tracer wire

.3 Denso Paste, LT Tape and Profiling Mastic.

2.3 BIOGAS PIPING

.1 Refer to Division 44 for the biogas piping materials and installation requirements.

2.4 PIPE BEDDING, COVER, AND SURROUND MATERIAL

.1 Granular ‘A’ as per OPSS.MUNI 1010 and Section 31 23 33 – Excavating, Trenching, and Backfilling.

2.5 TRACER WIRE

.1 Install tracer wire along forcemains as per OPSS standards and connect to PVC pipe, fittings, valves, etc. to form a continuous loop.

.2 Test the loop of tracer wire and demonstrate to Contract Administrator that it functions properly after the backfill has been completed.

2.6 BACKFILL MATERIAL

.1 Select Subgrade material to OPSS.MUNI 1010.

2.7 INSULATION

.1 50mm thick extruded Polystyrene foam, minimum compressive strength 275kPa as per ASTM D 1621-73. Standard of acceptance:

.1 D.O.W HI-40,

.2 Owens Corning Foamular C400;

2.8 PROTECTIVE MASTIC/TAPE

.1 Protective mastic and tape shall be Densopol 60 or approved alternate.

PART 3 EXECUTION

3.1 PREPARATION

.1 Clean and dry pipes and fittings before installation.

.2 Obtain approval of pipes and fittings from Contract Administrator prior to installation.

3.2 TRENCHING

.1 Do trenching Work in accordance with Section 31 23 33 - Excavating, Trenching and Backfilling.

.2 Do not allow contents of any sewer or sewer connection to flow into trench.

.3 Trench alignment and depth require approval of Contract Administrator prior to placing bedding material and pipe.

3.3 GRANULAR BEDDING

.1 Place bedding in unfrozen condition.

.2 Place granular bedding materials in uniform layers not exceeding 150 mm compacted thickness to depth indicated.

.3 Shape bed true to grade and to provide continuous, uniform bearing surface for pipe.

.4 Shape transverse depressions as required to suit joints.

.5 Compact each layer full width of bed to at least 95% of Standard Proctor Maximum Dry Density (SPMDD).

.6 Fill excavation below bottom of specified bedding adjacent to manholes or structures with compacted bedding material.

3.4 INSTALLATION

.1 Lay and join pipes in accordance with manufacturer's recommendations and to approval of Contract Administrator.

.2 Lay pipes on prepared bed, true to line and grade, with pipe invert smooth and free of sags or high points. Ensure barrel of each pipe is in contact with shaped bed throughout its full length. Tolerances: 3mm in 3 m.

.3 Buried HDPE pipe and fittings shall be installed in accordance with ASTM D 2321 or ASTM D 2774 for pressure systems and AWWA Manual of Water Supply Practices M55 Chapter 8. For additional information, contractor should refer to Chapter 7 of PE Handbook of Polyethylene (2nd Edition)

.4 Do not exceed maximum joint deflection recommended by pipe manufacturer.

.5 Do not allow water to flow through pipe during construction, except as may be permitted by Contract Administrator.

.6 Make watertight connections to manholes using suitable gaskets in new structures or using a Link Seal at connections to existing structures.

.7 Install protective mastic and tape in accordance with manufacturer’s recommendations on all metallic buried pipe, fittings and valves.

3.5 PIPE SURROUND AND COVER

.1 Place surround material in unfrozen condition.

.2 Hand place surround material in uniform layers not exceeding 200 mm compacted thickness as indicated. Do not dump directly on pipe.

.3 Place layers uniformly and simultaneously on each side of pipe.

.4 Install insulation as indicated on Contract Drawings.

3.6 BACKFILL

.1 Place backfill material in unfrozen condition.

.2 Place backfill material, above pipe surround in uniform layers not exceeding 300 mm compacted thickness up to grades as indicated. Backfill material is to be compacted to at least 95% of SPMDD.

3.7 FIELD TESTING OF SEWERS

.1 Repair or replace pipe, pipe joint or bedding found defective.

.2 When directed by Contract Administrator, draw metal mandrel 95% of inside diameter of pipe through sewer to ensure pipe is free of obstructions or deflections.

.3 Carry out CCTV camera inspection on each section of sewer.

.4 Provide colour digital video (DVD) inspection for sewers (2 copies of video and report). Report to document condition of sewer to satisfaction of Contract Administrator. Cost of inspection to be paid by Contractor.

.5 Repair and retest sewer sections as required, until test results are acceptable.

.6 Repair visible leaks regardless of test results.

.7 Obtain a letter of compliance from Municipality and submit to Contract Administrator.

3.8 FIELD TESTING OF FORCEMAINS

.1 Notify Contract Administrator a minimum of 48 hours in advance of proposed tests. Perform tests in presence of Contract Administrator.

.2 Strut and brace caps, bends, and tees to prevent movement when test pressure is applied.

.3 Expel air from forcemain by slowly filling forcemain with water.

.1 Drill and tap high points and install suitable cocks to vent air and to be shut when pressure is applied.

.2 Remove stops after satisfactory completion of test and seal holes with tight fitting plugs.

.4 Apply hydrostatic test pressure of 345 kPa (50 psi) minimum after backfilling of trench, based on elevation of lower point in forcemain and corrected to elevation of test gauge, for period of 2 hours.

.5 Remove joints, fittings and appurtenances found to be defective and replace with new sound material and make watertight.

.6 Define leakage as amount of water supplied from water storage tank in order to maintain test pressure for minimum of 2 hours.

.7 Do not exceed allowable leakage defined as $A = T \times F \times D \times L$, where T is the time in hours, F is 0.041 L/mm of pipe dia/km of pipe/hour, D is pipe diameter in mm, and L is the pipe length in km.

.8 Locate and repair defects if leakage is greater than amount specified.

.9 Repeat test until leakage is within specified allowance for full length of forcemain.

END OF SECTION

PIPE CULVERTS

PART 1 GENERAL

1.1 SECTION INCLUDES

.1 Materials and installation for pipe culverts.

1.2 RELATED SECTIONS

.1 Section 01 33 00 - Submittal Procedures.

.2 Section 01 61 00 - Common Product Requirements.

.3 Section 31 05 16 - Aggregate Materials.

.4 Section 31 23 33 - Excavating, Trenching and Backfilling.

1.3 REFERENCES

.1 American Society for Testing and Materials International, (ASTM)

.1 ASTM C117, Standard Test Method for Material Finer Than 0.075 mm (No. 200) Sieve in Mineral Aggregates by Washing.

.2 ASTM C136, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.

.3 ASTM D698, Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3 (600 kN-m/m^3)).

.4 ASTM D 1751, Standard for Specification for Performed Expansion joint Filler for Concrete Paving and Structure Construction (Non-extruding and Resilient Bituminous Types).

.2 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-8.1, Sieves, Testing, Woven Wire, Inch Series.

.2 CAN/CGSB-8.2, Sieves, Testing, Woven Wire, Metric.

.3 Canadian Standards Association (CSA International)

.1 CSA B1800 Series, Thermoplastic Non-pressure Piping Compendium.

.2 CSA A3000, Cementitious Materials Compendium.

.4 Ontario Provincial Standard Specifications (OPSS);

.1 OPSS 421 – Pipe Culvert Installation in Open Cut

1.4 SUBMITTALS

.1 Inform Contract Administrator at least 4 weeks prior to commencing work, of proposed source of bedding materials and provide access for sampling.

.2 Submit manufacturer's test data and certification at least 4 weeks prior to beginning work.

.3 Certification to be marked on pipe.

1.5 DELIVERY, STORAGE AND HANDLING

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

PART 2 PRODUCTS

2.1 PIPE

.1 Corrugated Steel Pipe (CSP)

.1 68 x 13 x 2mm to CSA Standard G401 with galvanized, aluminized type 2 coating.

.2 High Density Polyethylene Pipe (HDPE):

.1 Watertight HDPE pipe with a minimum pipe stiffness of 320 kPa manufactured to CSA B 182.8.

.3 Each pipe shall be marked CSA approved as outlined in respective OPSS sections.

2.2 GRANULAR BEDDING, SURROUND, AND COVER

.1 Type 1 (Granular ‘A’) material in accordance with Section 31 23 33 – Excavating, Trenching, and Backfilling.

2.3 BACKFILL MATERIAL

.1 Type 3 (Select Subgrade Material), in accordance with Section 31 23 33 - Excavating, Trenching and Backfilling.

PART 3 EXECUTION

3.1 TRENCHING

.1 Do trenching Work in accordance with Section 31 23 33 - Excavating Trenching and Backfilling.

.2 Obtain Contract Administrator's approval of trench line and depth prior to placing bedding material or pipe.

3.2 BEDDING

.1 Dewater excavation, as necessary, to allow placement of culvert bedding in dry condition.

.2 Place minimum thickness of 200 mm of approved granular material on bottom of excavation and compact to minimum 95% of corrected maximum dry density.

.3 Shape bedding to fit lower segment of pipe exterior so that width of at least 50% of pipe diameter is in close contact with bedding and to camber as indicated or as directed by Contract Administrator, free from sags or high points.

.4 Place bedding in unfrozen condition.

3.3 LAYING CULVERTS

.1 Commence pipe placing at downstream end.

.2 Ensure bottom of pipe is in contact with shaped bed or compacted fill throughout its length.

.3 Do not allow water to flow through pipes during construction except as permitted by Contract Administrator.

3.4 JOINTS

.1 Corrugated steel pipe:

- .1 Match corrugations or indentations of coupler with pipe sections before tightening.
- .2 Tap couplers firmly as they are being tightened, to take up slack and ensure snug fit.
- .3 Insert and tighten bolts.
- .4 Repair spots where damage has occurred to spelter coating by applying two coats of asphalt paint approved by Contract Administrator or two coats of zinc rich paint.

.2 High Density Polyethylene Pipe:

- .1 Install gaskets in accordance with manufacturer's recommendations.
- .2 Maintain pipe joints free from mud, silt, gravel and other foreign material.
- .3 Avoid displacing gasket or contaminating with dirt or other foreign material. Gaskets so disturbed shall be removed, cleaned and lubricated and replaced before joining is attempted.
- .4 Complete each joint before laying next length of pipe.
- .5 Minimize joint deflection after joint has been made to avoid joint damage.
- .6 At rigid structures, install pipe joints not more than 1.2 m from side of structure.

.7 Apply sufficient pressure in making joints to ensure that joint is complete as outlined in manufacturer's recommendations.

3.5 PIPE SURROUND AND COVER

.1 Place surround material in unfrozen condition.

.2 Upon completion of pipe laying, and after Contract Administrator has inspected pipe joints, surround and cover pipes as indicated.

.3 Place surround material in uniform layers not exceeding 200 mm compacted thickness as indicated

.4 Place layers uniformly and simultaneously on each side of pipe.

.5 Compact each layer from pipe invert to spring line of pipe to at least 95% of corrected maximum dry density.

.6 Compact each layer from spring line of pipe to underside of top of cover (300mm above pipe obvert) to at least 100% of corrected maximum dry density.

3.6 BACKFILL

.1 Place backfill material in unfrozen condition.

.2 Place backfill material, above pipe surround in uniform layers not exceeding 300 mm compacted thickness up to grades as indicated. Backfill material is to be compacted to at least 95% of corrected maximum dry density.

.3 Protect installed culvert with minimum 600 mm cover of compacted fill before heavy equipment is permitted to cross. During construction, width of fill, at its top, to be at least twice diameter or span of pipe and with slopes not steeper than 1:2.

.4 Place backfill in unfrozen condition.

END OF SECTION

FOUNDATION AND UNDERSLAB DRAINAGE

PART 1 GENERAL

1.1 SECTION INCLUDES

.1 Materials and installation for foundation and underslab drainage.

1.2 RELATED SECTIONS

.1 Section 03 10 00 – Concrete Forms and Accessories.

.2 Section 31 05 16 - Aggregate Materials.

.3 Section 31 23 33 - Excavating, Trenching and Backfilling.

1.3 REFERENCES

.1 Canadian General Standards (CSA International).

.1 CSA –A23.1/A23.,Concrete Materials and Methods of Concrete Construction/Methods of Test for Concrete.

.2 CSA B1800, Plastic Non-pressure Pipe Compendium - B1800 Series (Consists of B181.1, B181.2, B181.3, B181.5, B182.1, B182.2, B182.4, B182.6, B182.7, B182.8 and B182.11).

.1 CSA B182.2-02, PVC Sewer Pipe and Fittings (PSM Type).

.2 American Society for Testing and Materials International, (ASTM).

.1 ASTM D698, Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3 (600 kN-m/m^3)

.3 Ontario Provincial Standard Specifications (OPSS);

.1 OPSS 1004, 1860

1.4 SITE CONDITIONS

.1 Examine geotechnical investigation report.

1.5 SUBMITTALS

.1 Submit manufacturer’s test data and certification at least 2 weeks prior to commencing work.

.1 Certification to be marked on pipe.

.2 Submit manufacturer’s information data sheets and instructions.

1.6 DELIVERY, STORAGE AND HANDLING

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

PART 2 PRODUCTS

2.1 BEDDING AND SURROUND MATERIALS

.1 Bedding and surround material is to be 19mm Clear Stone per OPSS MUNI 1004, extending a minimum of 300mm both above and below subdrain pipe.

.2 Subdrain pipe is to be perforated polyethylene pipe per OPSS 1840, minimum 320 kPa stiffness, covered with a knitted geotextile sock per OPSS 1860.

.3 Filter fabric is to be Class II non-woven geotextile per OPSS 1860.

2.2 BACKFILL MATERIAL

.1 Type 2, in accordance with Section 31 23 33 - Excavating, Trenching and Backfilling.

.2 Excavated or graded material existing on site may be suitable to use if approved by Contract Administrator.

PART 3 EXECUTION

3.1 EXAMINATION

.1 Ensure graded base conforms with required drainage pattern before placing bedding material.

.2 Ensure improper slopes, unstable areas, areas requiring additional compaction or other unsatisfactory conditions are corrected to approval of Contract Administrator.

.3 Ensure foundation wall and waterproofing have been installed and approved by Contract Administrator before placing bedding material.

3.2 BEDDING PREPARATION

.1 Cut trenches in base and place bedding material in uniform layers not exceeding 150 mm compacted thickness to depth as indicated.

.2 Shape bed true to grade and to provide continuous, uniform bearing surface for pipe.

3.3 PIPE INSTALLATION

.1 Ensure pipe interior and coupling surfaces are clean before laying.

.2 Lay perforated pipe tubing level minimum to slope of 1:100. Face perforations and coupling slots downward.

.3 Lay non-perforated pipe to slope of 1:50 from perforated pipe to disposal area. Make joints watertight.

.4 Grade bedding to establish pipe slope.

.5 Install end plugs at ends of collector drains to protect pipe tubing ends from damage and ingress of foreign material.

.6 Install end plugs at ends of collector drains.

.7 Lay perforated pipe around perimeter of the tanks as indicated.

.8 Connect subdrain to outlet swale at elevation indicated on contract drawings

3.4 BACKFILL MATERIAL

.1 Place backfill material above pipe surround in uniform layers not exceeding 200 mm compacted thickness up to grades as indicated.

.2 Under paving and walks, compact backfill to at least 95% corrected maximum dry density. In other areas, compact to at least 90% corrected maximum dry density.

END OF SECTION

CONCRETE ENCASED DUCT BANKS AND MANHOLES

PART 1 GENERAL

1.1 RELATED SECTIONS

.1 Section 01 33 00 - Submittal Procedures.

.2 Section 01 74 21 – Construction/Demolition Waste Management and Disposal.

.3 Section 03 10 00 – Concrete Forming and Accessories.

.4 Section 03 20 00 – Concrete Reinforcing.

.5 Section 03 33 00 – Cast-in-Place Concrete.

.6 Section 26 05 00 – Common Work Results - Electrical.

.7 Section 26 05 27 – Grounding – Primary.

.8 Section 31 23 33 - Excavating, Trenching and Backfilling.

1.2 REFERENCES

.1 Canadian Standards Association (CSA),

.1 CAN/CSA-A3000, Cementitious Materials Compendium. Includes:

.1 CAN/CSA-A5, Portland Cement

.2 CSA A23.1/A23.2, Concrete Materials and Methods of Concrete Construction/Methods of Test for Concrete.

.3 CSA G30.3, Cold-Drawn Steel Wire for Concrete Reinforcement.

.4 CSA G30.5, Welded Steel Wire Fabric for Concrete Reinforcement.

.5 CSA-G30.18, Billet-Steel Bars for Concrete Reinforcement.

.2 American Society for Testing and Materials (ASTM),

.1 ASTM D1056, Specification for Flexible Cellular Materials – Sponge or Expanded Rubber.

.3 Ontario Provincial Standard Specifications (OPSS);

.1 OPSS 603 – Installation of Ducts

1.3 SUBMITTALS

.1 Submit manufacturer’s test data and certification at least 2 weeks prior to commencing work.

.2 Submit manufacturer’s information data sheets and instructions.

.3 Submit shop drawings for precast manholes.

1.4 DELIVERY, STORAGE AND HANDLING

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

1.5 RECORD DRAWINGS

.1 Provide record drawings, including details of pipe and duct bank materials, maintenance and operating instructions in accordance with Section 01 78 00 – Closeout Submittals.

PART 2 PRODUCTS

2.1 PVC DUCTS AND FITTINGS

.1 Rigid PVC duct to CSA C22.2 No. 211.1, Type DB2, with 50mm thick concrete topping as shown on drawings.

.2 Rigid PVC bends, couplings, reducers, bell end fittings, plugs, caps, adaptors same product material as duct, to make complete installation.

.3 Rigid PVC 90º and 45º bends.

.4 Rigid PVC 5º angle couplings.

.5 Expansion joints as required.

.6 Use epoxy coated galvanized steel conduit for sections extending above finished grade.

2.2 SOLVENT WELD COMPOUND

.1 Solvent cement for PVC duct joints.

2.3 RIGID EPOXY COATED CONDUIT

.1 Rigid epoxy coated galvanized steel conduit with zinc coating and corrosion resistant epoxy finish inside and outside. Use for sections extending above finished grade as indicated on drawings.

.2 Factory “ells” where 90° bends are required for 27 mm and larger conduits.

2.4 PRECAST CONCRETE MANHOLES

.1 Precast concrete manholes and auxiliary sections fabricated in steel forms. Precast manholes to ASTM C 478/C 478M with manhole ladder rung spacing of 450mm (maximum).

.2 Aggregates: to CSA A23.1/A23.2.

.3 Portland cement: to CAN/CSA-A3001.

.4 Steel welded wire fabric mesh reinforcing: to CSA G30.18.

.5 Pulling inserts and bolts for racks integrally cast in concrete.

.6 Neoprene gasket seals between manhole sections: to ASTM D1056.

2.5 MANHOLE FRAMES AND COVERS

.1 Cast iron manhole frames and covers. Covers are to be 762mm diameter and bolted on to prevent unauthorized entry.

2.6 GROUNDING

.1 Ground rods in accordance with Section 26 05 27 - Grounding - Primary for Cable Rack Grounding.

2.7 CABLE RACKS

.1 Hot dipped galvanized cable racks and supports.

.2 12 x 100 mm pre-set inserts for rack mounting.

2.8 CABLE PULLING EQUIPMENT

.1 Pulling iron: galvanized steel rods, size and shape as indicated.

.2 Pull rope: 6 mm stranded nylon polypropylene, tensile strength 5 kN, continuous throughout each duct run with 3 m spare rope at each end.

2.9 CONCRETE & REINFORCEMENT

.1 Concrete per OPSS 1350 (minimum 28-day compressive strength of 30 mPa) and reinforcement per OPSS 1440 and as shown on electrical drawings. Refer to Division 3-Concrete.

2.10 MARKERS

.1 Provide 75 mm wide, 4 mil, polyethylene marker tape in all trenches. Use red colored tape with repeating black lettering “Caution – Buried Electrical Line” or similar message. Install at depth as per drawings.

PART 3 EXECUTION

3.1 INSTALLATION GENERAL

.1 Install underground duct banks and manholes including formwork.

.2 Build duct bank and manholes on undisturbed soil or on well compacted granular fill not less than 150 mm thick, compacted to 95% of corrected maximum dry density.

.3 Open trench completely between manholes to be connected before ducts are laid and ensure that no obstructions will necessitate change in grade of ducts.

.4 Install ducts at elevations and with slope as indicated and minimum slope of 400H:1V.

.5 Install base spacers at maximum intervals of 1.5m levelled to grades indicated for bottom layer of ducts.

.6 Lay PVC ducts with configuration as indicated with preformed interlocking, rigid plastic intermediate spacers to maintain spacing between ducts at not less than 60 mm horizontally and vertically. Stagger joints in adjacent layers at least 50 mm and make joints watertight. Encase duct bank with 50 mm thick concrete cover. Use epoxy coated galvanized steel conduit (i.e. corroguard) for sections extending above finished grade level.

.7 Make transpositions, offsets and changes in direction using 5 degree bend sections, do not exceed a total of 20 degree with duct offset.

.8 Use bell ends at duct terminations in manholes or buildings.

.9 Use conduit to duct adapters when connecting to conduits.

.10 Terminate duct runs with duct coupling set flush with end of concrete envelope when dead ending duct bank for future extension.

.11 Cut, ream and taper end of ducts in field in accordance with manufacturer's recommendations, so that duct ends are fully equal to factory-made ends.

.12 Allow concrete to attain 50% of its specified strength before backfilling.

.13 Use anchors, ties and trench jacks as required to secure ducts and prevent moving during placing of concrete. Tie ducts to spacers with twine or other non-metallic material. Remove weights or wood braces before concrete has set and fill voids.

.14 Clean ducts before laying. Cap ends of ducts during construction and after installation to prevent entrance of foreign materials.

.15 Immediately after placing of concrete, pull through each duct wooden mandrel not less than 300 mm long and of diameter 6 mm less than internal diameter of duct, followed by stiff bristle brush to remove sand, earth and other foreign matter. Avoid disturbing or damaging ducts where concrete has not set completely. Pull stiff bristle brush through each duct immediately before pulling-in cables.

.16 Install four 3 m lengths of 15M reinforcing rods, one in each corner of duct bank when connecting duct to manholes or buildings. Wire rods to 10M dowels at manhole or building and support from duct spacers. Protect existing cables and equipment when breaking into existing manholes. Place concrete down sides of duct bank filling space under and around ducts. Rod concrete with flat bar between vertical rows filling voids.

.17 In each duct install pull rope continuous throughout each duct run with 3 m spare rope at each end.

3.2 MANHOLES

.1 Install pre-cast manholes.

.2 Provide 115 mm deep window to facilitate cable bends in wall at each duct connection. Terminate ducts in bell-end fitting flush with window face. Provide four 10M steel dowels at each duct run connection to anchor duct run. On runs of 16 ducts and over, support concrete duct encasement on a 700 mm wide by 75 mm thick concrete pier poured against manhole wall between slab and bottom of duct run, provide dowels for anchoring.

.3 Alternately connect large duct runs by leaving square opening in wall, later pouring duct run and wall opening in one pour, and install 10M x 3m reinforcing rods in duct run at manhole connection.

.4 Precast manhole shall be fabricated to ensure that the manhole top is level with finished grade in paved areas and 40 mm above grade in unpaved areas. Shop drawings are to illustrate this.

.5 Install manhole frames and covers for each manhole. Set frames in concrete grout onto manhole neck.

.6 Install cable racks, anchor bolts and pulling irons as indicated.

.7 Grout frames of manholes. Cement grout to consist of two parts sand and one part cement and sufficient water to form a plastic slurry.

.8 Ensure filling of voids in joint being sealed. Plaster with cement grout, walls, ceiling and neck.

.9 Spray paint "X" on ceiling of manhole above floor drain or sump pit.

3.3 INSPECTIONS

.1 Inspection of duct will be carried out by Contract Administrator prior to placing.

END OF SECTION

DIRECT BURY UNDERGROUND CABLE DUCTS

PART 1 GENERAL

1.1 RELATED SECTIONS

.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 - Electrical.

.4 Section 31 23 33 – Excavating, Trenching and Backfilling.

.5 Section 33 65 73 – Concrete Encased Duct Banks and Manholes.

1.2 REFERENCES

.1 Canadian Standards Association (CSA)

.1 CSA C22.2 No. 211.1, Rigid Types EBI and DB2/ES2 PVC Conduit.

.2 CSA C22.2 No. 211.3, Reinforced Thermosetting Resin Conduit RTRC and Fittings (Bi-national standard, with UL 1684).

.2 Ontario Provincial Standard Specifications (OPSS)

.1 OPSS Section 603 – Installation of Ducts

.2 OPSS Section 604 – Installation of Cable

1.3 SUBMITTALS

.1 Submit WHMIS MSDS - Material Safety Data Sheets acceptable to Labour Canada, and Health and Welfare Canada for solvent cement. Indicate VOC content.

.2 Submit manufacturer’s data and certification at least 2 weeks prior to commencing work.

.3 Submit manufacturer’s information data sheets and instructions.

1.4 DELIVERY, STORAGE AND HANDLING

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

1.5 RECORD DRAWINGS

.1 Provide record drawings, including details of pipe and cable duct materials, maintenance and operating instructions.

PART 2 PRODUCTS

2.1 PVC DUCTS AND FITTINGS

.1 Rigid PVC duct: to CSA C22.2 No. 211.1 Type DB2, for direct burial with minimum wall thickness at any point of 2.8 mm. Nominal length: 3.0 m plus or minus 12 mm.

.2 Rigid PVC split ducts as required.

.3 Rigid PVC bends, couplings, reducers, bell end fittings, plugs, caps, adaptors same product material as duct, to make complete installation.

.4 Rigid PVC 90º and 45º bends as required.

.5 Rigid PVC 5º angle couplings as required.

.6 Expansion joints every 50m (minimum).

.7 Use epoxy coated galvanized steel conduit for sections extending above finished grade.

2.2 SOLVENT WELD COMPOUND

.1 Solvent cement for PVC duct joints.

2.3 CABLE PULLING EQUIPMENT

.1 Use 6 mm stranded nylon pull rope tensile strength 5 kN.

2.4 MARKERS

.1 75 mm wide, 4 mil, polyethylene marker tape in all trenches. Use red colored tap with repeated black lettering “Caution – Buried Electrical Line”. Install at depth as per drawings.

2.5 BEDDING, COVER AND SURROUND MATERIALS

.1 All materials as per Specification Section 31 23 33 – Excavating, Trenching, and Backfilling.

.2 Type 1 (Granular ‘A’) and Type 2 (Granular ‘B’) Type II) material.

.3 Sandfill as per Specification 31 23 33 for electrical/communications trenches

PART 3 EXECUTION

3.1 INSTALLATION

.1 Install duct in accordance with manufacturer's instructions.

.2 Clean inside of ducts before laying.

.3 Ensure full, even support every 1.5 m throughout duct length.

.4 Slope ducts with 1 to 400 minimum slope.

.5 During construction, cap ends of ducts to prevent entrance of foreign materials.

.6 Pull through each duct wooden mandrel not less than 300 mm long and of diameter 6 mm less than internal diameter of duct, followed by stiff bristle brush to remove sand, earth and other foreign matter. Pull stiff bristle brush through each duct immediately before pulling-in cables.

.7 In each duct install pull rope continuous throughout each duct run with 3 m spare rope at each end.

.8 Install markers as required.

END OF SECTION

UNDERGROUND ELECTRICAL SERVICE

PART 1 GENERAL

1.1 SECTION INCLUDES

.1 Provision of rigid conduit and concrete – encased underground service ducts.

1.2 RELATED SECTIONS

.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 – Electrical.

.4 Section 26 05 27 – Grounding – Primary.

.5 Section 26 05 28 – Grounding – Secondary.

.6 Section 26 05 34 – Conduits, Conduit Fastenings and Conduit Fittings.

.7 Section 26 05 43 – Installation of Cables in Trenches and in Ducts.

.8 Section 33 65 76 – Direct Buried Underground Cable Ducts.

1.3 REFERENCES

.1 Canadian Standards Association (CSA)

.1 CSA A23.1/A23.2, Concrete Materials and Methods of Concrete Construction/Methods of Test for Concrete.

.2 Ontario Provincial Standard Specifications (OPSS);

.1 OPSS Sections 604, 609

1.4 REGULATORY REQUIREMENTS

.1 Co-ordinate and meet requirements of power supply authority. Ensure availability of power when required.

.2 Perform work to comply with relevant provincial/territorial regulations.

1.5 SUBMITTALS

.1 Provide submittals in accordance with Section 01-33-00 – Submittal Procedures and Section 26 05 00 – Common Work Results for Electrical.

.2 Product Data;

.1 Submit manufacturers printed product literature, specifications, and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.

PART 2 PRODUCTS

2.1 MATERIALS

.1 Underground ducts: to Section 33 65 76 – Direct Buried Underground Cable Ducts, rigid PVC type, size as indicated and Section 33 65 73 – Concrete Encased Duct Banks.

.2 Epoxy coated rigid steel galvanized conduit and fittings: to Division 26. Use for sections extending above finished grade.

.3 Conductors: copper, type RWU-90, to Section 26 05 21 – Wires and Cables (0 - 600v), size and number of conductors as indicated.

.4 Meter socket: weatherproof, to Section 26 09 23.01 – Metering and Switchboard Instruments.

.5 Pole mounted outdoor load break switch as per Section 26 28 13.02 – Outdoor Load Break Switches and Fuses.

.6 Concrete: to CSA A23.1/A23.2 and Division 3 – Concrete.

.7 Ground at terminal pole enclosure as per Section 26 05 27 – Grounding – Primary.

.8 Bedding, Cover and Surround Materials

.1 All materials as per Specification Section 31 23 33 – Excavating, Trenching, and Backfilling.

.2 Type 1 (Granular ‘A’) and Type 2 (Granular ‘B’) Type II) material

.3 Sandfill as per Specification 31 23 33 for electrical/communications trenches.

.9 Pulling Iron:

.1 22 mm diameter hot dipped galvanized steel bar with exposed triangular shaped opening.

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 cables in trenches and in ducts in accordance with Section 26 05 43 – Installation of Cables in Trenches and in Ducts.

.2 Allow adequate conductor length for connection to supply by power supply authority.

.3 Install meter socket and conduit.

.4 Install pole mounted load break switch as indicated.

.5 Allow adequate conductor length for connection to service equipment.

.6 Make grounding connections in accordance with Section 26 05 28 – Grounding – Secondary.

.7 Provide concrete encasement in accordance with CSA A23.1 and as indicated on drawings.

.8 Install pulling irons as required.

.9 Seal ducts and conduits at building entrance location after installation of cable.

3.3 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 00 – Common Work Results – Electrical and Section 01 91 13 – General Commissioning (Cx) Requirements.

.2 Perform additional tests as required by authority having jurisdiction.

.3 Submit written test results for review and approval.

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

PROCESS GENERAL REQUIREMENTS

PART 1 GENERAL

1.1 SUMMARY

.1 Section includes supply, installation, testing and commissioning of mechanical equipment in Divisions 44 and 25 supplemented by details shown or specified in respective Sections. All costs associated with these services are to be included in the price(s) quoted.

1.2 GENERAL CLAUSES

.1 Comply with Division 01.

.2 Unless there are more restrictive requirements in respective Sections, provisions of this Section apply.

.3 Ensure that control panels and/or components provided as part of packaged equipment conform to requirements of the Specifications, Division 25 through 28 and Drawings.

.4 For control and electrical elements, use this Section in conjunction with the Drawings for conformance to style, quality, and product demonstrated and selected. Provide instrumentation and control devices as detailed in the Specifications and shown on the Drawings, including the Electrical Divisions 25 through 28.

.5 All equipment and controls to be CSA compliant and identified as such.

.6 Comply with laws, ordinances, rules, regulations, codes, and orders of authorities having jurisdiction relating to work.

.7 It is the Contractor's responsibility to ascertain from each Supplier the extent of work required for the complete installation of each piece of equipment, and to ensure that each Supplier has full knowledge of the required duty of the equipment to be installed.

.8 Be fully acquainted with all work under this Contract. At no time will any claim be considered due to misunderstanding of the work involved.

.9 Immediately upon receipt of the Start Work Order, issue a Purchase Order or Sub-Contract for designated equipment. Submit a copy of the Purchase Order or agreement to the Contact Administrator. Failure to order equipment in a timely fashion will not be considered as a reason to extend the Contract schedule.

1.3 SYSTEM DESCRIPTION

.1 It is the intent of all Sections of these Specifications to specify a complete and operating system that will perform its intended function(s). All devices, fittings, valves and other appurtenances required to perform this function shall be considered as part of the Specifications, even if not explicitly identified.

.2 Design requirements:

.1 Provide heavy-duty mechanical equipment designed for continuous operation.

.2 Maximum vibration velocity (measured at equipment bearings): 1 mm/s.

.3 Co-ordination requirements:

.1 Equipment, such as pressure switches, may be shown on Process, Mechanical and/or Instrumentation Drawings. They may also be shown on Electrical Drawings due to wiring requirements. Provide these devices under Division 25, 26, and 44, respectively. Equipment and devices are wired according to the Electrical Drawings and Specifications.

.2 Coordinate requirements of equipment supplied with piping, structural supports, ventilation/cooling, electrical service, instrumentation and control interface, and other ancillaries specified in other Divisions.

1.4 REFERENCES

.1 Standards:

.1 AFBMA Std 9, Load Ratings and Fatigue Life for Ball Bearings.

.2 AFBMA Std 11, Load Ratings and Fatigue Life for Roller Bearings.

.3 ANSI/ASME, Boiler and Pressure Vessel Code, Section VIII, Division 1.

.4 ANSI B1.1, Unified Screw Threads.

.5 ANSI B1.20.1, Pipe Threads, General Purpose.

.6 ANSI B16.1, Cast Iron Pipe Flanges and Flanged Fittings Class 25, 125, 250 and 800.

.7 ANSI B16.5, Pipe Flanges and Flanged Fittings, Steel, Nickel Alloy and Other Special Alloys.

.8 ANSI B18.2.1, Square and Hex Bolts and Screws, Including Askew Head Bolts, Hex Cap Screws, and Log Screws.

.9 ANSI B18.2.2, Square and Hex Nuts.

.10 ANSI/ASME B31.1, Power Piping.

.11 ANSI/ASME B31.3,Chemical Piping.

.12 ANSI/ASME B31.9, Building Services Piping.

.13 ANSI B32.1, Metal Products.

.14 ANSI B46.1, Surface Texture.

.15 ANSI/ASME B1.20.1, General Purpose Pipe Threads.

.16 ASTM A 48, Specification for Gray Iron Castings.

.17 ASTM A307, Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.

.18 ASTM A320, Alloy-Steel Bolting Materials for Low Temperature Service.

.19 CSA CAN3-S16.1-M, Steel Structures for Buildings (Limit State Design).

.20 CSA C59-M, Welded Steel Construction (Metal Arch Welding).

.21 CSA S244, Welded Aluminum Design and workmanship (Inert Gas Shielded Arch Processes).

.22 CSA W47.1, Certification of Companies for Fusion Welding of Steel Structures.

.23 CSA W47.22-M, Certification of Companies for Fusion Welding of Aluminum.

.24 Canadian Electrical Code (CEC), Safety Standard for Electrical Installations.

.25 ANSI/CSA B149.6-15 Code for Digester Gas, Landfill Gas and Biogas Generation and Utilization Published 2015, as amended.

.26 TSSA Digester, Landfill & Biogas Approval Code TSSA-DLB-2016, as amended.

.2 Certificates:

.1 Shop finished metal: Certify that shop finished metal components received specified protective coating system.

.2 Welding aluminum: Certify that companies welding aluminum components are CSA-approved (CSA W47.2).

1.5 SHOP DRAWINGS AND SAMPLES

.1 The following shall be submitted in compliance with Section 01 33 00:

.1 Manufacturer's product data including catalogue cuts.

.2 Equipment name, identification number and specification numbers.

.3 Shop drawings showing details, dimensions, anchorage details, and installation of equipment with all special fittings, appurtenances and required clearances.

.4 Shipping weights.

.5 Calculations of equipment anchorage forces and anchorage details.

.6 Certification that the single manufacturer accepts the indicated unit responsibilities.

.7 Parts list with materials of construction by ASTM reference and grade.

.8 List of at least 5 installations and telephone numbers, where identical equipment has been used.

.9 Documentation of experience of specialist who will perform torsional and vibration analysis.

.10 Torsional and lateral vibration analysis reports.

1.6 SERVICES OF MANUFACTURER

.1 Provide Inspection, Start-up, and Field Adjustment services in accordance with the requirements of Division 01 using an authorized service representative of the manufacturer. At a minimum, the authorized service representative shall visit the site and witness the following:

- .1 Installation of equipment.
- .2 Inspection, checking and adjusting the equipment
- .3 Start-up and field testing for proper operation.
- .4 Perform field adjustment to ensure that the equipment installation and operation comply with the Specifications.
- .5 Allow one (1) full working day on site per visit.

1.7 TRAINING

.1 Provide training to Owner in accordance with Section 01 91 41 – Commissioning Training.

1.8 FACTORY TESTING

.1 Provide the following services for factory testing, unless otherwise indicated:

- .1 Test product at factory for compliance with specified requirements.
- .2 Statically and dynamically balance rotating elements of equipment at factory prior to final assembly to provide smooth operation. Provide Contract Administrator with 10 business days advance notice of factory test.
- .3 Contract Administrator may witness factory test.
- .4 Do not deliver equipment to site until equipment has met specific requirements of factory tests.

1.9 COORDINATION

.1 The Contractor shall coordinate with the system and equipment manufacturers, the Vendor's installation and supply scope or work because the Contractor shall be responsible for the entire installation and commissioning.

.2 If there is a discrepancy for the Vendor's supply scope or work shown on the process drawings, the Contractor shall provide all required piping, power cables and communication cables for the complete commissioning and controls.

.3 Fully coordinate the work of all related specification sections. Use equipment specifications together with all sitework, concrete, building, electrical and controls specifications as necessary in order to produce a fully coordinated product meeting all necessary specifications.

.4 When manufacturers field services are provided by the equipment manufacturer, the Contractor shall coordinate the services with the equipment manufacturer. The Contractor shall give the Engineer written notice at least 30 days prior to the need for manufacturer's field services furnished by others.

1.10 PRODUCTS DELIVERY, STORAGE AND HANDLING

.1 Unless otherwise indicated in the respective Sections, the Contractor is to be responsible for unloading any equipment upon delivery to site. Unloading to be done carefully and according to the Manufacturer's recommended practices.

.2 Deliver, store and handle equipment in accordance with Section 01 61 00 and the following additional requirements:

.1 Deliver material to site in original, unbroken packages, containers or bundles bearing name of manufacturer.

.2 Box, crate or otherwise protect equipment from damage and moisture during shipping, handling and storage.

.3 Protect bearings, seals and glands from grit and foreign matter.

.4 Protect equipment from exposure to corrosive fumes.

.5 Arrange for delivery of equipment to site to meet applicable dates in progress schedule.

.6 Arrange for delivery of anchor bolts, templates, embedded miscellaneous metals, and other similar items to site as required during construction.

.7 Do not arrange for delivery to site of equipment until suitable storage space exists within the storage facility on site so that equipment can be protected from weather, construction debris, and dust.

.8 Keep equipment dry at all times.

.9 Store equipment at site prior to installation in temporary weathertight, heated storage facilities free from dust, moisture, and other conditions that could damage equipment.

.10 Do not use plastic wrappers to prevent accumulation of condensate in gears and bearings, if equipment is stored for extended period.

.11 Remove rejected equipment damaged during shipment, storage or installation and replace with new identical equipment.

.12 Improperly stored equipment will be rejected from site.

1.11 UNIT RESPONSIBILITY

.1 Equipment systems made up of two or more components shall be provided as a unit by the manufacturer of the driven equipment. The manufacturer of the driven equipment shall assume the unit responsibility. Unless otherwise indicated, the Contractor shall cause each system component to be furnished by the manufacturer with unit responsibility. The extent of the manufacturer's responsibilities shall include engineering the specified equipment, preparation of all submittal materials, coordinating manufacture and procurement, compatibility and shipment of all

specified components, design of all equipment supports, providing installation and testing specialists to assist the Contractor in completing the installation and commissioning the equipment, furnishing factory certified specialists to train the Owner's staff, and the production and submission of specified operation and maintenance manuals. The Contractor is responsible to the Owner for performance of all systems as indicated. The Contractor shall ensure the submittal of a Certificate of Unit Responsibility signed by the manufacturer with unit responsibility.

1.12 SPECIAL TOOL

.1 Provide one complete set of special tools recommended by manufacturer for maintenance and repair of each separate type of equipment.

.2 Store special tools in tool boxes.

.3 Identify tool box with equipment number with stainless steel or solid plastic name tags attached to box.

1.13 SPARE PARTS

.1 Provide spare parts recommended by manufacturer with equipment where specified in respective Sections.

.2 Include in any submittals a list of the Manufacturer's recommended spare parts.

.3 Tag spare parts by Project equipment number and identified as to part number, equipment manufacturer and sub-assembly component (if appropriate).

.4 Protect spare parts subject to deterioration such as ferrous metal items and electrical components with lubricants or desiccants. Encapsulate spare parts in hermetically sealed plastic wrapping.

.5 Store spare parts in wooden boxes with hinged cover and locking hasp if spare part weighs less than 50 pounds. Provide strap type hinges. Paint and identify box with stencilled lettering stating name of equipment, equipment numbers and words "Spare Parts". Provide neatly typed inventory of spare parts on underside of cover.

1.14 ALTERNATE EQUIPMENT

.1 The Contractor shall base his tender price on quotations received from the equipment suppliers as hereinafter specified, unless otherwise noted. Should the contractor wish to propose an alternate, after the tender closing and award of the contract, the alternate may be considered if there is a financial and quality incentive provided for consideration.

PART 2 PRODUCTS

2.1 GENERAL

.1 Provide equipment as follows:

.1 Specified products meeting specified requirements.

.2 New products from current and specified manufacturer.

.3 Suitable for intended purposes, of high quality and free of defects.

.4 Equipment to operate at highest efficiency possible for that equipment type.

.5 Products and materials recommended by specified manufacturer for intended service.

.6 All working parts to be standard sizes such that parts will be interchangeable between like units and that the Owner be able to obtain replacement and repair parts at any time in the future.

2.2 EQUIPMENT GENERAL REQUIREMENTS

.1 Provide equipment designed for:

.1 Service factor: Use minimum service factor of 1.25 in selection and design of mechanical power transmission components unless otherwise specified in various Sections.

.2 Welding: Except as otherwise indicated, welding shall comply with ANSI/AWWA D100 AND AWWA C206 and the following:

.1 Composite fabricated steel assemblies which are to be erected or installed inside a hydraulic structure, including any fixed or movable structural components of mechanical equipment, shall have continuous seal welds and shall prevent entrance of air or moisture.

.2 Welding shall be by the metal-arc method or gas-shielded arc method described in the American Welding Society's "Welding Handbook" as supplemented by other AWS standards.

.3 Qualification of welders shall comply with AWS Standards.

.4 In assembly and during welding, the component parts shall be clamped, supported, and restrained to minimize distortion and for control of dimensions. Weld reinforcement shall comply with the AWS code. Upon completion of welding, weld splatter, flux, slag, and burrs left by attachments shall be removed. Welds shall be repaired to produce a workmanlike appearance with uniform weld contours and dimensions. Sharp corners of material which is to be painted or coated shall be ground to a minimum of 1/32-inch on the flat.

.5 All austenitic Stainless Steel welds shall be cleaned in accordance with ASTM A380-88 Section 6.2.11. The acid solution is as defined in ASTM A380 Table A2.1 Annex A2. Materials shall receive a final

rinse using ordinary industrial or potable water and passivated in conformance with ASTM A380 Section 8.3.

.3 Equipment identification: Legible identifying mark corresponding to equipment number indicated.

.4 Shop fabrication: In accordance with shop drawings.

.5 Tolerances: Maximum variation in length of members without machine finished ends that are framed is 1.59 mm for members 9.1 m or less, maximum 3.175 mm for members over 9.1 m in length.

.6 Vibration Level: Except as otherwise indicated, equipment subject to vibration shall be provided with restrained spring-type vibration isolators or pads complying with the manufacturer's written recommendations.

.7 Seismic Design: The seismic design of equipment and equipment supports shall be based on the horizontal peak ground acceleration indicated in the Geotechnical Report or in the Ontario Building Code requirements for Post Disaster Buildings.

2.3 PIPE HANGERS, SUPPORTS AND GUIDES

.1 Pipe connections to equipment shall be supported, anchored, and guided to minimize stresses and loads on equipment flanges and equipment. Supports and hangers shall comply with the requirements of Section 44 05 50.

2.4 BEARINGS

.1 Bearings for rotating equipment:

.1 Design: B-10 life expectancy to Anti-Friction Bearing Manufacturers Association Inc. (AFBMA) at rated conditions of service for minimum 100,000 working hours, unless otherwise specified.

.2 Grease fittings for bearing lubrication.

.3 Bearing selection based on following criteria: Fitting practice, mounting, lubrication, sealing, static rating, and housing strength.

.4 Lubricated-for-life bearings: Factory lubricate with manufacturer's best recommended grease to insure maximum bearing life and best performance.

.5 Re-lubricatable type bearings: Grease nipple for loading and capped vent to relieve aged grease.

.6 Equip oil lubricated bearings with either pressure lubricating system or separate oil reservoir type system.

.7 Design oil lubrication systems of sufficient size to absorb heat energy generated in bearing under maximum ambient temperature of 40°C. Provide filler pipe and external level indicator gauge.

.8 Bearing housings: Cast iron or steel, unless otherwise specified.

.9 Bearing mounting arrangement: to published standards of manufacturer.

.10 Electric motors: Design bearings so no grease or oil can escape.

2.5 SHAFTING

.1 Continuous shafting between bearings.

.2 Size shafting to transmit power required.

.3 Provide keyways in accordance with manufacturer's standard practice.

.4 Select materials for shafting for type of service, torque transmitted, and effect of corrosive gases, moisture, and fluids used in service.

.5 Materials:

.1 Low carbon cold-rolled steel shafting: ASTM A 108, Grade 1018.

.2 Medium carbon cold-rolled shafting: ASTM A 108, Grade 1045.

.3 Corrosion resistant shafting: stainless steel or Monel, whichever is most suitable for service.

2.6 GEARS AND GEAR DRIVES

.1 Except as otherwise indicated, gears shall be of the helical or spiral-bevel type, designed and manufactured in accordance with AGMA Standards, with a minimum service factor of 1.7, a minimumL-10 bearing life of 60,000 hours at the worst combination of specified operating conditions, in accordance with ABMA 9 or 11, and a minimum efficiency of 94 percent. Worm gears shall not be used.

.2 Gear speed reducers or increasers shall be of the enclosed type, oil- or grease-lubricated and fully sealed, with a breather to allow air to escape but keep dust and dirt out. The casing shall be of cast iron or heavy duty steel construction with lifting lugs and an inspection cover for each gear train. An oil level sight glass and an oil flow indicator shall be provided and installed for easy reading.

.3 Gears and gear drives as part of an equipment assembly shall be shipped fully assembled for field installation.

.4 Material selections shall comply with AGMA values and the manufacturer's recommendations. Input and output shafts shall be properly designed for the service and load requirements. Gears shall be computer-matched for minimum tolerance variation. The output shaft shall have 2 positive seals to prevent oil leakage.

.5 Oil level and drain location shall be readily accessible. Oil coolers or heat exchangers with all required appurtenances shall be included where indicated.

.6 Where gear drive input or output shafts connect to couplings or sprockets, the gear drive manufacturer shall supply matching key.

2.7 DRIVE CHAINS

.1 Power drive chains shall be commercial type roller chains complying with ANSI standards and of materials best suited for the process fluid.

.2 A chain take-up or tightener shall be provided in every chain drive arrangement.

.3 A minimum of one connecting or coupler link shall be provided with each length of roller chain.

2.8 EQUIPMENT GUARDS

.1 All equipment to be guarded in compliance with Ontario Health and Safety Act (OHSA) requirements and any other applicable regulations.

.2 Without limiting clause 2.8.1 above, provide equipment guards for couplings, belts, chain drives, extended shafts, and exposed moving or rotating parts:

- .1 Securely mounted guards.
- .2 Reinforced, minimum 2.8 mm thick sheet steel or expanded sheet metal.
- .3 Smooth edges and corners with borders neatly welded to perforated sheet.
- .4 Hinged, latched and lockable access doors.
- .5 Hot-dip galvanize steel guards after fabrication.
- .6 Guards designed to totally enclose couplings, belts, chain drives, extended shafts, and exposed moving or rotating parts.
- .7 Paint guards to same standard as parent equipment.
- .8 Removable type guards to facilitate maintenance of moving parts.
- .9 Make provision to extend grease fittings through guards to an accessible area.

2.9 CAUTION SIGNS

.1 Use vinyl stick-on type decals placed onto clean, smooth surface of equipment to be posted.

.2 Where insufficient space exists, use decal applied to galvanized mild steel, fibreglass, or plastic sheet fastened to equipment.

.3 Provide signs that read “CAUTION - AUTOMATIC EQUIPMENT MAY START AT ANY TIME”.

.4 Letters: 25 mm in height, red, on yellow background.

.5 Mounting posts and hardware. Mount close to guarded moving parts.

.6 Sufficiently sized taps to avoid plugging and to permit instruments to be installed.

2.10 EQUIPMENT NOISE LEVELS

.1 Design equipment for quiet operation.

.2 Overall noise level at equipment to be maximum 85 decibels measured on "A" weighting network using survey and field methods conforming to ANSI S1.13 and CSA Z107.2, unless otherwise specified.

.3 If hearing protection is required, Contractor shall install signs as directed at each door entering the area where hearing protection is required.

2.11 EQUIPMENT IDENTIFICATION

.1 Nameplates for equipment:

- .1 Securely attached in suitable location.
- .2 Nameplate material: Corrosion-resistant metal.
- .3 Impressed type lettering on equipment.
- .4 Provide a minimum of the following information on nameplate (units to be metric):
  - .1 Model number.
  - .2 Serial number.
  - .3 Capacities.
  - .4 Efficiency.
  - .5 Brake horsepower.
  - .6 Other information required to uniquely identify equipment.

2.12 ELECTRICAL CONTROL AND INSTRUMENTATION

.1 Provide CSA approved instrumentation, control, and electrical devices that bear CSA approvals sticker.

.2 Electrical equipment shall bear CSA labels and/or ULC where applicable per the Canadian Electrical Code and the Electrical Safety Authority. Conform to the requirements of the Canadian Electrical Code, Ontario Building Code, local, municipal and provincial authorities. Equipment not complying with the above approvals shall have on-site inspection by ESA, and the Contractor shall provide all necessary work to satisfy ESA requirements in order to obtain approval. All associated fees, cost of material and labour shall be provided by the Contractor. All necessary application or documentation required shall be provided by Contractor. Substantial Completion will not be awarded until all ESA permits and approvals are provided to the Contract Administrator for operation of the equipment and facilities.

.3 Indicating Lights: Use oil-tight transformer type indicating lights with low voltage lamps and push-to-test features, with coloured lenses in accordance with the specifications and Electrical Drawings.

.4 Disconnect Switches: Disconnect switches in accordance with the specifications and Electrical Drawings.

.5 Cables: Cables in accordance with the specifications and Electrical Drawings.

.6 Conduits: Conduits, conduit fastenings, and fittings in accordance with the specifications and Electrical Drawings.

.7 Grounding: Grounding in accordance with the specifications and Electrical Drawings.

.8 Programming: All computer/control programs required for the intended operation of supplied equipment, as designed and as shown on the Contract Drawings and in the Specifications, shall be considered an essential component of that equipment. Such programs are to be delivered as part of the shop drawing review, and no delivery of equipment shall occur until all required programs have been approved by the Contract Administrator.

.9 Pilot Devices:

.1 Electrical pilot devices including switches, relays, and contacts: Use heavy-duty industrial quality devices in accordance with the specifications and Electrical Drawings.

.2 Contacts that provide alarm, malfunction or control to external systems must be rated for minimum 10 Amps continuous at 120 Volts AC, except for pressure switches and temperature switches rated minimum 5 Amps continuous at 120 Volts AC.

2.13 OVERLOAD PROTECTION

.1 General: Where indicated, mechanical or electronic overload protection devices shall be installed on equipment.

.2 Mechanical System: The overload protection shall be a mechanical device designed to provide reliable protection in the event of excessive overload. It shall be a ball detent type designed for long term repeatability and life. It shall be infinitely adjustable by a single adjusting nut which shall be tamper proof, and incorporate a torque monitoring and control system. It shall activate an alarm set for 85 percent, and a motor cut-out switch set for 100 percent of maximum continuous running torque. A visual torque indicator shall be provided and oriented so that it may be read from the walkway. The dial shall be calibrated from 0 to 100 percent of maximum continuous running torque. The design of the torque limiter should initiate the mechanical disengagement of the drive upon overload. Each unit shall be suitable for outdoor and corrosive environments with a protective finish, corrosion inhibiting lubricants and a stainless steel cover.

.3 Electronic System: Overload protection may bean Electronic Torque Monitoring Control System capable of displaying torque, rpm's, one level of overload, and two

levels of overload of the drive system. It shall incorporate a time-delay for start up and a voltage monitoring and compensation circuit for up to ±15 percent variation.

The overload device shall have an enclosure suitable for outdoor installation at temperatures of 0-70 °C, and relative humidity up to 95 percent. A visual torque dial shall be provided and oriented so that it can be easily read from the walkway.

The torque monitoring system shall be calibrated to include: alarm and shut down the system in the event the torque drops to 50 percent of normal running; alarm at 85 percent of maximum continuous running torque and shut down the motor at maximum continuous running torque of the equipment. The system shall be calibrated at the factory of the equipment manufacturer, and it shall be capable of monitoring twice the maximum continuous running torque of the equipment.

.4 Maximum Continuous Running Torque shall be defined as the lesser of: the motor continuous running torque rating, the gear drive continuous running torque rating, or the driven mechanism continuous running torque rating, not exceeding a service factor of 1.0.

2.14 PUDDLE FLANGES AND PIPE SLEEVES

.1 Provide Puddle Flanges and Pipe Sleeves: at points where pipes pass through masonry, concrete, fire rated assemblies, floors/grating, and as indicated. All of these products are to be cast-in-place in coordination with Division 03, coring will not be accepted where puddle flanges or pipe sleeves are shown. Refer to Section 44 05 50 for detail requirements.

2.15 ANCHOR BOLTS, NUTS AND WASHERS

.1 Unless otherwise indicated, anchor bolts, nuts and washers for anchoring equipment to foundations and connecting bolts for equipment assemblies supported by other assemblies shall conform to the requirements of Division 05. Unless otherwise specified, the Contractor shall provide Type 316 stainless steel anchor bolts and washers, and Type 416 stainless steel or other corrosion resistant, non-galling alloy nuts . In ferrous chloride and ferric chloride containment areas, unless otherwise specified, provide Hastelloy C or Alloy 276 anchor bolts, nuts, washers and connecting bolts.

2.16 SPROCKETS

.1 General: Sprockets shall be used in conjunction with chain drives and chain-type material handling equipment.

.2 Materials: Except as otherwise indicated, sprockets shall comply with the following:

.1 Sprockets with 25 teeth or less, normally used as a driver, shall be medium carbon steel in the 0.40 to 0.45 percent carbon range.

.2 Type A and B sprockets with 26 teeth or more, normally used as driven sprockets, shall be minimum 0.20 percent carbon steel.

.3 Large diameter sprockets with Type C hub shall be cast iron conforming to ASTM A 48, Class 30.

.4 Sprockets shall be accurately machined to ANSI Standards. Sprockets shall have deep hardness penetration in tooth sections.

.5 Finish bored sprockets shall be provided complete with keyseat and set screws.

.6 Sprockets shall be of the split type or shall be provided with taper-lock bushings.

.7 Idler sprockets shall be provided with brass or Babbitt bushings, complete with oil hole and axial or circumferential grooving. Steel collars with set screws in both sides of the hub shall be provided.

PART 3 EXECUTION

3.1 FINISHES

.1 Finish equipment to following quality:

.1 Welds: free of slag, ground and buffed.

.2 Surfaces of castings: ground smooth.

.3 Corners and edges on sheet metal work: rounded.

.4 Materials and equipment: free of dents.

.5 Machined surfaces finished: to specified tolerances.

3.2 PUMP TESTING

.1 The Contractor with Supplier shall perform the pump testing.

.2 Comply with ANSI/HI 14.6-2016, Rotodynamic Pumps for Hydraulic Performance Acceptance Tests.

.3 Comply with ANSI/HI 11.6-2017, Rotodynamic Submersible Pumps: for Hydraulic Performance, Hydrostatic Pressure, Mechanical and Electrical Acceptance Tests

.4 Complete a factory hydrostatic pressure tests and submit the test reports.

.5 The standard tests shall be carried out on a combination of a pump and associated valves and fittings at the final site installation.

.6 Comply with ISO 10816-3, API 610 and other standards for the vibration limits.

.1 An acceptable vibration level would be below 0.16 in/sec (pk) or 2.8 mm/sec (rms) as per ISO 10816-3.

.2 Based on the API 610 requirement the overall vibration for overhung pump shall be less than 3 mm/s (0.12 in/s) for overall frequency and 2 mm/s (0.08 in/s) for discrete frequency.

.7 For the mechanical test on the non-submersible pumps, the flow at the inlet and outlet of the whole combination shall comply with the following requirements:

.1 Testing operating conditions and procedure in accordance with ANSI/HI 14.6-2016.

.2 Dry-run test for 10 seconds

.3 Vibration at the pump bearing housing in two directions perpendicular to the shaft and in the axial direction.

.1 Vibration instruments can be either handheld or rigidly attached to the pump. For pumps with speeds above 600 rpm, the measurement instrumentation should be capable of measuring the RMS vibration velocity.

.2 Refer to ANSI/HI 9.6.4 Rotodynamic Pumps for Vibration Measurements and Allowable Values for Vibration Test Requirements, including Instrumentation.

.3 The planes of measurement shall be horizontal, perpendicular to the pump shaft (x), vertical (y) and at 90° to the above planes, parallel to the shaft for horizontal pumps and perpendicular for vertical pumps (z).

.4 Temperature of both bearings or bearing housings.

.1 Temperature instruments can be any recognized temperature sensor, such as pyrometers, thermometers, thermo-couples, and the like.

.2 They should be capable of measuring the metal temperature on the outside of the housing of both bearings and may be handheld.

.5 Leakage from mechanical seals, gaskets and bearing lubricant. Visual observation is sufficient for all leakage.

.6 Oil temperature when oil sump is used.

.8 Submit the test records or reports with the following data:

.1 The manufacturer’s serial number, pump type and size

.2 Acceptance criteria

.3 Vibration levels with measurement locations

.4 Noise levels

.5 Bearing temperature

.6 Ambient temperature

.7 Leakage

.8 Free-running rotating parts

.9 Date of test

3.3 BLOWER TESTING

.1 Comply with ISO 5389:2005, PTC 10-1997, IS 1940/1, ASME PTC 10-997, ASME PTC 19.5 and ISO 5801 First Edition 1997-06-01.

.2 Complete a factory performance, overspeed spin, balance and vibration tests, noise level tests, power draw tests and submit the test reports.

.3 On-site vibration and surge test

.1 The standard tests shall be carried out on a combination of blower (s) and associated valves and fittings at the final site installation.

.2 Submit the test records or reports with the vibration limits/levels and noise levels.

3.4 PAINTING AND CLEANING OF STAINLESS STEEL

.1 If specified in various Sections, prepare surfaces, shop prime and factory finish equipment to Division 05 and Division 09 for priming and painting of steel.

.2 If exposed surfaces of equipment are not specified to be factory painted in various Sections, prepare surfaces, and shop prime equipment in accordance with Division 09. Field painting to be done after equipment is installed and successfully tested.

.3 All stainless steel shall be cleaned following completion of the commissioning process and prior the issuance of the certificate of substantial completion according to the following:

.1 The supplied welded stainless steel assemblies are to be cleaned in accordance with ASTM A380-88 Section 6.2.11. The acid solution is as defined in ASTM A380 Table A2.1 Annex A2. Materials have a final rinse using ordinary industrial or potable water and are dried in conformance with ASTM A380 Section 8.3.

.2 Welds shall be acid passivated. Pickling paste (AVESTA 101 or equivalent) shall be brushed on all welds and overlap into the heat affected zones (HAZ). Paste shall be left on for 1-2 hours before water flush and neutralization with a soda ash solution. Contractor is responsible for all clean up.

.3 All surface blemishes and weld tacks shall be blended smooth using Walters (or equiv.) blender disc (80 grit). The complete surface shall be glass bead polished to uniform finish using # 6 glass bead. After polishing, the surface shall be rinsed then passivated using citric acid solution. Solution shall be mixed at a ratio of 4 parts water to 1 part dry citric acid powder (by volume). Solution shall be sprayed onto surface and left for 30 minutes before water flushing the complete surface.

3.5 EQUIPMENT INSTALLATION – GENERAL

.1 Install equipment components as follows:

.1 Couplings: To manufacturer's and onsite representative's installation instructions.

.2 Insulating connections: To manufacturer's installation instructions.

.3 Packaged equipment: Co-ordinate space and structural requirements, clearance, utility connections, signals, outputs and features required by manufacturer including safety interlocks.

3.6 EQUIPMENT PREPARATION

.1 Prior to equipment installation, inspect and field measure to ensure that previous work is not prejudicial to successful installation of equipment.

.2 Provide required notices, submit drawings, obtain permits, licenses and certificates and pay fees required for work.

.3 Make minor modifications to suit piping and other installed equipment and structural element locations and elevations.

3.7 EQUIPMENT INSTALLATION

.1 Provide labour and materials to install equipment. Employ only skilled tradesmen licensed in the Province of Ontario, for all work requiring tradesmen including but not limited to welders, pipefitters and red seal plumbers.

.2 Install equipment at locations indicated on Drawings.

.3 Minimum installation standards: To manufacturer's written instructions and in accordance with shop drawings.

.4 Install piping and miscellaneous items supplied as part of equipment including sensors and wiring, lubrication piping, pressure gauge tubing, pressure gauges, pressure switches, transmitters, pneumatic valve operator tubing, and other similar items.

.5 Dimensions where shown in Drawings for equipment bases, piping connections, and similar items are approximate and must be allowed for in installation of equipment to suit actual equipment supplied.

.6 Make necessary modifications to piping connections or to pipe work to suit equipment supplied.

.7 Use only new bolts, nuts and gaskets for any pipe joint or mechanical connection that is made during the installation/re-installation of any equipment.

.8 Place equipment base template at appropriate location.

.9 Supply necessary shims, gaskets and other similar items and necessary lifting and loading equipment and tools required to complete installation.

.10 Level equipment using stainless steel shims. Levelling nuts are not allowed.

.11 Where equipment is supplied with plate steel base, provide access holes in top of plate and grout base in accordance with Division 03 00 00 requirements. Neatly form, bevel, and trim finished grout.

.12 Refer to manufacturers' recommendations included in shop drawing submittal to determine sequence of installation.

.13 Demonstrate final alignment (hot or cold as applicable) to Contract Administrator and manufacturer, with no soft foot and no pipe strain.

.14 Do not tighten pipes until grout is set. Tighten so that there are no excessive stresses placed on flanges due to misalignment.

.15 Lubrication:

.1 Extend inaccessible lubrication points and lubricant drains to convenient locations.

.2 Remove storage lubricant and provide initial fill of new lubricants for equipment.

.3 Lubricant grade as recommended by equipment manufacturer.

.16 On machined bases without shims: provide minimum 1.5 mm brass shim stock under drive.

.17 Install equipment on foundation with suitably sized anchor bolts. Ensure true alignment of parts, especially pumps and drives.

.18 Install equipment level and plumb. Use of "pipe springing" and "Dutchmen" to correct misalignment and misfitting is not permitted.

.19 Equipment drains: pipe to floor drains, or funnel floor drains in a neat and tidy manner are confirmed by the Contract Administrator. All equipment drains shall be located at the low points and at section isolating valves unless otherwise specified.

.20 Supply and install all necessary vibration control dampeners.

3.8 EQUIPMENT ALIGNMENT

.1 Align equipment after plates are shimmed at anchor bolts.

.2 Recheck alignment after securing equipment to foundation before grouting plates in place.

.3 Recheck alignment of equipment handling hot fluids during initial operation.

3.9 EQUIPMENT FIELD TESTS

.1 Field Test equipment for compliance with Specifications.

.2 Field test in accordance with Section 01 91 13 and Division 44.

.3 Provide advance notice of tests to Contract Administrator as specified in Section 01 91 13 and Division 44.

.4 Contract Administrator may witness field tests.

.5 Calibrate, test, start-up, adjust, and commission equipment in accordance with manufacturer's written instructions and under supervision of equipment manufacturer if specified under respective Sections.

.6 Include in inspection:

.1 Soundness (without cracked or otherwise damaged parts).

.2 Completeness of installation as specified and as recommended by manufacturer.

.3 Correctness of settings, alignment and relative arrangement of various parts of system.

.7 Check controls and safety devices.

.8 Check equipment is level and drive is aligned.

.9 Modify or replace equipment failing tests.

.10 Perform additional tests due to material changes requested by Supplier that were approved by Contract Administrator or due to failure of materials of construction to meet Specifications.

.11 Provide copies of manufacturer's site report to Contract Administrator in accordance with requirements of Section 01 91 13.

.12 Manufacturer's report to include:

.1 Description of inspection, tests, adjustments made, quantitative results and suggestions for precautions to be taken to ensure proper maintenance.

.2 Verification that equipment conforms to Specifications for service intended and is ready for permanent operation.

.13 Equipment will be accepted after successful start-up, receipt of manufacturer's report and completion of the commissioning process.

3.10 GUARANTEES AND WARRANTY

.1 Unless otherwise indicated in the specific Sections contained herein, all equipment and services supplied under this Division shall be guaranteed by the Contractor to be free from all defects, in manufacture or installation, and wear for a period of at least one (1) year from the date of Substantial Completion.

.2 This guarantee will allow for the repair or replacement of improperly operating equipment at the Owner's discretion. The Contractor shall provide temporary equipment of equal capacity for the duration of any period in which the equipment is non-functional at no additional cost to the Owner.

.3 The length of this warranty period shall be extended to one (1) year from the date that any repaired or replaced equipment is returned to service, for that equipment only.

.4 If the Contractor obtains a guarantee from the Manufacturer, the signature of an authorized representative of the Manufacturer must accompany that guarantee and the Owner must be listed on the guarantee.

3.11 FORMS

.1 Forms listed below are required to complete the installation and start-up procedures:

.1 Manufacturer's Installation Certification Form.

.2 Pre-Commissioning Certification Form.

END OF SECTION

IDENTIFICATION

PART 1 GENERAL

1.1 SUMMARY

.1 This section includes the provision of mechanical labelling and identifying materials for the following items:

.1 Process Piping, new and existing

.2 Buried Piping (Division 33)

.3 Equipment and Process Vessels, Tanks, Valves, Actuators and all specialized equipment supplied under Division 44

.4 Control Panels and Instrumentation required under Division 22, 25, 26 and 44.

1.2 RELATED SECTIONS

.1 The following Sections applies to the work of this Section. Other Sections of the Specifications, not referenced below, shall also apply to the extent required for proper performance of the scope listed herein.

.1 Conform with Division 01, 22, 25 and 26

.2 Conform with Division 22

1.3 CODES AND STANDARDS

.1 This section shall comply with the current editions of the following codes:

.1 CAN/CGSB-24.3-92 Identification of Piping Systems.

.2 MOE Standard for Pipe Identification in Water and Wastewater Treatment Plants in Ontario.

.3 Ministry of Labour Workplace Hazardous Material Information System (WHMIS) Policy.

1.4 SUBMITTALS

.1 Shop Drawings:

.1 The following shall be submitted in compliance with Section 01 33 00:

.2 Provide a list of all piping, valves and actuators, tanks, control panels, instruments and equipment which will be labelled and/or tagged with the following:

.1 Pipe/Valve/Instrument or Equipment number

.2 Service

.3 Valve Type

.4 Drawing No.

.3 Provide samples containing the nameplates, pipe markings/labels and tags.

PART 2 PRODUCTS

2.1 MANUFACTURER'S EQUIPMENT NAMEPLATES

.1 Metal nameplate mechanically fastened to each piece of equipment by manufacturer.

.2 Lettering and numbers to be raised or recessed.

.3 Information to include, as appropriate:

.1 Equipment: Manufacturer's name, model, size, serial number, capacity.

.2 Motor: voltage, Hz, phase, power factor, duty, frame size.

2.2 SYSTEM NAMEPLATES

.1 Colours:

.1 Hazardous: red letters, white background.

.2 Elsewhere: black letters, white background (except where required otherwise by applicable codes).

.2 Construction

.1 3 mm thick laminated plastic, matte finish, with square corners, letters accurately aligned and machine engraved into core.

.3 Sizes:

.1 Conform to the following table:

Size #	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

.3 For all tanks, vessels and equipment: Use size # 9

2.3 EXISTING IDENTIFICATION SYSTEMS

.1 Apply existing identification system to new work, if a standardize system is present and in place.

.1 Where existing identification system does not cover for new work, use identification system specified this section.

.2 Before starting work, obtain written approval of identification system from Contract Administrator.

2.4 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 and MOE Standard for Pipe Identification in Water and Wastewater Treatment Plants in Ontario except where specified otherwise. Coordinate the pipe marker piping naming and colour list with the Contract Administrator.

.2 Pictograms:

.1 Where required, to Workplace Hazardous Materials Information System (WHMIS) regulations.

.3 Legend

.1 Block capitals to sizes and colours listed in CAN/CGSB 24.3.

.2 Pipe diameter shall determine the appropriate marker and test sizes as per the following table. The minimum height is 13 mm, for pipes less than 25 mm diameter provide tagging.

Outside Diameter of Piping or Insulation Covering	Minimum Letter/Number Height
19 – 32 mm	13 mm
38 – 51 mm	19 mm
64 – 150 mm	32 mm
200 – 250 mm	64 mm
Over 250 mm	89 mm

.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 All other pipes: Pressure sensitive vinyl with protective overcoating, waterproof contact adhesive undercoating, suitable for ambient of 100%RH and continuous operating temperature of 50°C.

.7 Colours and Legends:

.1 Where not listed, obtain direction from Contract Administrator.

.2 Colours for legends, arrows: To following table:

Background Colour	Legend, Arrows
Yellow	Black
Green	White
Red	White

.8 Background colour marking and legends for piping systems shall be green.

2.5 VALVES, CONTROLLERS

.1 Galvanized aluminum tags with 12 mm stamped identification data filled with black paint.

.1 Include flow diagrams for each system, of approved size, showing charts and schedules with identification of each tagged item, valve type, service, function, normal position, location of tagged item.

2.6 LANGUAGE

.1 Identification to be in English.

.2 Use one nameplate, label, etc. for each language.

PART 3 EXECUTION

3.1 TIMING

.1 Provide identification only after all painting specified Section 09 91 10 - Interior Painting has been completed.

3.2 INSTALLATION

.1 Perform work in accordance with CAN/CGSB-24.3 except as specified otherwise.

.2 Provide ULC and or 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 Protection

.1 Do not paint, insulate or cover in any way.

3.4 LOCATION OF IDENTIFICATION ON PIPING

.1 Pipe markers should be positioned so that they can be easily seen from the normal angle of approach, below the centerline of the pipe if the pipe is overhead, and above the centerline if the pipe is below eye level. Markers are required at the following locations:

.1 On long straight runs in open areas, equipment rooms, galleries, tunnels: at no more than 6.0m intervals 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 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, dampers, etc. Where this is not possible, place identification as close as possible, preferably on upstream side.

.9 Identification to be easily and accurately readable from usual operating areas and from access points.

.10 Position of identification to be approximately at right angles to most convenient line of sight, considering operating positions, lighting conditions, risk of physical damage orinjury and reduced visibility over time due to dust and dirt.

3.5 VALVES AND 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.

IDENTIFICATION

.2 Install one copy of flow diagrams, valve schedules mounted in frame behind non-glare glass where directed by Contract Administrator. Provide one copy (reduced in size if required) in each operating and maintenance manual.

.3 Number valves in each system consecutively.

END OF SECTION

FIELD PRESSURE TESTING OF PROCESS PIPE

PART 1 GENERAL

1.1 SCOPE

.1 This specification covers hydrostatic testing and pneumatic testing of piping after erection and prior to initial operation.

.2 References

.1 All references to codes and standards shall be to the latest edition of the following including addenda.

.1 American National Standards Institute/American Society of Mechanical Engineers (ANSI/ASME) B31.1 – Power Piping and B31.3 Process Piping.

.3 Applicable codes including ANSI/ASME B31.1, B31.3, and standards shall apply. All references to codes and standards shall be to the latest issue of the same.

.4 In the event repairs or additions are made following the pressure tests, the affected piping shall be retested, using the test procedures applied to the original system.

.5 All piping shall be hydrostatic tested.

.6 All piping shall be tested as required by the T.S.S.A.

.7 Acceptance of system under test shall follow Section 44 01 28 - Piping System Acceptance.

1.2 RESPONSIBILITY AND RECORDS

.1 Contractor shall be responsible for all testing. Contractor shall see that all required tests are made in accordance with this specification and shall arrange for tests to be witnessed by Engineer.

.2 The Contractor shall see that adequate records are maintained. These shall include test pressure, temperature, duration, date and time of day test fluid, and signatures of Contract Administrator and Contractor's representatives who witnessed the test, identification of piping system tested. Contractor shall provide a test plan and schedule to Contract Administrator at start of work. The format of these records shall be approved by the Contract Administrator before field pressure testing begins.

.3 It shall be the responsibility of the Contractor, in accordance with the Contract Administrator's instructions, to ensure that no equipment or piping is subjected to a higher pressure than indicated in the test requirement documents furnished by the Contract Administrator.

.4 Test procedures shall be reviewed with Contract Administrator as part of the normal safety review.

PART 2 PRODUCTS

2.1 TEST EQUIPMENT

.1 All necessary connections between the piping to be tested and the water source, together with pumping equipment, water meter, pressure gauges, and all other equipment, materials, and facilities required to perform the specified tests, shall be provided. All required flanges, valves, bulkheads, bracing, blocking, and other sectionalizing devices shall also be provided. All temporary sectionalizing devices shall be removed upon completion of testing. Vents shall be provided in test bulkheads where necessary to expel air from the piping to be tested.

.2 Water meters and pressure gauges shall be accurately calibrated and shall be subject to review and acceptance by Engineer.

.3 Permanent gauge connections shall be installed at each location where test gauges are connected to the piping during the required tests. Drilling and tapping of pipe walls will be permitted as required. Upon completion of testing, each gauge connection shall be fitted with a removable plug or cap acceptable to Engineer.

PART 3 EXECUTION

3.1 PREPARATION FOR TESTING

.1 Piping that is not to be tested shall be isolated. If isolation is impractical, the test conditions shall be determined by agreement with the Contract Administrator representative.

.2 Lines (not intended to carry liquids) which are spring or counterweight supported shall be temporarily blocked up if hydrostatic tested, in order to sustain the weight of test fluid. Blocks shall be removed immediately after the system is drained.

.3 All valves within the system to be tested, except as described in Paragraphs 3.1.4, and 3.1.6, shall be in an open position.

.4 Shut-off valves in instrument lead lines from process lines and equipment shall be closed and instruments disconnected.

.5 All dirt, debris or loose foreign materials shall be removed by flushing from piping prior to hydrostatic testing.

.6 Relief valves and safety valves shall be blanked off at the inlet flange of the valves. Screwed relief and safety valves shall be removed and replaced with plugs or caps.

.7 All flanges, threaded joints and field welds shall be left bare of insulation and free of all visual obstructions. All underground pipe joints, except those encased in concrete anchors, if any, shall be left exposed. Underground lines shall be adequately shored to prevent pull-out of joints.

.8 The Contractor shall supply all materials (blanks, plugs, vents, gaskets and drain valves) necessary for testing. Blank flanges, blank plates, etc., shall be selected to withstand the test pressure. After tests the materials shall remain the property of Contractor, except drain valves which shall remain in place.

.9 Blank flanges, blank plates, etc., shall have handles painted a bright color to make them readily identifiable for removal prior to start-up operations.

.10 After testing is completed, piping shall be blown out with air to remove all debris.

.11 All welded attachments (such as pipe supports and hangers) shall be made before testing.

.12 Piping and equipment shall be thoroughly vented of air before the final hydrostatic test pressure is applied. Vent connections shall be located at high points of system.

.13 Insulation is not to be applied over any joints in the piping prior to completion of test.

.14 All instrument floats not rated for the test pressure shall be removed before hydrostatic testing.

.15 Control valves not resistant to the test pressure shall be removed from the piping system prior to test.

.16 Expansion joints shall be provided with restraints to withstand the added pressure load under test, or shall be removed or isolated from the test.

.17 Precautions shall be taken by opening vents or by other means to prevent building up excessive pressure in equipment adjacent to portions of the piping under tests.

.18 Restrictions to flow, such as orifice plates and mixing nozzles, shall not be installed or shall be removed. Where necessary, items removed shall be replaced with temporary spool pieces provided by Contractor.

.19 Lines containing check valves shall have the source of pressure on the upstream side of the valve. If this is impossible, the check valve shall be blanked off or removed.

.20 If the test fluid in the system is subject to thermal expansion, precautions shall be taken to avoid excessive pressure.

.21 All pipe runs and interconnecting branch lines subject to the same test conditions shall preferably be tested at the same time. Equipment shall be isolated from testing unless authorized by the Contract Administrator.

3.2 HYDROSTATIC TEST PRESSURE

.1 The hydrostatic test pressure shall meet the ASME/ANSI B31.1 Piping Code Requirements. Other piping systems hydrostatic test pressures shall be in accordance with ASME B31.3 for Normal Fluid Service.

.2 Generally, the hydrostatic test pressure shall be determined within the following guidelines:

.1 1½ times the pressure class of the piping and flanges (i.e. 1034KPa system - test pressure = 1550KPa).

.2 Non-metallic piping shall be tested as required by ASME B31.3 but within manufacturers' limitations.

3.3 ALTERNATE TESTS

.1 When pressure testing is not feasible, (examples are large diameter lines not designed to withstand the weight of the water and refractory lined piping) an alternative test may be considered with the approval of the Contract Administrator. The alternatives are as follows:

.1 A combination of 100% radiography plus liquid penetrant examination plus a sensitive leak test.

.2 A combination of 100% radiography plus magnetic particle examination plus a sensitive leak test.

3.4 TEST PROCEDURE

.1 All testing must be scheduled and coordinated with Contract Administrator representative.

.2 Hydrostatic pressure shall be applied by means of a suitable test pump which shall not be connected to the pipeline until ready to test. An approved operator shall constantly attend to the pump whenever it is connected to the pipeline. The pump shall be disconnected whenever the pump operator or the inspector leaves the pump or test site for any reason.

.3 The pump shall be disconnected or suitable block and bleed valves operated during the period the test pressure is being held.

.4 At least two indicating test gauges shall be provided, one on the pump or air source and one on the piping to be tested. The gages are to be checked frequently against a "standard" gage or dead weight tester and should read between 1½ times (min) to 3 times (max) the test pressure.

.5 The piping under test shall be held at full test pressure for at least ½ hour without leaks.

.6 Clean water shall be used as the testing medium when hydrostatic testing materials other than stainless steel. Other liquids may be used when necessary and upon approval by Owner.

.7 Hydrostatic testing of austenitic stainless steel shall be performed using potable water. Test water in stainless steel piping shall be immediately drained after test and all residual water removed.

.8 When water is used in cold weather, it shall be heated or protected by inhibited antifreeze to avoid freezing. Water temperature during testing shall be a minimum of 15.5°C. Prior approval shall be obtained from the Contract Administrator representative for the use of antifreeze.

.9 Retesting of lines after repair shall be done at pressures originally specified for the test.

.10 Underground pressure lines shall be tested before backfilling.

.11 Instruments shall be tested in accordance with the recommendations of Contract Administrator Instrument Engineer.

3.5 DRAINING AFTER HYDROSTATIC TESTING

.1 All lines shall be drained after the hydrostatic test.

.2 After pump suction and discharge lines have been drained, the piping shall be reassembled. It is imperative that a temporary strainer be installed in the pump suction at this time.

3.6 PRESSURE TESTING REQUIREMENTS FOR WATER, SLUDGE AND AIR PIPING

.1 All specified tests shall be made by and at the expense of the Contractor in the presence, and to the satisfaction, of the Engineer. Piping shall be tested at the following pressures:

Service	Material	Test Medium	Test Pressure
Water Supply (Potable and non-potable water)	SS, Steel, DI and PVC	Water	1379 kPa (200 Psig)
Process / Channel Mixing Air	SS	Compressed air with 100 percent of all oil 0.025 micron and larger removed	100 kPa (14.5 Psig)

Service	Material	Test Medium	Test Pressure
Blowers Discharge Piping	SS	Compressed air with 100 percent of all oil 0.025 micron and larger removed	67 kPa (9.7 Psig)
Process Piping, designed to contain liquid	SS	Water	675 kPa (100 Psig)
Other System			As per the manufacturer's recommendations

3.7 FINAL PROCEDURES AFTER PRESSURE TESTING

.1 Replace all control valves and check valve action for proper direction.

.2 Remove all temporary blocks from spring or counter-weight supported pipelines.

.3 Replace all orifice plates and mixing nozzles, and other in-line instrumentation.

.4 Connect all instruments removed for the testing operation.

.5 Remove all temporary blanks and blinds.

.6 Use all new gaskets when replacing control valves, orifice plates, blanks, blinds, etc.

.7 Valves which were closed for pressure testing and/or draining shall be returned to the proper position.

.8 Temporary piping supports shall be removed.

.9 Replace all relief valves and safety valves.

.10 Remove any restraints that may have been provided for expansion joints.

.11 Disconnect test equipment, test pump, test gages and test safety valves.

END OF SECTION

PROCESS PIPING SYSTEM ACCEPTANCE

PART 1 GENERAL

1.1 SCOPE

.1 This specification defines the requirements for testing and acceptance of construction of piping systems.

1.2 PURPOSE

.1 A procedure for inspecting, testing and accepting completed process, utility, and other miscellaneous piping systems after installation by a construction Contractor.

.2 The procedure develops the essential features based on the three phases of a testing program, namely:

.1 Pretest requirements
.2 Test requirements
.3 Post-test requirements

.3 An organization routing from inception to acceptance is also described.

1.3 APPLICABLE SPECIFICATION SECTIONS

.1 This procedure is to be used with the following specification sections which establish the design criteria for the tests.

Section 44 40 00 – Process Piping

PART 2 MATERIALS

2.1 NOT APPLICABLE

.1 Not Applicable.

PART 3 EXECUTION

3.1 PIPING TESTING PROCEDURE

.1 The focal point is the pipe test package, which is an accumulation of information about the pipeline system to be tested. For each test made, there is a particular package describing, through drawings and specifications, what is required to make that piping system complete. The pipe test package is separated into three phases, defined as follows:

Pretest - Pipeline system completed to the point that is physically ready for a test and that each component in the system can withstand potentially greater than

normal weights and pressures of the test. All radiographic examinations are complete and documented.

Test - The piping system is filled with test media, pressurized, tested to specific requirements and witnessed.

Post-Test - Test blinds and test medium have been removed and all items have been installed. The piping is now ready for precommissioning.

The exceptions to this system are "in-service" tests where the basic elements of this total procedure are followed, except that the proposed pressure test is deferred until after the service has been turned on.

3.2 DOCUMENTATION

.1 Pipe inspection, testing and acceptance require the preparation of a master testing plan for the systems. Piping test numbers are assigned, and these documents are cross referenced to insure that all pipe lines to be constructed are included within the pipe test master plan.

.2 The Contractor shall assemble individual test packages containing:

.1 P&ID - P&ID highlights the pipelines to be included in the test system and establishes the in-line devices, line and equipment isolation that must be accomplished prior to the initiation of the test.

.2 Piping Inspection and Acceptance Record - This form provides the pipe test descriptions. Sign-off locations are provided for pre-test inspection approval, hydrotest witness and post test acceptance.

.3 Inspection Punch list Sheet - Used to highlight incomplete and/or incorrect installation found during inspection. Same sheet is used for sign-off of the inspection punch list after completion.

.3 Upon completion of the Piping Systems Acceptance Package, the Contractor shall prepare a progress tracking system based on the number of packages and the status of inspection, testing and acceptance.

3.3 ORGANIZATIONAL RESPONSIBILIES

.1 The piping test package must be routed through the organizations involved with construction and operation of the piping systems. Any change or deficiency found during the pipe test and inspection process is best located and identified as soon as possible. Then the change or deficiency can be corrected without an additional and costly hydrostatic test.

.2 The following outline shows the flow of the test package throughout the construction organization.

.1 Pre-Test

a. Contractor prepares pipeline master testing plan.

b. Contractor assembles test packages.

c. Inspection by Contractor and sign-off of pre-test mechanical inspection or preparation of a punchlist list and correction before submitting to Contract Administrator.

.2 Contract Administrator Inspection Activities

a. Inspection by Engineer's Construction & Operations Group(s) and preparation of a punchlist.

b. Engineer's Construction Group identifies punchlist items requiring completion prior to test. Returns punctilist list to Contractor. Contractor completes critical punch list items and returns to Engineer's Construction Group.

c. Engineer's Construction Group then checks that all punchlist items have been completed prior to signing the approval for test.

.3 Contractor Activities

a. Works off punchlist list items and resubmits to Engineer for approval for hydrotest.

b. Prepares for test.

.4 Test

.1 Contractor Activities

a. Fills system to be tested with water or other test medium as noted on line list.

b. Applies test procedure according to line list or as amended by Engineer's Construction Group.

c. Tightens lines as needed.

d. Holds pressure for at least one-half hour before calling Engineer to witness.

.5 Engineer's Construction Activities

a. Witness hydrotest.

b. Sign-off test inspection portion of Piping Inspection and acceptance Record.

.6 Contractor Activities (when applicable)

a. Route copy of signed test package to mechanical, electrical, instrumentation, insulation and painting Contractors as a signal that pipeline system is now cleared for other work to proceed; i.e., final alignment of pumps, prime painting of welds, topcoating coating of insulated and uninsulated lines.

.3 Post-Test

.1 Contractor Activities

a. Vent lines

Remove blinds

Plug vents and drains

Replace instruments and specialty items

Remove temporary supports

Check off and sign post-test check list

b. Rechecks the pipeline system to be sure line is mechanically complete.

.2 Engineer's Construction Activities

a. Engineer's Construction Group shall reinspect the pipeline system to make sure that all elements are complete except for heat tracing and insulation.

b. Engineer's Construction Group then submits a post-test punchlist list or signs-off as complete and accepted.

.4 Final Disposition

.1 Contractor Activities

a. The Contractor transmits test packages to Engineer's Construction Group after each package is accepted by Engineer.

b. Punchlist list items preventing completion of a test package due to material deliveries are considered complete if those punchlist list items are transferred to the master project punchlist list.

END OF SECTION

PIPE WELDING

PART 1 GENERAL

1.1 GENERAL

.1 This Section applies to all process and building mechanical pipe welding.

.2 Do all work associated with the welding process, such as procedure qualification, welder qualification, line-up, welding, and weld inspection, examination and testing, in accordance with the latest edition of ANSI/ASME B31.3 Category D fluid service, except when the terms of this standard are added to or modified by these specifications.

1.2 RELATED SECTIONS

.1 Division 1 – General Requirements

.2 Section 11116 – Piping, Valves and Fittings

1.3 REFERENCE STANDARDS

.1 ANSI/ASME B31.3 Process Piping Code (ASME B31.3)

.2 ASME Boiler and Pressure Vessel Code (ASME BPVC):

.1 Section V, Nondestructive Examination

.2 Section IX, Welding and Brazing Qualifications

.3 CAN/CSA W48, Filler Metals and Allied Materials for Metal Arc Welding:

.1 Note: CSA W48.3 (Low Alloy Steel Covered Electrodes) has been substituted by CAN/CSA W48, which also includes additional five previous W48.x Standards.

.4 CSA W178.1, Certification of Welding Inspection Organizations

.5 CSA W178.2, Certification of Welding Inspectors

.6 CAN/CGSB 48.9712, Non-destructive Testing: Qualification and Certification of Personnel.

PART 2 PRODUCTS

2.1 STAINLESS STEEL PIPING AND FITTINGS

.1 Details as described in the contract drawings and Section 44 05 50 Process Piping.

2.2 FILLER MATERIAL

.1 Shielded metal arch electrodes (manual welding) to conform to CSA W48. Grade to be of tensile strength equivalent to or greater than the ultimate tensile strength of the parent metal, and to be suitable for the electric current characteristics, position of welding, and other conditions of intended use.

2.3 END BEVELS

.1 Provide pipe ends with mill bevels. Bevels to be 30° with a vertical lip of 1.60 mm unless specified otherwise. Field bevels to be reasonably smooth and uniform, and dimensions shall be in accordance with the qualified welding procedure.

2.4 EQUIPMENT

.1 Welding equipment to be 200 A or larger DC machines, and to be designed and maintained in an acceptable condition to obtain the specified results.

PART 3 EXECUTION

3.1 GENERAL

.1 Welding to be performed using procedures qualified to ASME B31.3. Surfaces to be welded shall be smooth, uniform, free of fins, lamination, tears, slag, grease, paint, and other deleterious conditions which might adversely affect welding. All aspects of the process as outlined in ASME B31.3 shall conform to the welding procedure specification.

.2 Contractor to submit five (5) copies of proposed welding procedure to the Engineer using the forms provided at the end of this section. Procedure to be used to prepare the test joints required for qualification.

3.2 WELDER QUALIFICATION

.1 Welders engaged on the work to possess valid certificates of qualification from the appropriate governing authority for pipeline welding in the flat, vertical, and overhead positions. Certificates to be for the shielded metal arc method of welding. Provide copies of certificates to the Engineer when qualification test results are submitted.

.2 Welders to qualify under ASME BPVC Section IX, American Welding Society (AWS) or Canadian Welding Bureau (CWB).

.3 A record shall be made of the test given to each welder and of the detailed results of each test. Record to be maintained by Contractor and a list of qualified welders and procedures in which they are qualified to be provided to the Engineer. Welders may be required to requalify if there is a question about their ability.

3.3 QUALIFICATION OF THE WELDING PROCEDURE

.1 Contractor to prepare test joints in accordance with the proposed welding specification and as stated in the proposed welding procedure submitted to the Engineer. Contractor to give the Engineer written notice of when and where the welding of the test joints will take place so that the Engineer can be present. Test joints to be tested at Owner's expense, and in accordance with ASME B31.3. Upon qualification, no change in the procedure will be permitted without the Engineer's written approval.

3.4 WEATHER CONDITIONS (FIELD WELDING)

.1 Welding shall not be done when the quality of the completed weld would be impaired by prevailing weather conditions, including but not limited to moisture, blowing sands, high winds, or low temperatures. Windshields may make conditions for welding satisfactory.

.2 If, in the opinion of the Engineer, protection from prevailing weather conditions is necessary, then welding shall cease until this protection has been placed correctly. The Contractor will not be compensated for "downtime" delays of this nature.

.3 Metal surfaces in and adjacent to the welding groove to be dry before welding commences and while welding is in progress.

.4 When ambient temperature is below 0oC, welding operations to cease, unless an appropriate welding procedure has been qualified.

3.5 PRODUCTION WELDING

.1 Production welding to conform to the following stipulations:

.2 No pup (intermediated pull-up piece of pipe) shorter than 1m or 3 pipe diameters, whichever dimension is greater to be installed in the line. There shall be at least 1 full joint of pipe installed between pups which are shorter than 5m. All pups must be moved ahead on a current basis and installed in the line.

.3 No two weld beads shall be started or stopped in the same location. Each weld pass shall be visually examined and any defects (i.e., pin holes, slag inclusions, gas pockets, and undercutting, etc.) shall be repaired prior to welding the next pass.

.4 Striking the arc on the pipe at any point other than the welding groove shall not be allowed. Any section of pipe which has been arc burned may, at the Engineer's discretion, be cut out and replaced at the Contractor's expense.

.5 No weld to be subjected to sudden variations in temperature and no welded sections to be subjected to stresses, due to movement of pipe, loading on pipe, etc., until the welds have cooled below 38oC. Damage caused by the welded pipe being subjected to stresses before complete cooling of welds to be corrected at the Contractor's expense.

.6 All temperatures to be measured by pyrometric crayons or other suitable devices approved by the Engineer.

.7 All passes to have no more than 5 minutes elapse between the previous pass termination and the commencement of the next pass. When ambient temperature is below 0oC, maximum lapse time allowable is 4 minutes.

.8 Use inert gas backing for stainless steel welding. Solar flux prohibited for liquid commodity piping.

.9 For stainless steel pipes carrying solids-containing liquids or slurries pickle all joints and heat affected zones on interior and exterior. Use of pickling paste subject to the Engineer's review. Observe regulatory requirements for disposal of acid.

.10 Passivate exterior of all stainless-steel welds after completion. Neutralize and rinse joints.

.11 For pickling and passivation detail refer to ASTM A380 or Section 15200, Line Code H1.

3.6 LINEUP CLAMPS

.1 Internal lineup clamps to be used whenever practicable and when used shall not be removed until root bead is complete. External lineup clamps may be used only when use of internal lineup clamps is not practicable. Root bead segments used in connection with external lineup clamps to be uniformly spaced around the circumference of the pipe, and to have an accumulative length of not less than 50% of the pipe circumference before the clamp may be removed. Pipe to remain supported and stationary until root bead is completed.

3.7 CLEARANCE

.1 When the pipe is welded in a trench, bell hole to be of sufficient size to provide the welder or welders ready access to the joint so that their skill is not impaired. When pipe is welded above ground, the working clearance around the pipe at the weld shall be not less than 400 mm.

3.8 PIPE HANDLING

.1 Extreme care to be exercised to prevent damage to pipe. Damage to be repaired as directed by the Engineer and at the expense of the Contractor. Bevel ends to be repaired if damaged.

.2 All dents in the pipe deeper than 3.2mm to be removed by cutting dented portion of the pipe out, re-bevelling the cut ends, welding, and recoating.

3.9 INSPECTION

.1 After completion of the welding operation, pipe to be left uncoated for a period sufficient to permit the independent third-party Inspector approved by the Owner to carry out inspection (as defined by ASME B31.3, section 340.1) on the welds. Contractor to allow a reasonable time for the Inspector to conduct examination of the tie-in welds.

.2 Work performed will be rigidly inspected. Such inspection shall not relieve Contractor of responsibility for performing work in conformance with the specifications. Contractor to notify the Inspector in advance of performing any work in order that inspection may be arranged. The Inspector may reject any work that does not comply with the specified requirements. Contractor to furnish the Inspector

with reasonable facilities and space for inspection and obtaining any information the Inspector desires respecting the character of material used and progress and condition of the work.

.3 The Inspector may use any method of examination necessary to establish quality control and ensure adherence to welding procedures. The Inspector has the right to accept or reject any weld not meeting the approved procedures and/or specified requirements.

.4 Specified percentage of welds is subject to visual examination, liquid penetrant examination, and random radiographic examination, the cost of which will be borne by the Contractor. Radiographic inspection to be carried out by operators certified in conformance with CSA W178.

.5 Non-destructive examination standards specified in Section V of ASME BPVC to be used as basis for examination procedures.

3.10 REPAIR OR REMOVAL OF WELD DEFECTS

.1 Repair or removal of weld defects to be in accordance with Section IX of ASME BPVC. Back welding is not allowed without qualification of the welding procedure used.

.2 Repair of welds shall follow ASME B31.3, Section 328.6, Weld Repair.

.3 All costs for repairing defective welds, including radiographic and other examination of the corrected work, shall be borne by the Contractor.

3.11 COATED PIPE PROTECTION AND FIELD COATING

.1 Protect and prepare for field welding all carbon steel pipe which has been previously coated.

.2 After field welding, pipe coating of welded joints to be completed as follows:

.1 Coating of welded joints in the field to be done in accordance with AWWA (American Water Works Association) C210, Section 3.5. Primer and field coating of bare surfaces to be the same materials as used for shop coating of pipe.

.3 If damage of the coating occurs in the field, repair damaged portions in accordance with AWWA C210, Section 3.4.

3.12 SPECIALIST INSPECTION, EXAMINATION AND TESTING

.1 Examination by the manufacturer, fabricator, or erector (as defined by ASME B31.3, section 341.1) shall follow section 341.4.2 of that code for Category D Fluid Service. Examination methods shall follow Table 341.3.2 for Category D Fluid Service. The Contractor shall keep a record of weld numbers that were examined. Where

applicable, different welds shall be examined by different methods. The cost of this examination shall be borne by the Contractor.

.2 In addition to the above Contractor examination, the Inspector shall visually examine not less than 15% of all welds. In addition, not less than 10% of fillet welds shall be examined by liquid penetrant. In addition to this, not less than 10% of circumferential butt welds shall be examined by random radiography. The cost of this examination shall be borne by the Contractor.

.3 The Inspector shall keep a record of weld numbers that were visually examined, of welds that were examined by liquid penetrant, and of welds examined by random radiography. Different welds shall be examined by different methods.

.4 Examination procedures:

.1 Perform examinations by specialist qualified in accordance with CSA 178.1 and CSA 178.2 and approved by the Engineer,

.2 And according to ASME BPVC, Section V, CAN/CGSB 48.9712, and authority having jurisdiction.

.5 Visual examination: include entire circumference of all welds externally.

.6 Failure of examinations:

.1 Upon failure of any weld by visual examination, the Inspector shall perform additional visual examination as directed by the Engineer of a total of 20% of all welds, selected at random by the Engineer. The cost of this examination shall be borne by the Contractor.

.2 Upon failure of any weld by penetrant examination, the Inspector shall perform additional penetrant examination as directed by the Engineer of a total of 15% of all welds, selected at random by the Engineer. The cost of this examination shall be borne by the Contractor.

.3 Upon failure of any weld by random radiography, the Inspector shall perform additional radiography as directed by the Engineer of a total of 15% of all welds selected at random by the Engineer. The cost of this examination shall be borne by the Contractor.

.7 For leak (pressure) testing refer to ASME B31.3, sections 345.2.2 (duration; however, use double the time), 345.4.2 (pressure) and 345.7 (alternative).

3.13 DEFECTS CAUSING REJECTION

.1 Acceptance criteria for welds shall follow ASME B31.3, section 341.3.2, Table 341.3.2 in particular, for Category D Fluid Service.

.2 Any rejected welds shall be repaired or replaced.

3.14 PRESSURE TESTING

.1 For additional pressure testing of completed sections of pipe refer to Detailed Piping Specifications.

END OF SECTION

PIPE WELDING

PROPOSED WELDING PROCEDURE

DATE _____

JOB TITLE _____

ASSOCIATED ENGINEERING PROJECT NO. _____

CLASSIFICATION OF PIPE _____

MAXIMUM TENSILE STRENGTH _____

MAXIMUM YIELD STRENGTH _____

PERCENTAGE ELONGATION IN 50 mm _____

MILL TEST FORWARDED TO ASSOCIATED ENGINEERING (YES/NO) _____

LADLE ANALYSIS FORWARDED TO ASSOCIATED ENGINEERING (YES/NO) _____

CARBON CONTENT _____

CARBON EQUIVALENT _____

EXTERNAL COATING _____

INTERNAL COATING _____

PROCESS _____

DIAMETER AND WALL THICKNESS _____

JOINT DESIGN _____

PIPE WELDING

FILLER METAL

Pass	Size	AWS Classification	Voltage	Amperage	Polarity	Brand
1						
2						
3						
4						
5						

POSITION _____

DIRECTION OF WELDING _____

NUMBER OF WELDERS _____

TIME LAPSE BETWEEN PASSES _____

INTER-PASS HEATING (IF REQUIRED) _____

METHOD OF HEATING _____

CLEANING BETWEEN PASSES _____

_____

_____

PREHEAT _____

MINIMUM AMBIENT TEMPERATURE

_____

FIELD ENGINEERED PROCESS PIPE SUPPORTS

PART 1 GENERAL

1.1 INTENT OF SECTION

.1 This Section covers the design, furnishing and installation of pipe hangers, brackets, and supports. Pipe supports shall be furnished complete with all necessary inserts, bolts, nuts, rods, washers, and other accessories.

.2 This section also covers the spacing of expansion joints in piping systems. Expansion joint products and materials are covered in the respective piping sections.

.3 Concrete and fabricated steel supports shall be as indicated on the drawings, as specified in other sections, or, in the absence of such requirements, as permitted by Engineer.

.4 Contractor shall retain a Professional Engineer specialized in piping systems to design all pipe supports based on standard supports, piping design and layout on the Contract Drawings in accordance with the requirements specified herein.

1.2 SCOPE

.1 This standard covers the fabrication and installation procedures for engineered pipe supports. This generally applies to piping 65mm diameter and larger, unless noted otherwise.

.2 Refer to line list on P&ID drawing for lines which require engineered pipe supports.

1.3 CODES

.1 Standards and Specification Sheets: The codes, standards, and specification/data sheets listed shall be the latest edition.

.1	CAN3-S16.1	Steel Structures for Buildings
.2	ASME B31.1	Power Piping
.3	MSS-SP-58	Pipe Hanger and Support - Materials, Design and Manufacture
.4	MSS-SP-69	Pipe Hangers and Supports - Selection and Application
.5	MSS-SP-89	Pipe Hangers and Supports - Fabrication and Installation Practices
.6	ANSI B18.2.1	Square and Hex Bolts and Screws
.7	ANSI B18.2.2	Square and Hex Nuts
.8	ANSI B1.1	Unified Screw Threads (UN and UNR Thread Forms)
.9	ANSI/ASME	Pipe Threads, General Purpose B1.20.1

.10 CSA W47.1 Certification of Companies for Fusion Welding of Steel Structures.

.11 ASME B31.3 Process Piping

1.4 PIPE SUPPORT DESIGN

.1 Contractor shall engineer and design pipe support systems for piping of 65mm dia and larger in accordance with ASME B31.3 for Normal Fluid Service. Pipe supports shall be engineered and certified by a Professional Engineer licensed to practice in Ontario.

.2 Contractor shall submit to Engineer for review all support details.

.3 Operating and installation loads, direction and amount of movement shall be shown on the detail drawings.

.4 Supplementary steel required for attachment to roof, wall or floor structure shall be engineered and supplied by the Contractor. Supplementary steel for rod hangers shall be engineered and supplied by the Contractor. All supports and supplementary steel shall be hot dipped galvanized after fabrication. All supports and supplementary steel submerged in tanks shall be type 336L stainless steel.

.5 All field welds and shop welds of non-catalog items will be indicated on the detail drawing using American Welding Society standard welding symbols.

.6 The location of a particular support assemblies shall be shown on the drawings issued to Engineer for review.

.7 Support loads shall not exceed building elements design loadings. Contractor shall review with structural Engineer building loads and shall space or design supports so that building elements design loads are not exceeded.

.8 Provide bracing of piping in accordance with Section 44 02 41 Seismic Restraint.

.9 Construct pipe hanger and support to manufacturer's recommendations utilizing equipment manufacturer's regular production components, parts and assemblies.

.10 Design hangers and supports to support systems under all conditions of operation, allow free expansion and contraction, prevent excessive stresses from being introduced into pipework or connected equipment.

.11 Provide for vertical adjustments after erection and during commissioning.

.12 Ensure that supports, guides, anchors do not transmit excessive quantities of stress or heat to building structure.

.13 Maximum rod length to be 1.5m. Pipes requiring supports with rod lengths greater then 1.5m shall have supplementary steel attached to structure to reduce rod length to less than 1.5m.

.14 Main blower and pump suction/discharge headers shall be supported from below utilizing supplementary steel support racks which have base plates secured to floor.

.15 All supports to be arranged to provide maximum access to valves and other equipment requiring access.

.16 Do not weld directly to stainless steel pipes with steel supports. Provide clamps with bondable Teflon sheet between clamp and stainless steel pipe.

1.5 DIMENSIONAL TOLERANCES

.1 This section covers maximum tolerances in fabricated pipe supports except for cast or forged products.

.2 Tolerances for raw materials such as strip, sheet, bar, plate, pipe, tubing, structural and bar size shapes shall be in accordance with recognized standards and specifications. Tolerances for casting and forgings shall be in the individual manufacturer's standards.

.3 Manufacturing Tolerances:

- .1 Cut Lengths - Linear
  - .1 Hanger rods ± 12mm
  - .2 Structural shapes, pipe, tubing ± 3mm.
  - .3 Plates & bars ± 3mm
- .2 Threads:
  - .1 Screw threads to ANSI B1.1, Class 1A, 2A and 2B
  - .2 Pipe threads to ANSI/ASME B1.20.1
- .3 Weld Sizes - All welds plus only, no minus
- .4 Angularity - all manufacturing methods to ± 4 degrees
- .5 Holes - Drilled or Punched Only
  - .1 Location - center to edge, or center to center, ± 1.6mm
  - .2 Diameter - plus .2 times metal thickness or minus 0.8mm

1.6 SHOP DRAWINGS

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

.2 Complete data and catalog cuts or drawings covering fabricated pipe supports, fabricated inserts, and stainless steel, galvanized, and copper and plastic-coated pipe supports shall be submitted in accordance with Section 01 33 00 – Submittals.

.3 The Contractor shall provide the detailed piping layout. Coordinate with the expansion manufacturer coupling installation with the coupling manufacturer. Present the fixed and sliding pipe supports locations with couplings on the layout. Data shall include a listing of the intended use and general location of each item submitted.

.4 Submit shop drawings stamped by a Professional Engineer in the Province of Ontario for review. Where required, Include pipe stress analysis output including design inputs, support locations, deflections and reaction forces at each support location on supporting structures.

.5 Prior to the first shop drawing submittal, provide a 4-hour workshop with the Owner and Consultant to demonstrate the pipe support stamping Engineer's design approach and how it meets all design criteria listed in the contract documents. Incorporate comments from the Owner and Consultant for items including but not limited to support location requests for improved accessibility into pipe support design.

.6 A formal request must be made in advance of any shop drawing submittals, if the pipe support stamping Engineer would like to deviate from any of the design criteria provided in the contract documents. Approval of this request shall be at the full discretion of the Owner and Consultant.

1.7 QUALIFICATIONS OF WORKMANSHIP

.1 Use organizations approved under the Canadian Welding Bureau to the requirements of CSA W47.1, Division 2, to undertake welding operations using welders qualified to perform the type of welds required.

PART 2 PRODUCTS

2.1 GENERAL

.1 In certain locations, pipe supports, anchors, and expansion joints have been indicated on the drawings, but no attempt has been made to indicate every pipe/valve support, anchor, and expansion joint. Unless otherwise specified, It shall be Contractor's responsibility to provide a complete system of supports, to provide expansion joints, and to anchor all piping, in accordance with the requirements specified herein. Additional pipe supports may be required adjacent to expansion joints, couplings, valves and scum piping.

.2 Fabricate hangers, supports and sway braces in accordance with ANSI B31.1 and MSS-SP-58.

.3 Support from structural members, where structural bearing does not exist or inserts are not in suitable locations, provide supplementary structural steel members. Do not suspend from metal deck. Anchoring of piping and equipment shall be to manufacturers recommendations. Submit anchorage system, arrangement and type of hanger supports with calculations for review. Supplemental steel to be galvanized after fabrication.

.4 Finishes:

.1 Hangers and supports: galvanized after manufacturer.

.2 Use electro-plating galvanizing process.

.3 Ensure steel hangers in contact with copper piping are epoxy coated.

.5 Provide seismic bracing of piping in accordance with Section 44 02 41, Seismic Restraints.

.6 Use components for intended design purpose only. Do not use for rigging or erection purposes.

.7 Steel sections (except tube sections) and plates: to CSA G40.21, type 300W.

.8 Welding Materials: to CSA W59.1.

.9 All metals submerged in water or in corrosive environments shall be type 316L stainless steel.

.10 All metals exposed to weather shall be type 316L stainless steel or 6061-T6 aluminum.

.11 Unless otherwise specified, The pipe supports shown on the Contract Drawings are typical details and are meant to show general arrangements only for the purposes of base bid pricing. It is the Contractor’s responsibility to finalize member sizes, connections and anchorage to the structure. The Contractor may modify the supports and hangers for wall or HSS anchorage based on the typical ones on the Contract Drawings and herein, but the Engineer’s approval shall be required.

.12 Pipe hangers or guides shall not be used for a fixed-point pipe support.

.13 Unless otherwise specified, Provide hangers for valves with horizontal installation for 350 mm or larger pipe sizes. Submit the valve weight data and hangers with required design load.

.14 Unless otherwise specified, Pipe stress analysis shall be performed on the piping system to finalize location and design of pipe supports, couplings and expansion joints. Analysis to include environmental loads including wind, ice and seismic loads, thermal effects, pipe operating and test pressures, and dead loads from insulation.

.15 Wherever indicated, the contractor shall not delete or relocate the supports, expansion joints or couplings shown on the drawings without the engineer's written approval. The contractor is required to follow exactly the details as shown on these drawings. Pipe stress analysis is not required in this case.

.16 Coordinate pipe support locations with coupling and expansion joint requirements.

.17 The absence of pipe supports and details on the Drawings shall not relieve the Contractor of responsibility for sizing and providing supports throughout all pipelines.

.18 After installation a professional engineer, retained by the Contractor and licensed in the Province of Ontario, shall complete a Site review and then submit a letter, sealed and signed, stating that the pipe supports and anchorage are designed and installed to the requirements of post-disaster facility as per the Ontario Building Code Division B, Part 4, Article 4.1.8.18 for post-disaster structure as well as the pipe stress analysis report.

2.2 UPPER ATTACHMENTS

.1 Concrete:

.1 Hollow core block concrete: Adhesive material applied with screen tube.

.1 Acceptable material: Hilti Hit Adhesive Anchors, HY-20.

.2 Coordinate minimum embedment of adhesive anchors with anchor manufacturer.

.3 Submit anchor manufacturer's recommendations for anchoring to structural engineer prior to drilling for supports.

.2 Solid cast in place concrete or hollow core slabs: Adhesive material fastened into solid base.

.1 Acceptable material: Hilti Hit Adhesive Anchors, HY150.

.2 Coordinate anchor locations with precast slab supplier so that anchor locations provide adequate concrete thickness.

.3 Coordinate spacing of hangers with precast slab supplier so that support loads do not exceed slab capacities. Provide supplementary steel as required so that supports can be placed where required if adequate bearing does not exist.

.4 Coordinate minimum embedment of adhesive anchors with anchor manufacturer.

.5 Submit anchor manufacturer's embedment and precast slab suppliers' recommendations for anchoring to structural engineer prior to drilling for supports.

.2 Steel beam (bottom flange):

.1 Cold piping NPS 2 and under: malleable iron C clamp to MSS-SP-58, type 19. ULC listed.

.1 Standard of Acceptance: Anvil fig.61.

.2 Cold piping NPS 2½ and larger and all hot piping: malleable iron beam clamp to MSS-SP-58, type 28 or 29. ULC listed.

.1 Standard of Acceptance: Anvil fig.229.

.3 Steel beam (top):

.1 Cold piping NPS 2 and under: malleable iron "top of beam" C clamp to MSS-SP-58, type 19. ULC listed.

.1 Standard of acceptance; Anvil fig.61.

.2 Cold piping NPS 2½ and larger and all hot piping: steel jaw, hook rod with nut, spring washer and plain washer, to MSS-SP-58, type 25. ULC listed.

.1 Standard of Acceptance: Anvil fig.227.

.4 Steel oist:

.1 Cold piping NPS 2 and under: steel washer plate with double locking nuts.

.1 Standard of Acceptance: Anvil fig.60.

.2 Cold piping NPS 2½ and larger and all hot piping: steel washer plates with double locking nut, carbon steel clevis and malleable iron socket.

.1 Standard of Acceptance: Anvil: washer plate fig.60; clevis, fig.66; eye nut, fig.290.

.5 Steel channel or angle (bottom):

.1 Cold piping NPS 2 and under; malleable iron C clamp to MSS-SP-58, type 23. ULC listed.

.1 Standard of Acceptance: Anvil fig.86.

.2 Cold piping NPS 2½ and larger and all hot piping; universal channel clamp. ULC listed.

.1 Standard of Acceptance: Anvil fig.226.

.6 Steel channel or angle (top):

.1 Cold piping NPS 2 and under; malleable iron "top of beam" C clamp to MSS-SP-58, type 19. ULC listed.

.1 Standard of Acceptance: Anvil fig.61.

.2 Cold piping NPS 2½ and larger and all hot piping: steel jaw, hook rod with nut, spring washer and plain washer, to MSS-SP-58, type 25. ULC listed.

.1 Standard of Acceptance: Anvil fig.227.

2.3 MIDDLE ATTACHMENT (ROD)

.1 Carbon steel threaded rod electro-galvanized finish.

.1 Standard of Acceptance: Anvil fig.146.

.2 Ensure that hanger rods are subject to tensile loading only.

.3 Provide linkages where lateral or axial movement of pipework is anticipated.

2.4 PIPE ATTACHMENT

.1 Cold piping, steel or cast iron: hot piping steel, with less than 25mm horizontal movement; adjustable clevis to MSS-SP-58, type 1. ULC listed. Galvanized finish.

.1 Standard of Acceptance: Anvil fig.260.

.2 Uninsulated Cold copper piping; uninsulated hot copper piping with less than 25mm horizontal movement; adjustable clevis to MSS-SP-58, type 1. Copper plated.

.1 Standard of Acceptance: Anvil fig.CT-65.

.3 Suspended hot piping, steel and copper, with horizontal movement in excess of 25mm; pipe roller to MSS-SP-58, type 43. Galvanized finish.

.1 Standard of Acceptance: Anvil fig.174 and fig.171.

.4 Bottom supported hot piping, steel and copper: pipe roller stand to MSS-SP-58, type 45.

.1 Standard of Acceptance: Anvil fig.271.

.5 Pipe hangers and supports on all cold pipework and hot pipework above NPS 1 must be oversized to accommodate thermal insulation and to avoid penetrating the vapour barrier.

.6 Do not weld supports directly to stainless steel pipes. Provide clamps welded to support plates. Provide bondable Teflon sheet between clamps and stainless steel pipes.

2.5 RISER CLAMPS

.1 Steel or cast-iron pipe: galvanized carbon steel to MSS-SP-58, type 42. ULC listed.

.1 Standard of Acceptance: Anvil fig.261.

.2 Copper pipe: carbon steel copper finished to MSS-SP-58, type 42.

.1 Standard of Acceptance: Anvil fig.CT-121.

.3 Provide bondable 1.5mm thick teflon sheet between clamps and stainless steel pipes. Overlap min. 10mm either side of support.

2.6 SADDLES AND SHIELDS

.1 Cold and hot piping NPS 1¼ and over: protection shield with high density insulation (25.4mm thick polyisocyanurate) under shield with uninterrupted vapour barrier.

.1 Standard of Acceptance: Anvil fig.167.

.2 Hot piping NPS 1¼ and over: protective saddle with insulation under saddle.

.1 Standard of Acceptance: Anvil fig.160 to 166.

.2 Tack weld protective saddle to carbon steel pipe.

PART 3 EXECUTION

3.1 APPLICATION

.1 Anchorage shall be provided to resist thrust due to temperature changes, changes in diameter or direction, or dead ending. Anchors shall be located as specified to force expansion and contraction movement to occur at expansion joints, loops, or elbows, and as needed to prevent excessive bending stresses and opening of mechanical couplings. Anchorage for temperature changes shall be centered between elbows and mechanical joints used as expansion joints.

.2 Unless otherwise specified, When expansion joints are required, pipe guides or sliding support shall be provided adjacent to expansion joints. Guides will not be required where mechanical couplings are permitted as expansion joints. Guides shall be located on both sides of expansion joints, except where anchors are adjacent to the joint. Unless otherwise indicated on the drawings or by the manufacturer, one guide shall be within four pipe diameters from the joint and a second guide within 14 pipe diameters from the first guide. Pipe guides shall not be used for support.

.3 Pipe supports for insulated cold piping systems shall be sized for the outside diameter of the insulated pipe, and an insulation protection shield shall be installed between the support and the insulation. Rigid insulation inserts shall be installed between the pipe and the insulation shields for piping larger than 2 inches [50mm] or when needed to prevent crushing of the insulation. Inserts shall be of the same thickness as the adjacent insulation and shall be vapor sealed.

3.2 FABRICATION

.1 Fabricate hangers, supports and sway braces in accordance with ANSI B31.1, B31.3 and MSS-SP-58.

.2 This section covers fabrication of pipe support components and assemblies.

.1 Material of construction shall be CSA G40.21, type 300W unless otherwise noted. Plates, rods, bars, etc. which are used for the fabrication of support

assemblies may be cut to shape or size by shearing, sawing, machining, grinding or thermal cutting.

.2 Thermal cutting processes shall be suitable for the material to which it is applied. After thermal cutting, slag shall be removed prior to further fabrication or use. Discolouration remaining on the flame cut surface is not considered to be detrimental oxidation.

.3 Drilling and punching shall be performed as required by drawings and specifications.

.4 Screw threads shall be in conformance with ANSI B1.1 Class 1A, 2A and 2B for coarse thread series and Class 2A & 2B for the eight thread series.

.5 Pipe threads shall be in accordance with ANSI/ASME B1.20.1 either straight or tapered as required.

.6 All threaded rod shall be hot-dip galvanized

.7 Welding shall be performed where indicated on the detail drawings in accordance with the welded joint requirements specified in the CAN3-S16.1. When welding any attachment to a pressure pipe, such welding shall to the specific applicable welding procedures which have been qualified in accordance with Section IX of the ASME Boiler & Pressure Vessel Code and T.S.S.A. Pressure Vessels branch requirements. A copy of the fabricator's procedures and weld qualification record shall be submitted for owner review and record.

.8 Fabricate supports in accordance with ASME B31.1, Power Piping.

3.3 INSPECTION

.1 There will be an inspection program to ensure that all aspects of work performed comply fully with specified requirements. The owner may elect to conduct inspection during fabrication.

3.4 MARKING

.1 When pipe supports are to be shop fabricated, each pipe support shall have its identifying mark number painted on with water-proof paint in letters at least 20mm high.

3.5 PIPE SUPPORT INSTALLATION

.1 Engineered pipe supports shall be located in strict accordance with the pipe support location drawing supplied by the Contractor and certified. Relocation and reorientation of any pipe support from the specified location shall not be permitted without written permission of the Contractors design engineer.

.2 Installed pipe supports shall be used only for their intended purpose. They shall not be used for rigging or erection purposes.

.3 The contractor is responsible for developing an installation sequence giving priority to major components and groups of piping closest to the supporting structure.

.4 Prior to connecting pumping units or other equipment to pipe sections, support complete piping assembly and anchor in perfect alignment with pumping units and sleeves to prevent movement of piping assembly and strain on pumping units or equipment.

.5 Support all valves and risers so that weight of valve or valve assembly is not carried by adjacent horizontal pipe sections.

.6 Provide heavy rubber material between pipe and galvanized supports.

.7 Provide plastic hose material over all threaded rods used as part of pipe clamps.

.8 All material in contact with the supported pipe shall be of the same material unless separated by suitable means.

.9 All material welded to the supported pipe shall be of the same material as the pipe.

.10 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 be to industry standards.

.3 Steel pipes: Install below coupling or shear lugs welded to pipe.

.4 Cast iron pipes: Install below joint.

.5 Provide bondable Teflon sheet between clamps and stainless steel pipes.

.11 Use approved constant support type hangers where:

.1 vertical movement of pipework is 13mm or more, transfer of load to adjacent hangers or connected equipment is not permitted.

.12 Use variable support spring hangers where:

.1 transfer of load to adjacent piping or to connected equipment is not critical.

.2 variation in supporting effect does not exceed 25% of total load.

.13 Provide support within 300mm (12") of each horizontal elbow.

.14 Space supports for non-metallic pipe as per manufacturer’s instructions.

3.6 MAXIMUM PIPE SUPPORT SPACINGS

.1 The maximum pipe support spacings shall be as follows:

Type of Pipe	Pipe Support Max Spacing	Max Run Without Expansion Joint, Loop, or Bend	Expansion Joint Max Spacing
	m [ft]	m [ft]	m [ft]
Stainless steel			
31 mm [1-1/4 inch] and smaller	2.4 [8]	9.1 [30]	30.5 [100]
38 to 100 mm [1-1/2 to 4 inches]	3.6 [12]	9.1 [30]	30.5 [100]
100 to 250 mm [4 to 10 inches]	4.5 [15]	24.4 [80]	24.4 [80]
Over 250 mm [10 inch]	5.5 [18]	24.4 [80]	24.4 [80]

PVC, HDPE & FRP Pipe Maximum Spacings:

1. Provide all pipe supports shown on the Contract Drawings.
2. Contractor shall provide the pipe support maximum spacing as per the manufacturer's recommendations with calculations.
3. The calculations shall include the input data with the pipe type, maximum deflection, max temperature, wind/seismic effects, specific gravity and correction factors, etc.

.2 Unless otherwise specified, Provide a pipe expansion joint with two pipe supports on both side of expansion joints to account for each structural expansion joint. The spacing between two supports shall not be more than 1.0m.

.3 Unless otherwise specified, One of sliding supports between fixed supports shall be a pipe guide as per Process Details in the Contract Drawings.

.4 Unless otherwise specified, Provide one (1) flexible coupling at every 90-degree bends to allow for deflection.

3.7 HANGER INSTALLATION

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

.2 Adjust hangers to equalize load.

.3 Do not suspend from metal deck.

3.8 HORIZONTAL MOVEMENT

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

.2 Where horizontal pipe movement is less than 13mm (½") offset pipe hanger and support so that rod hanger is vertical in the hot position.

3.9 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.

3.10 SEISMIC RESTRAINT

.1 Provide seismic restraint of systems in accordance with Section 44 02 41 - Seismic Restraint.

END OF SECTION

FIELD PAINTING REQUIREMENTS

PART 1 GENERAL

1.1 SCOPE

.1 This specification outlines the requirements for field surface preparation and field painting of metallic surfaces.

1.2 GENERAL REQUIREMENTS

.1 The Contractor shall provide all supervision, labor, tools, equipment (including but not limited to compressors, scaffolding, brushes, mixers and spray devices) drop cloths, protective covers and filters and materials necessary to prepare and paint surfaces.

.2 Clean-up, debris removal and disposal according to all applicable laws and regulations are the responsibility of the Contractor unless the Engineer provides a written exemption.

.3 The following items, although galvanized, shall be painted when colour coding or additional corrosion protection is necessary.

.1 Bolting and associated hardware for painted structural steel and painted steel piping.

.2 Painted pipe clevis and other painted pipe supports.

1.3 SURFACE CLASSIFICATION

.1 The following surfaces have been cleaned and primed by others (unless otherwise noted in Contract Documents).

.1 Shop fabricated equipment including items supplied with manufacturer's standard paints such as pumps, motors, agitators, compressors, etc.

.2 All in-line carbon steel instruments and valves.

.2 The following surfaces shall not be painted, unless otherwise specified.

.1 Plastics and rubber.

.2 Aluminum and copper materials.

.3 Galvanized surfaces (except for touch-up of damaged galvanizing, bolting and pipe supports).

.4 Insulation, except where bituminous insulation mastic covering is utilized.

.5 Stainless steel piping and piping components.

.3 The following surfaces shall not be painted but shall be protected during surface preparation and paint application:

.1 Instrument and electrical panel boards, push buttons, controls, switches, fuse boxes, valve operators, or valve controllers.

.2 Sprinkler heads.

.3 Fire extinguishers.

.4 Glass parts of all instruments and gauges.

.5 Valve stems and PSV's.

.6 Machined surfaces of moving parts.

.7 Gasket surfaces.

.8 Identification nameplate and pipeline identification marks (except to renew).

.9 Removable signs shall be removed during surface preparation and paint application. After acceptance of painting activity signs shall be securely reinstalled.

.10 Electrical light fixtures, light bulbs, power connections.

.11 Concrete floors.

.12 Coatings on existing equipment and piping (outside the scope of project).

.13 Equipment nameplates.

.14 Stainless steel valves. (Unless valves are not insulated, and piping identification painting is specified).

.4 Any paint spilled, splashed, or misapplied on items listed in Paragraph 1.3.2 or 1.3.3 must be removed before the job is accepted as complete. Items listed in Paragraph 1.2.3 that are damaged or would be damaged by restoring the surface shall be replaced by the Contractor.

.5 The items and surfaces to be field painted and paint systems to be used are listed in the Painting Schedule. This typically includes:

.1 Uninsulated surfaces of carbon steel.

.2 Exposed carbon steel of uninsulated and insulated piping including back-up flanges, valves, bolting, supports and attachments.

.3 Exposed carbon steel parts of alloy or non-metallic equipment.

.4 Exposed stainless steel piping and valves for identification purposes.

.5 Refer to Section 13075 – Mechanical Identification for colour schedule for exposed piping painted for identification purposes.

.6 Engineer supplied equipment have been painted by the manufacturer and requires no further painting. Touch up any damaged surfaces to match manufacturer's paint system.

.7 Galvanized steel supports and galvanized steel building components damaged due to welding and other operations shall be touched up in accordance with Section 09 91 23.

PART 2 MATERIALS

2.1 PAINTING SCHEDULE – CARBON STEEL

TYPE ITEM	TEMPERATURE RANGE °C (2)	SURFACE PREPARATION	PRIME COAT & APPLICABLE SPECIFICATION SECTION	INTERMEDIATE COAT & APPLICABLE SPECIFICATION SECTION	FINISH COAT & APPLICABLE SPECIFICATION SECTION
Piping (3)					
Insulated	-28°C to 150°C	Near-White Blast	Epoxy Phenolic Specification 44 01 48	None	None
Un-Insulated Indoor	-28°C to 93°C	Near-White Blast	Enamel primer as per item 2.7	Enamel finish coat as per item 2.8	Enamel finish coat as per item 2.8
Un-Insulated Outdoor	-28°C to 93°C	Near-White Blast	Enamel primer as per item 2.7	Enamel finish coat as per item 2.8	Enamel finish coat as per item 2.8
Pipe Supports – See Note 1					

Note:

(1) The supports touching the pipe (i.e. shoes, saddles, hangers, etc.) shall be painted as per the requirements for the pipe and all the pipe support touching hot piping above 150ºC shall be painted as per the requirements for the pipe. All structural steel supports shall be hot dipped galvanized. Galvanized steel supports and galvanized steel building components damaged due to welding and other operations shall be touched up in accordance with Section 44 01 52.

(2) To determine which temperature range a pipe to be painted falls into, refer to operating temperature of line, listed in Line List on P & ID drawings.

(3) Piping colours are provided in Section 44 00 90.

2.2

Inorganic zinc and zinc-rich organic primed items should be aged (weathered) for 24 hours at 21ºC and for 48 hours when the temperature is 10ºC or less prior to topcoating with high build topcoats. By field topcoating shop primed items, the open, porous surface of these primers generally have sufficient time to fill with carbonates and sulfates and, therefore, the risk of blistering and/or pinholing of topcoats is minimized. Shop application of topcoats over freshly applied primers should be avoided.

2.3

Near-white blast surface preparation shall be in accordance with Steel Structures Painting Council (SSPC) and National Association of Corrosion Engineers (NACE) Standard SSPC-SP-10 (NACE-2), “Near White Metal Abrasive Blast”. Removal of at least 95% of all surface matter leaving the area free of all visible residues.

2.4

All carbon steel surfaces shall be solvent cleaned as per SSPC-SP-1, “Solvent Cleaning” to remove all oil, grease and similar contaminates prior to near white blast surface preparation.

2.5 PAINTING SCHEDULE – AUSTENITIC STAINLESS STEEL

Paint piping only when required for identification purposes as noted in Section 44 00 90.

TYPE ITEM	TEMPERATURE RANGE °C	SURFACE PREPARATION	COATING	NOTES
Equipment & Piping	60°C to 150°C	Solvent Clean & Brush Blast	Epoxy Phenolic Specification 44 01 48	(2)

NOTES

.1 Always protect austenitic stainless steel from zinc coating.

.2 Associated carbon steel surfaces shall have surface preparation, primer, and topcoat designated in Specification 44 01 48.

2.6 PAINTING OF GALVANIZED PIPING AND SUPPORTS

.1 Galvanized piping and supports shall receive one coat of vinyl wash primer, one coat Moore’s Retardo Rust Inhibitive Paint and two coats of Satin Impervo Enamel.

.2 Prepare surfaces and apply paint in accordance with manufacturer’s recommendations.

.3 Paint galvanized piping only when required for identification purposes as noted in Section 44 00 90.

2.7 ENAMEL PRIMER

.1 Enamel Primer to be Benjamin Moore’s Rust Inhibitive paint, or equivalent.

.2 Preparation of Surfaces:

.1 Where conventional primer is used touch up shop paint primer on steel with CAN/CGSB-1.40-M89 to CGSB 85-GP-14M.

.3 Application:

.1 Sand and dust between each coat to remove defects visible from distance up to 1.5m using No.00 sandpaper.

.2 Apply paint by brush; rollers may be used elsewhere. Spray paint only when requested or approved by Contract Administrator.

.3 Use only unadulterated paint. Thin as specified by manufacturer.

.4 Do not paint caulked joints except as directed by the Contract Administrator.

.5 Touch up visible suction spots on dried primer and ensure that they are sealed before application of second coat. Repeat on second coat if still visible.

2.8 ENAMEL INTERMEDIATE AND FINISH COATS

.1 Enamel Intermediate and finish coat to be Benjamin Moores satin Impervo Enamel, or equivalent.

.2 Preparation of Surfaces:

.1 Where conventional primer is used touch up shop paint primer on steel with CAN/CGSB-1.40-M89 to CGSB 85-GP-14M.

.3 Application:

.1 Sand and dust between each coat to remove defects visible from distance up to 1.5m using No.00 sandpaper.

.2 Apply paint by brush; rollers may be used elsewhere. Spray paint only when requested or approved by Contract Administrator.

.3 Use only unadulterated paint. Thin as specified by manufacturer.

.4 Do not paint caulked joints except as directed by the Contract Administrator.

.5 Touch up visible suction spots on dried primer and ensure that they are sealed before application of second coat. Repeat on second coat if still visible.

PART 3 EXECUTION

3.1 PAINTING

.1 Prior to applying any coating, all previously applied paints shall be sufficiently dried or cured to permit topcoating. All surfaces shall be unscarred, in good condition and free of oils, greases, excessive gloss, dust or other contaminants.

.2 Surfaces which have been primed or painted shall not be handled, worked on or otherwise disturbed until primer or paint is completely dry and/or set.

.3 Surface preparation, cleaning and painting operations shall be scheduled so that contamination of freshly applied paint is prevented.

3.2 MATERIALS

.1 The paint materials, their solvents and catalysts shall be supplied by the same paint manufacturer.

.2 All materials shall be delivered and stored in their original packages with their labels intact and seals unbroken.

.3 All paint materials shall be stored under cover in a dry place and protected from freezing temperatures and excessive heat. The paint materials shall be stored in accordance with paint manufacturer's instructions.

.4 Material substitutions are not allowed without prior written approval of owner.

.5 Compressed air used for blast cleaning, for removal of abrasives on blasted surfaces and for spray application shall be oil and moisture-free.

3.3 TOUCH-UP AND REPAIR

.1 Items painted with manufacturer's standard coating and operating shall be touched-up (where required) with paint of equal type. If the paint film is extensively damaged or is of unknown generic type, the item shall be solvent, hand or power tool cleaned and fully coated with primer and finish coat of equal type.

.2 All primed areas that have been damaged (by welding, scarring, etc.) shall be spot cleaned and touched up prior to applying the subsequent coats. These areas shall be cleaned, using solvent and power tools to remove all loose paint, heat degraded paint, rust bloom, scale, dirt, grease, oils or other foreign contaminant and to develop adequate anchor patterns. Adherent primer at edge of damaged area shall be roughened and feathered back from cleared area. After cleaning, reapply coating to cleaned areas to meet dry film requirements in referenced specification.

.3 Primed surfaces that are damaged and require greater than 30% touch-up shall have complete surface preparation and have full prime coat application to meet dry film requirements in reference specifications.

.4 Where existing steel surfaces finish coating have been damaged from welding or other operations; Contractor shall power wire brush the damaged area and then paint as per specifications for pipe supports.

3.4 COLOURS

.1 Final paint coat colour selection shall be made at the job site by the Contract Administrator using standard colours of approved paint suppliers according to the following General Colour Guide:

.1 The selected colours shall be supplied from single batch lots (to avoid colour variation). For large order of paints, minimum number of batch lots shall be supplied.

.2 Final topcoat colour section shall result in colour contract between coats.

.3 Failure to provide contrasting colours (unless prior written approval is granted by Contract Administrator), incorrect colour, varying colour (because of use of multiple lots of coating) shall be grounds for rejection.

.4 Areas rejected because of items listed above shall be repaired/replaced to Contract Administrator's satisfaction at the Contractor's expense.

.5 Colours must be cut in a neat straight line where two colours meet.

.6 Where colours are selected to meet plant or governmental safety requirements, colour tones and wavelength characteristics shall comply with these requirements.

.7 Contractor may utilize additional finish coat(s) of the same finish material or different generic system (i.e. aliphatic urethane) to meet special or safety colour requirements, provided that:

.1 Prior written Engineer approval is granted.

.2 Coating is an approved product from an approved supplier per the appropriate Specification.

.3 Coating will be at least as chemically and ultraviolet resistant as the specified topcoat.

.4 Film build requirement of the selected topcoat system is satisfied.

3.5 FIELD SURFACE PREPARATION AND PAINTING PRIOR TO ERECTION

.1 Copper slags and high chloride bearing abrasives shall not be used as abrasive blast media.

.2 Unless otherwise prohibited, Contractor may request permission to set up a surface preparation and/or painting area to:

.1 Satisfy "shop" abrasive blast cleaning and "shop" priming requirements.

.2 Conduct "field" or in-situ abrasive blasting, surface preparation, primings or intermediate topcoating. Finish coating shall only be conducted after erection, unless written approval to do otherwise is granted by Engineer.

.3 Contractor may conduct surface preparation and/or painting in conjunction with Paragraph 3.5.2 if the following additional requirements are satisfied:

.1 Temperature and humidity criteria for application are not exceeded.

.2 Abrasive from blast cleaning does not damage or interfere with function of Engineer equipment.

.3 Stands or supports used to facilitate surface preparation and/or painting are of sufficient height from ground to prevent contamination of prepared and/or painted surfaces.

.4 Degree of handling damage is not excessive or would not require full recoating.

.5 Touch-up of damaged painting will not create an unsightly appearance when coating application is completed.

3.6 SAFETY AND EQUIPMENT PROTECTION

.1 Contractor should take into account possible wind shifts, exhaust fan drafts, high personnel traffic areas, and the proximity of instruments, controls, rotating equipment or other equipment susceptible to damage from particulate matter or painting.

.2 Personnel safety is of key importance. Areas to have surface preparation and/or painting shall be cordoned off with warning signs or safety ribbons. Walkways in the vicinity of blast cleaning are to be cordoned off with visqueen or tarps to help isolate the effects of sandblasting.

.3 Filter presses, pumps, motors, turbines, compressors and other rotating equipment are highly susceptible to damage from particulate matter. Therefore, it is of utmost importance that this type of equipment be protected and that protection is maintained for the duration of the work. Details of protection methods are outlined in the “Application” section of this procedure.

.4 The work shall be conducted in such a manner as not to damage any existing buildings, structures, insulation, piping, equipment, etc. Any such damage shall be required by Contractor at its expense, unless Contractor is directed otherwise by Engineer in writing.

.5 “Safe Work” permits are required for grinding, chipping, blast cleaning and painting. In addition to the “Safe Work” permits, “Hot Work” permits are required if there is a source of ignition for flammable materials in the area. Dry abrasive blasting, welding, cutting, electrical devices, needle guns, and grinding equipment are representative of this type of work.

.6 “Safe Work” and “Hot Work” permits are issued by the General Contractor group for the area in which work is to be done. These permits are in written form and must be obtained prior to commencing work and shall be good only for the time and work indicated on the permit. They will not be issued until the procedures for equipment and personnel protection are complete and approved by the Engineer.

.7 Protective coverings are to be checked prior to each shift to be sure they are intact. The Contractor should periodically tour his area to be sure that the protection is maintained. If equipment has been exposed, it is the responsibility of the Contractor that this be corrected immediately, even if it means stopping on-going work.

.8 It is the responsibility of the Contractor to protect plant personnel and equipment. Should the Engineer deem that the Contractor is not adequately maintaining the protection of equipment and personnel, all work may be stopped until the protection of equipment is corrected.

.9 Contractor Equipment

.1 All equipment required by the Contractor shall be operated safely and be in a safe condition. The Engineer reserves the right to forbid the use of any equipment which the Engineer believes to be unsafe.

.2 All pressurized equipment shall have pressure gauges and regulators, as recommended by equipment manufacturer and shall meet all applicable Local, Provincial and Federal Regulations. The pressure device shall be maintained in safe working order. All pressurized equipment shall meet all applicable laws and regulations.

.10 The safety rules for Contractors are to be followed. They will be strictly enforced; failure to comply can lead to expulsion from the site.

.11 Electric motors, compressors, turbines, tank vents, etc., are to have foam filter material (equal to Preciation Air Filters, Part No. FR-52530) over any air intakes, with no openings to allow sand or paint chips to enter. The filters shall be a minimum of 20mm thick.

.12 Motor shaft seals, couplings, gear boxes and bearings are to be enclosed with visqueen or other suitable material and sealed in a manner that will prevent particulate damage.

.13 Piping, equipment, insulation, and other items near surfaces which are to be cleaned and painted shall be protected from over blast damage and overspray with visqueen, tarps, rubber, or other suitable material approved by Engineer.

.14 Drains and drainage trenches shall be covered to prevent sand or debris from entering. This also includes safety shower drains and eyewash stations. Drain covers are to be removed at the end of the project. The painting contractor must remove any debris or sand that could possibly wash into the drains. The Contractor shall be liable for the cost of cleaning drains that become plugged as a result of his work.

.15 Instrumentation, tubing, wiring and gauges are to be wrapped with visqueen and taped to keep debris out and wrapped with rubber sheeting if there is the possibility of damage from overblast or overspray.

.16 Unless Engineer indicates otherwise, all work associated with protection of plant equipment and personnel shall be performed by Contractor.

3.7 INSPECTION

.1 Contractor shall provide Contract Administrator with full access to all items being prepared, cleaned and/or painted.

.2 Contractor, at the request of Contract Administrator's inspector, shall place one handful from each bag of abrasives into a bucket of clean water to detect clays, oils or other objectionable foreign matter. Typically, these materials float on water surface.

.3 Contractor is to utilize and provide for Contract Administrator's use all testing tools and equipment to ensure compliance with humidity and temperature criteria and to inspect all phases of surface preparation, materials and paint application/cure. All testing tools and equipment shall be calibrated and in good working condition.

.4 Contractor shall repair at his expense, all rejected surface preparation and coating application to Contract Administrator's satisfaction.

.5 Contractor is to provide, in writing, details to Contract Administrator of all corrective action on rejected surface preparation, materials and applications.

END OF SECTION

TOUCH UP OF GALVANIZED STEEL

PART 1 GENERAL

1.1 SCOPE

.1 This specification outlines a paint system using a one component zinc rich primer for field touch-up of galvanized steel surfaces operating below 660C.

1.2 SHOP DRAWINGS

.1 Submit shop drawings in accordance with the Section 44 00 10 - Process General Requirements and Section 01 33 00.

PART 2 MATERIALS

2.1 THE ACCEPTABLE PRIMERS ARE:

.1 Galvanox Type I, Subox Division, Carboline Co., 40 Burlews Ct., Hackensack, NJ 07901.

.2 Z.R.C. Cold Galvanizing Compound, ZRC Chemical Products Co., 21 Newport Avenue, Quincy, MA 02171.

.3 Galvicon, Southern Coatings, P.O. Box 460, Slidell, LA 70459.

PART 3 EXECUTION

3.1 SURFACE PREPARATION

.1 Weld areas and small areas of damaged galvanizing shall be hand or power tool cleaned in accordance with Steel Structures Painting Council SSPC-SP-2 or 3, latest editions.

.2 If large areas of damaged galvanized are to be cleaned, use brush blast cleaning per Steel Structures Painting Council SSPC-SP-5, latest edition.

.3 All grease, oils or other foreign matter shall be removed in accordance with solvent cleaning SSPC-SP-I, latest edition and per manufacturer's recommended practice.

.4 Clean all exposed carbon steel per above and adjacent adherent galvanized for a distance of 12mm minimum.

3.2 APPLICATION

.1 The specific manufacturer’s instructions must be followed for handling, mixing, curing, application, thinning, equipment, re-coat time, cleaning of equipment, and storage.

.2 Primer shall not be applied when the metal surface or ambient air temperature is below 4.4°C or is expected to drop to 1.7°C before the primer has dried. The relative humidity of the surrounding air shall not exceed 90% at the time of application. Primer shall not be applied when metal surface or ambient temperature is greater than 38°C.

.3 Primer shall not be applied when the surface temperature is less than 15°C above the dew point of the surrounding air.

.4 Primer shall not be applied to damp surfaces or in rain, fog or mist.

.5 Surfaces to be primed shall be dry and free of atmospheric contamination, dust, grease, abrasives, and other foreign matter.

.6 The steel shall be primed within eight hours of surface preparation.

.7 The primer may be applied by brush or spray. For brush application, do not mix to prevent settling of zinc pigment. For brush application, fully load brush and apply smoothly onto surface to be coated (do not brush over primer).

.8 Apply two coats of primer to a total dry film build between 3 and 4 mils.

3.3 INSPECTION

.1 All phases of surface preparation may be checked by the Engineer. The latest NACE Visual Standards for Blast Cleaned Surfaces will be used to determine compliance with standard. All primer materials and all phases of application are subject to inspection by the Engineer.

.2 Insufficient dry film thickness, bleeding, holidays, blisters, runs, sags, improper cure, dry spray, or extensive blemishes are causes for rejection.

.3 All materials, application and workmanship not meeting this standard or manufacturer's instructions shall be repaired or replaced at the Contractor's expense.

3.4 SAFETY

.1 In addition to safety requirements in contract documents, the pint formulator’s safety recommendations shall be used.

.2 Contractor’s safety procurers, including the ventilation requirements of .3 below, must be discussed with the Engineer before work can begin. These procedures must conform to all applicable laws and regulations.

.3 When applying primer in enclosed area, ventilation shall be provided during the time of application and three hours thereafter. Ventilation procedures must ensure that the air quality does not endanger the health of workers inside an enclosed area. The Contractor shall follow all applicable laws and regulations. In addition,

the contractor must also ensure that the air content inside any confined space never exceeds the permissible exposure limit (PEL) and one half the lower explosive limit (LEL) of any constituent of the paint system.

.4 All smoking materials, matches, flames, and spark producing tools and equipment are prohibited within 15m of the application area.

.5 Only portable lighting fixtures which are specifically approved as a complete assembly for use in a Class I, Division I location shall be used in enclosed areas when applying any part of a primer system. Supply voltage for lighting shall not exceed 32 volts.

END OF SECTION

SEISMIC RESTRAINTS

PART 1 GENERAL

1.1 SUMMARY

.1 This section specifies seismic restraints for bracing all piping systems and equipment specified in Division 44. This Section does not include seismic restraints for fire sprinkler systems.

.2 The contractor will retain a design engineer to review the installed piping system and equipment and design a seismic restraint system, including calculations as per the Ontario Building Code. The design, calculations and details shall be prepared and sealed by a professional engineer licenced in the Province of Ontario. The seismic design basis shall be for a Post Disaster Building.

.3 Definitions

.1 Longitudinal direction - direction parallel to the pipe axis (X orientation).

.2 Lateral direction - direction perpendicular to the pipe axis Y and Z orientations).

.4 Operating Conditions

.1 The seismic restraints specified in this section are provided to resist pipe movements and loads occurring as a result of an earthquake or other seismic event.

.2 Unless otherwise specified, all piping shall have bracing to resist seismic loading caused by forces applied at the individual pipe's center of gravity. Seismic loading shall be 1.0 g acting in the lateral and longitudinal directions and 0.5 g acting simultaneously in the vertical directions.

.5 Restraint Selection

.1 Unless otherwise specified, the contractor shall design, supply and install all seismic restraints for piping in accordance with the contract documents.

.2 The Contractor shall review the piping layout in relation to the surrounding structure and adjacent piping and equipment before designing the restraint to be used at each point.

.3 Piping systems shall not be braced to dissimilar parts of a building or to dissimilar building systems that may respond in a different mode during an earthquake. Examples: wall and a roof; solid concrete wall and a metal deck with lightweight concrete fill.

.4 Restraints shall be sized to fit the outside diameter of the pipe, tubing, or, where specified, the outside diameter of insulation.

.5 There shall be no contact between a pipe and restraint component of dissimilar metals. The contractor shall prevent contact between dissimilar metals when restraining piping and equipment by the use of copper-plated, rubber, plastic or vinyl coated, or stainless steel restraint components.

.6 Branch lines shall not be used to brace main lines.

.7 Seismic bracing shall not limit the expansion and contraction of the piping system.

1.2 QUALITY ASSURANCE

.1 References:

.1 This section contains references to the following documents. They are a part of this section as specified and modified. In case of a conflict between the requirements of this Section and those of the listed documents, the requirements of this section shall prevail.

.1 The Ontario Building Code for Post Disaster Buildings

.2 ANSI A58.1 Minimum Design Loads for Buildings and Other Structures

.3 AISC Manual of Steel Construction American Institute of Steel Construction, Manual of Steel Construction, Allowable Stress Design -9th Edition

.4 MSS SP-58 Pipe Hangers and Supports - Materials, Design and Manufacture

.5 MSS SP-69 Pipe Hangers and Supports - Selection and Application

.2 Approval: Seismic restraint load calculations required by this section shall be reviewed and signed by a structural engineer registered in the Province of Ontario.

1.3 SUBMITTALS

.1 Shop Drawings:

.1 The following shall be submitted in compliance with Section 01 33 00:

.2 Submit the design review, calculations, and installation details signed and sealed by a Professional Engineer registered in the Province of Ontario.

PART 2 PRODUCTS

2.1 ACCEPTABLE PRODUCTS

.1 Standard pipe restraints and components shall be manufactured by Carpenter & Patterson, B-Line, Kin-Line, Anvil, Michigan, Pipe Shields Incorporated, Superstrut, Unistrut, or equal. Pipe restraint materials shall conform to the requirements of MSS SP-58 and MFMA-1.

2.2 MATERIALS

.1 Unless otherwise specified, restraints, including braces, pipe and structural attachments, shall be hot-dip galvanized after fabrication except those within 2.0m of the top water level of any water bearing vessel/tank or reactor. Nuts, bolts and washers, fittings and accessories, may be mechanically zinc-coated except for

those subject to moisture or corrosive atmosphere or within 2.0m of the top water level of any water bear vessel/tank or reactor, which shall be type 304 stainless steel.

2.3 EXECUTION

.1 Provide equipment supports and anchoring devices to withstand the seismic design forces, so that when seismic design forces are applied, the equipment cannot displace, overturn, or become inoperable.

.2 Provide anchorages in conformance with recommendations of the equipment manufacturer and as shown on approved shop drawings and calculations.

.3 Construct seismic restraints and anchorage to allow for thermal expansion and contraction.

.4 Provide supports and anchoring so that, upon application of seismic forces, piping remains fully connected as operable systems which will not displace sufficiently to damage adjacent or connecting equipment or building members.

.5 Piping Connections: Provide flexible connections where pipes connect to equipment. Make the connections capable of accommodating relative differential movements between the pipe and equipment under conditions of earthquake shaking.

END OF SECTION

POWERED ACTUATORS

PART 1 GENERAL

1.1 RELATED SECTIONS

.1 Section 01 33 00 – Submittals

.2 Division 26 – Electrical

.3 Section 44 04 00 – Process Piping

1.2 SUBMITTALS

.1 Submit shop drawings and product data in accordance with Section 01 33 00 – Submittals.

.2 Provide maintenance data for incorporation into manual specified in Section 01 33 00 – Submittals. Data to include:

.1 Manufacturers name, type, model, capacity, complete model number and Serial number.

.2 Applicable operation and maintenance information as specified in section 01 33 00.

.3 Provide calculations for sizing and actuator torque calculations.

.4 Submit a completed ISA S20.50 Instrument Specification sheet for each device, with all fields completed.

.5 Installation certification form.

.6 Training Certification form.

1.3 DESCRIPTION

.1 All powered actuators shall be supplied together with the mechanical equipment (i.e. valves, gates, etc.) by the mechanical equipment supplier under Division 44.

.2 All sizing and selection of modulation and on/off control valve components shall be undertaken by the mechanical equipment supplier under Division 44.

.3 Sizing and matching of powered actuators to controlled devices shall be undertaken by the mechanical equipment supplier under Division 44 and coordinated with the work specified herein.

.4 Refer to the drawings and Valve Instrument Data sheets, attached to this section, for valve and actuator identification and specific information.

PART 2 PRODUCTS

2.1 GENERAL

.1 The actuators shall be suitable for use on a nominal three-phase, 208 Volt, 60Hz power supply with 120 Vac control transformer and are to incorporate motor, integral reversing starter, local control facilities, and terminals for remote control and indication connections. The actuator shall include a device capable of automatically correcting the phase relationship of a three-phase supply.

.2 Valves shall be capable of setting the torque level, position limits and configuration of the indication contacts without requiring the removal of any covers

.3 Actuators shall be watertight to NEMA rating specified in the Instrumentation data sheets and shall have an inner watertight and dustproof 'O' ring seal between the terminal compartment and the internal electrical elements of the actuator fully protecting the motor and all other internal electrical elements of the actuator from ingress of moisture and dust when the terminal cover is removed on site for cabling.

.4 Actuators installed in explosion/hazardous areas shall be adequately certified and suitable for use in the rated area.

.5 All external fasteners shall be of stainless steel.

.6 The enclosure of the electric actuator shall be provided with minimum 8 mil DFT epoxy coating.

2.2 ELECTRIC ACTUATORS, OPEN/CLOSE TYPE AND MODULATING TYPE

.1 The actuator shall be sized to guarantee valve closure at the specified differential pressure and with a 1.5x safety factor over the maximum required valve torque as specified by the valve manufacturer. Motor design shall ensure sufficient torque output in the event the supply voltage drops to 10% below nominal.

.2 The operating speed shall be such as to give valve closing and opening at approximately 250 to 300 mm per minute unless otherwise stated in the job specification.

.3 The actuator shall be capable of functioning in an ambient temperature ranging from -30°C to +70ºC, unless noted otherwise in the instrument data sheets attached.

.4 The electric motor shall be of a high torque, low inertia type, shall incorporate self re-setting thermostatic protection against overheating and be 15 minutes rated (minimum). The actuator shall de-energize the motor in the event of stall when attempting to unseat a jammed valve. Motors shall be equipped with Class H insulation.

.5 The actuator gearing must be totally enclosed, be of all metal construction and suitably lubricated without the use of special or exotic lubricants which may be difficult to source.

.6 A handwheel shall be provided for emergency (manual) operation and shall disengage the gear train by means of a declutching lever. Upon restoration of mainspower the actuator will automatically re-engage the motor gear train. Handwheels must not rotate whilst the actuator is operating via the motor.

.7 The handwheel size and gearing must ensure the required rim pull does not exceed 360N.

.8 Torque sensing must be through electronic means and it shall be possible to easily adjust the actuator's overall output to 40% to 100% of its rated torque.

.9 A minimum of four latching contacts shall be provided for the selection of a normally closed (NC) or normally open (NO) contact forum. Contacts should maintain and update position indication if the actuator is manually operated without main power available.

.10 The contacts shall be rated at 5A at 120V AC and can be individually designated to signal conditions such as:

- Valve opening, closing or moving
- Thermostat tripped, lost phase
- Motor tripped on torque in mid travel, motor installed.
- Actuator alarm, valve alarm, control system alarm
- Remote selected
- Actuator being operated by handwheel

.11 When requested in the instrument data sheets, the actuator must have a contactless transmitter to give a 4-20mA analog signal corresponding to valve position. The transmitter shall be auto ranging to the set actuator limits and be factory calibrated for 4-20mA (+/-1%).

.12 The actuator display shall include a dedicated numeric/symbol digital position indicator displaying valve position from fully open to fully closed in 1% increments. Red, green, and yellow lights corresponding to open, closed, and intermediate valve positions shall be included on the actuator display when power is switched on. The digital display should be maintained and updated during handwheel operation when all power to the actuator is isolated.

.13 The digital display shall be capable of indicating real time torque output and valve position during actual operating conditions.

.14 The reversing starter, control transformer, and local controls shall be integral with the valve actuator, suitably housed to prevent breathing and condensation buildup.

For On-Off service, the starter shall be an electromechanical type suitable for 60 starts per hour and of a rating appropriate to motor size.

.15 The integral transformer shall be fuse protected, have all necessary tappings and be adequately rated to provide power for the following functions:

- Energization of contactor coils
- 120 VAC output as indicated on the instrumentation data sheets for actuator remote circuits
- Supply all internal control circuits

.16 For modulating applications, actuators shall use a nominal three-phase 60Hz power source and incorporate solid state starters for optimum lifetime performance.

.17 When specified in the instrumentation data sheets, the actuator shall include for proportional analog control via 4-20mA or VDC input and as well as provide a return analog signal back to the SCADA confirming valve position. It should be possible to configure this device such that the valve will stay put, open or close upon loss of analog control signal.

.18 Integral to the actuator shall be local controls for Open, Close, and Stop, and a Local/Remote selector switch pad lockable in any one of the following three positions:

.1 Local Control Only
.2 Stop (No Electrical Operation)
.3 Remote Control plus Local Stop Only.

It shall be possible to select maintained or non-maintained local control.

.19 The terminals shall be embedded in a terminal block of high tracking resistance compound. The terminal compartment shall be separated from the inner electrical components of the actuator by means of a watertight seal. The terminal compartment of the actuator shall be provided with a minimum of three threaded cable entries. Each wire shall be clearly identified at each end.

A durable terminal identification card showing plan of terminals shall be provided attached to the inside of the terminal box cover indicating:

a) Serial Number
b) External Voltage Values
c) Wiring Diagram Number
d) Terminal Layout

This must be suitable for the contractor to inscribe cable core identification beside terminal numbers.

2.3 MANUFACTURERS

.1 Powered actuators to be supplied by Auma, Rotork or approved equivalent.

PART 3 EXECUTION

3.1 PREPARATION

.1 Prior to installation of the valve, field measure and check all equipment locations, pipe alignments, and structural installations. Ensure that sufficient space and accessibility is available for pneumatic and electric actuators.

.2 Where conflicts are identified, inform the Engineer and initiate the necessary modifications at no cost to the owner.

3.2 INSTALLATION

.1 Install actuators, related panels, and the interconnecting wiring as shown in the construction drawings and as recommended by the manufacturer.

END OF SECTION

SLUICE, CHANNEL, AND WEIR GATES

PART 1 GENERAL

1.1 SUMMARY

.1 This section specifies the supply and installation of heavy duty fabricated stainless steel slide gates, channel gates and downward opening weir gates indicated on the drawings and as specified herein.

.2 Each gate shall have a clear waterway, shall consist of a gate, guides, frames, brackets, wall thimbles with mounting bolts, stems and stem guides, manual actuators, electric actuators, and all other necessary appurtenances.

.3 The contractor shall furnish all labour, materials, equipment and incidentals required to install, ready for operation and field test stainless steel gates and appurtenances as shown on the Gate Schedule and/or Contract Drawings and as specified herein.

.4 The equipment provided under this section shall be fabricated to repeatable quality build norms, assembled, factory stroked and leak tested with signed and dated results. It shall be erected and placed in proper operating condition in full conformity with the drawings, engineering data, instructions and recommendations of the equipment manufacturer.

.5 Gates and operators shall be supplied by the gate manufacturer with all necessary parts and accessories indicated on the drawings, specified or otherwise required for a complete, properly operating installation and shall be the latest standard product of a manufacturer regularly engaged in the production of fabricated gates.

.6 Except as modified or supplemented herein, all gates and operators shall confirm to the applicable requirements of AWWA C561, latest edition.

1.2 QUALITY ASSURANCE

.1 References:

.1 This section contains references to the following documents. They are a part of this section as specified and modified. In case of a conflict between the requirements of this Section and those of the listed documents, the requirements of this section shall prevail, and all references shall be the latest edition including all addenda.

.1 American Water Works Association, AWWA C 513, Open Channel Sluice Gates.

.2 All the equipment specified under this Section shall be furnished by a single manufacturer with a minimum of 25 years' experience designing and manufacturing water control gates in North America. The manufacturer shall show evidence of satisfactory operation in at least 100 installations.

.3 The manufacturer's shop welds, welding procedures and welders shall be qualified and certified in accordance with the requirement of the latest edition of ASME, Section IX. Welders' certifications and procedures shall be made available for review and acceptance. Failure of conformity will be grounds for rejection.

.4 All wall mounted, four-sided sealing gates shall be shop tested in accordance with AWWA C561 Section 5.2.1, at the manufacturer's factory prior to shipment for both leakage and proper operation. Shop testing shall confirm compliance with the minimized leakage rate as specified in Section 2.1.2 of this specification. Signed and dated leak test certificates by the manufacturer or approved reputable independent third-party agent shall be provided. The owner or its authorized agents reserve the right to witness the leakage tests and shall do so at their discretion.

.5 The torque required to obtain the low leakage sealing shall not cause damage to the operator or actuator to lose its safety factor or overheat.

.6 The manufacturer shall be ISO 9001 certified (latest edition).

1.3 WARRANTIES

.1 A minimum warranty of two (2) years from Substantial Performance must be provided for the gate, appurtenances and actuators specified. It must cover all parts and labour, as well as any regular maintenance not specified in the technical manual delivered with the equipment.

1.4 SUBMITTALS

.1 The manufacturer shall submit the following drawings and data for approval in compliance with Section 01 33 00.

.1 Certified general arrangement drawings in metric units, showing principal dimensions, details of construction, materials list and details required for installation and operation.

.2 Signed and dated factory test reports for stroke test through the complete opening and closing stroke as well and quantified leak test results in litres per minute and per perimeter of seating. Documents shall be considered a submittal requirement and shall be supplied after manufacture of gate, prior to shipment.

.3 Valves failing to meet the minimum specified leakage rates shall be considered "failed" by the factory QA/QC. They shall not be shipped. Modifications made to meet specified leakage rates shall be noted for review, shall be permanent and shall withstand the expected longevity of the installation.

.4 Certification to ISO 9001 demonstrating a repeatable building methodology to assure pre-designated quality level as well as to provide for documented procedures for any deviant occurrences.

.5 Manufacturer shall demonstrate longevity of design and provide testing results for a 25,000-abrasive media accelerated life cycle test demonstrating leakage rates are still below allowable AWWA C561 leakage rates.

.6 Signed factory validation that all gate frame materials and supports are no less than 10 mm thick

.7 The manufacture shall demonstrate the sturdiness of the gate, as well as conformance to the latest edition of AWWA C561 by providing design calculations, confirming stress and deflection of the slide, yoke, and stem. Provide a P.Eng. stamped design validation that the slide shall consist of a flat plate reinforced with formed plates or structural members to limit its deflection of 1/720 of the gate's span under the design head.

PART 2 PRODUCTS

2.1 MATERIALS AND DESIGN

.1 The gates shall be designed for the specified seating and unseating head and shall be of the highest quality both as to materials and workmanship.

.2 The gates shall meet the requirements of AWWA C561 -latest edition. Stainless steel gates shall be made of Type 316 stainless steel.

.3 All parts of gates shall be amply proportioned for all stresses which may occur during installation and operation.

.4 Each gate shall be substantially watertight and shall have zero leakage, when closed.

.5 The gates shall close by rotation of the stems or handwheels, in a clockwise direction.

.6 The gates shall have heavy self-contained frames as noted in the specifications, machined and drilled for bolting to flat surfaces.

.7 Slide gates and weir gates shall be surface mounted to concrete wall or to pipe flange as shown on the drawings. All holes for bolts and studs shall be drilled. Coring of the holes will not be permitted.

.8 All anchor bolts and fasteners shall be Type 316L stainless steel.

.9 All handcrank gear operators shall be located 900mm above the top of grating/concrete at the location shown.

.10 All weir gates are to be provided with clear graduated cylinders around the rising stem in order to allow indexing of the top of weir position.

2.2 REPLACEMENTS

.1 Make interchangeable such individual pieces of the equipment herein specified which are furnished alike in each unit. Like pieces shall conform to exact dimensions on the working drawings made by the Manufacturer, so that no fitting or adjustment will be necessary in setting up the entire equipment, other than such as is usually done in high grade standard designed apparatus.

.2 It is essential that any defective piece of equipment be easily replaced by a new piece made in accordance with the drawings.

2.3 HEAVY DUTY FABRICATED SLIDE GATE

.1 Acceptable Gate Manufacturer: B.N.W. Model 77S or Fontaine Series 20.

.2 Slide gates shall be self-contained rising stem configuration as indicated in the gate schedule.

.3 Frames

.1 The gate frame shall be constructed of structural members or formed plate welded to form a rigid one-piece frame. The frame shall be of the flange back design suitable for mounting on a concrete wall (CW), concrete wall with extra-wide flange (CWX), round manhole (RM), round manhole with extra-wide flange (RMX), a wall thimble (WT), or a standard flange (SF). The frame shall be made of 316L stainless steel.

.2 The frame configuration shall be of the flush-bottom type and shall allow the replacement of the top and side seals without removing the gate frame from the concrete or wall thimble.

.4 Guides and Seals

.1 The guides shall be of such length as to retain and support at least two thirds (2/3) of the vertical height of the slide in the fully open position.

.2 The gate seal shall consist of mechanically retained resilient rubber seal that will provide tight shutoff. The resilient seal shall be replaceable and shall be securely fastened to the gate frame to prevent pull out due to high velocities during gate closing. The top and side seal material shall be Hypalon® or Ultra high molecular weight polyethylene (UHMW PE), suitable for use in wastewater containing abrasive material. The bottom seal material shall be resilient Neoprene. The seal shall be of a raised type to minimize the chance of solids buildup.

.3 The resilient neoprene bottom seal shall be set into the bottom member of the frame and shall form a flush bottom.

.4 The slide gates shall be of proven design capable of maintenance free tight shutoff.

.5 Thrust bearings at yokes shall be grease lubricated.

.5 Wall Gasket

.1 Gasket (between frame and wall thimble) shall be Neoprene in accordance with ASTM D2000 M2 BC 503.

.6 Wall Thimble

.1 The wall thimble shall be supplied by the gate manufacturer for all slide gates. Refer to the gate schedule for type and applicable locations. Material thickness should be according to the manufacturer's recommendations and be of sufficient resistance to handle the operating forces.

.7 Slides

.1 The gate slide shall be manufactured from 316 stainless steel having a minimum thickness of 10 mm. The slide shall consist of a flat plate reinforced with formed plates or structural members to limit its deflection to 1/720 of the gate's span under the design head.

.8 Stems and Couplings

.1 Lifting stems for self-contained gates shall be one piece type 316L stainless steel of ample cross-section to prevent distortion. The threaded portion of the stem at the actuator end shall extend 50mm past the actuator nut when the gate is at the bottom of its travel.

.2 The operating stem shall be designed to transmit in compression at least 2 times the rated output of the operating manual mechanism with a 178 N effort on the crank or handwheel.

.3 Provide machine cut threads of the Acme type.

.4 Stems shall be sized so that the slenderness ratio (L/r) for the unsupported length of the stem does not exceed 200.

.5 For extended stems in more than one piece with a nominal diameter of 45mm and larger, join the sections by grooved and keyed solid Couplings of greater strength than the stem.

.6 For extended stems provide adjustable fabricated 316L stainless steel stem guides required to prevent stem deflection.

.7 No slack or looseness shall exist between each stem sections or between the stem and the gate door. Even in reverse action, every movement of 1 mm of the higher stem section shall move the gate door by the same amplitude.

.8 Each gate with rising type stems shall be provided with transparent plastic, vented pipe stem covers and caps. Provide stem covers with OPEN and CLOSED position markings and graduations in metric.

.9 Provide a threaded stainless steel stop nut on all geared and ball bearing lifts.

.9 Operator

.1 Provide lifting devices for manually operated gates and for use with a portable power lifting device.

.2 Manual lift for slide gates shall be a yoke-mounted type for self-contained gate complete with a side mounted crank with a gear ratio as required for specified operating conditions.

.3 All bearings and gears shall be totally enclosed in a weather tight housing. The pinion shaft of crank-operated mechanisms shall be constructed of stainless steel and supported by roller or needle bearings. Gears shall be yoke mounted for self-contained gates.

.4 Gate shall be equipped with a locking mechanism (passive or active), allowing it to remain opened after actuator as been removed for maintenance.

.10 Yoke

.1 Self-contained gates shall be provided with a yoke made of structural members or formed plates. The maximum deflection of the yoke shall be 1/360 of the gate's span. Yoke shall be made of 316L stainless steel.

2.4 WEIR GATES

.1 Acceptable Gate Manufacturer: B.N.W. Model 77w or Fontaine Series 40.

.2 Weir gates shall be wall mounted down-ward opening gates fabricated of 316 stainless steel and come complete with flange back frame, wall thimbles and guide etc. Gates shall meet AWWA C561 standards for materials and allowable leakage.

.3 Weir gates shall be self-contained rising stem configuration as indicated in the gate schedule.

.4 The gate seal shall be as specified in 2.3.4 above. To provide minimum leakage at intermediate gate travel positions, a second mechanically retained neoprene wipe seal shall be provided around the perimeter of the gate. When fully closed (raised) the gate shall be leak tight.

.5 Frame, guide, wall thimbles, wall gasket, gate stems, slide, operators (actuators) and yoke will all be as specified above for slide gates.

.6 Gate frame shall be constructed of structural members or formed plate welded to form a rigid one piece-frame.

2.5 CHANNEL GATES

.1 Acceptable Gate Manufacturer: B.N.W. Model 77S or Fontaine Series 25.

.2 Channel gates shall be self-contained rising stem configuration as indicated in the gate schedule.

.3 Frames

.1 The channel gate frame shall be constructed of structural members or formed plate welded to form a rigid one-piece frame. The frame shall be made of 316L stainless steel.

.2 The frame configuration shall be of the flush-bottom type and shall allow the replacement of the top and side seals without removing the gate frame from the concrete or wall thimble.

.3 Frames of the channel gates in the Headworks and UV channels shall be embedded in the channel concrete surface.

.4 Guide, wall thimbles, wall gasket, gate stems, slide, operators (including power lifting device) and yoke will all be as specified above for slide gates.

.5 Gate Seal

.1 Side: Hypalon® or Ultra high molecular weight polyethylene (UHMW PE).

.2 Bottom: Neoprene

.3 Provide double o-ring between the concrete wall surface and gate frame.

2.6 GATE SCHEDULE

.1 The gates to be provided are outlined in the attached design drawings.

PART 3 EXECUTION

3.1 SHOP FINISHES

.1 Slide gate frame and slide shall be shop blasted using a stainless steel grit to remove manufacturing impurities.

.2 All stainless steel surfaces shall be fully pickled and passivated in accordance with ASTM A380, manufacturers must provide documentation verifying their procedures.

3.2 INSTALLATION

.1 Installation shall comply with the manufacturer's written instructions.

.2 Slide Gates

.1 Set wall thimbles in the forms level and plumb. Install gates on their respective thimbles free from distortion and undue strain and truly plumb and level. Ensure wall thimble is properly oriented with the gate prior to installation.

.2 Test gates to the seating and unseating pressures specified.

.3 Reduce leakage to amount specified.

.4 Protect all exposed apparatus and equipment from mortar drippings, wet concrete or other adhering substances.

.5 After installation, clean gates and operators of all foreign matter.

.3 Weir Gates

.1 Set wall thimbles in the forms level and plumb. Install gates on their respective thimbles free from distortion and undue strain and truly plumb and level. Ensure wall thimble is properly oriented with the gate prior to installation.

.2 Set single frame square and flush to the wall opening.

.3 Fasten flange back frame to wall with 316 SS anchor bolts.

.4 Adjust gate and operator to provide smooth operation.

.5 Test gates for allowable leakage.

.4 Field Testing

.1 The gates shall be operated through two complete open/close cycles to the satisfaction of the Engineer.

.2 If leakage exceeds the required criteria modifications shall be undertaken to correct the defect to the satisfaction of the Engineer. All costs associated with repairs shall be borne by the Contractor.

END OF SECTION

STOP PLATE

PART 1 GENERAL

1.1 WORK OF THIS SECTION

.1 The contractor shall furnish all labor, materials, equipment and incidentals required to install, ready for operation and field test stainless steel gates and appurtenances as shown on the Gate Schedule and/or Contract Drawings and as specified herein.

.2 The equipment provided under this section shall be fabricated to repeatable quality build norms, assembled, factory stroke and leak tested with signed and dated results. It shall be erected, and placed in proper operating condition in full conformity with the drawings, specifications, engineering data, instructions and recommendations of the equipment manufacturer.

.3 Gates and operators shall be supplied by the gate manufacturer with all the necessary parts and accessories indicated on the drawings, specified or otherwise required for a complete, properly operating installation, and shall be the latest standard product of a manufacturer regularly engaged in the production of fabricated gates.

.4 Except as modified or supplemented herein, all gates and operators shall conform to the applicable requirements of AWWA C561, latest edition.

1.2 QUALITY ASSURANCE

.1 All of the equipment specified under this Section shall be furnished by a single manufacturer with a minimum of 25 years' experience designing and manufacturing water control gates in North America. The manufacturer shall show evidence of satisfactory operation in at least 100 installations.

.2 The manufacturer's shop welds, welding procedures and welders shall be qualified and certified in accordance with the requirement of the latest edition of ASME, Section IX. Welders' certifications and procedures shall be made available for review and acceptance. Failure of conformity will be grounds for rejection.

.3 All wall mounted gates shall be shop tested in accordance with AWWA C561 Section 5.2.1, at the manufacturer's factory prior to shipment for both leakage and proper operation. Shop testing shall confirm compliance with the minimized leakage rate as specified in Section 2.01 of this specification. Signed and dated compliance by the manufacturer or approved reputable independent third party agent shall be provided. The owner or its authorized agents reserve the right to witness the leakage tests and shall do so at their discretion.

.4 The torque required to obtain the low leakage sealing shall not cause the actuator to lose its safety factor or overheat.

.5 Gates supplied under this section shall be a Series 29 Stainless Steel Stop Plate as manufactured by Fontaine-Aquanox or approved equivalent.

1.3 SUBMITTALS

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

.2 The manufacturer shall submit the following drawings and data for approval by the purchaser.

.1 Certified general arrangement drawings in metric units, showing principal dimensions, details of construction, materials list, and details required for installation and operation.

.2 Manufacturer shall demonstrate longevity of design and provide testing results for a 25,000 abrasive media accelerated life cycle test demonstrating leakage rates are still 50% below allowable AWWA C561 leakage rates.

.3 Manufacturer shall demonstrate repeatable quality design at time of manufacture. They shall provide historical test results of 1000 gates within the last twelve months to demonstrate that no less than 85% of all gates meet a leakage of rate less than 25% (0.025 gallon per minute per foot (0.30 l/min per meter)) of the allowable AWWA C561 leakage rate of sealing perimeter for gates less than 20 ft head.

.4 Signed factory validation that all gate frame materials and supports are no less than ¼ inch in width.

.5 The manufacturer shall demonstrate the sturdiness of the gate and shall provide design calculations confirming stress and deflection of the slide, yoke, and stem. Provide a design validation, stamped by a Professional Engineer licensed to practice in Ontario, that the slide shall consist of a flat plate reinforced with formed plates or structural members to limit its deflection to 1/720 of the gate's span under the design head.

PART 2 PRODUCTS

2.1 GENERAL DESIGN

.1 Gates shall be non self-contained of a single piece plate/stem and handle, as indicated on the Contract drawings and / or Gate Schedule.

.2 The stop plate shall be substantially watertight under the design head conditions. Without exception, under the design seating and unseating head, the leakage shall not exceed 0.05 U.S. gallon per minute per foot (0.60 l/min per meter) of seating perimeter. Modifications, if made, shall not affect the lift input requirements of the gate or the provided safety factor of the actuator.

.3 The sluice gates shall be designed to minimally withstand the design head shown in the schedule.

.4 The gate shall utilize maintenance free self-adjusting seals.

.5 All structural components of the frame and slide shall be fabricated of stainless steel having a minimum thickness of 1/4-inch (6.4 mm) and shall have adequate strength to prevent distortion during normal handling, during installation and while in service.

.6 Welds shall be sandblasted to remove weld burn and scale. Gates shall be thoroughly cleaned to remove any contamination prior to shipment. All iron and steel components shall be properly prepared and shop coated with a primer.

2.2 FRAME

.1 The frame shall be made of wrought stainless steel of the specified commercial grade or from commercially available structural shapes. The minimum material thickness of all members except seal retainers shall be ¼- inch. (6.4 mm) without exception. Gates with thinner materials shall be rejected. The owner reserves the right to field validate.

.1 The gate frame shall be constructed of structural members or formed plate welded to form a rigid one-piece frame. The frame shall be of the flange back design suitable for mounting on a concrete wall (CW) in front of the by-pass pipe. The guide slot shall be made of UHMWPE (ultra-high molecular weight polyethylene). Mounting style shall be as shown on the gate schedule and/or contract drawings.

.2 All wall mounted and thimble mounted gates shall be of the more robust flanged back design frame. Flat back design frames are not acceptable.

.3 All wall mounted gates shall mount with a ½" (12mm) thick resilient gasket between the gate frame and the concrete wall. The gasket shall be manufacturer supplied. The gasket shall seal the gate frame to the wall without issue with up to a 0.5 inches vertical deviation. Mounting with grout pads will not be acceptable

.4 A rigid stainless steel invert member shall be provided across the bottom of the opening. The invert member shall be of the flush bottom type on upward opening gates.

2.3 SLIDE

.1 The slide and reinforcing stiffeners shall be constructed of stainless steel plate. All structural components shall have a minimum thickness of 1/4-inch (6.4 mm)

.1 The slide shall be designed for the minimum safety factor of 4 with regard to ultimate tensile, compressive, and shear strength, and a minimum safety factor of 2 with regard to the tensile, compressive, and shear yield strength. The slide shall consist of a flat plate reinforced with formed plates or

structural members to limit its deflection to 1/720 of the gate's span under the design head.

2.4 GUIDES AND SEALS

.1 All gates shall be provided with maintenance free, self-adjusting seal system utilizing UHMWPE seals and resilient compression cord to restrict leakage without affecting the lift loads and shall be in accordance with the requirements listed in this specification.

.1 The self-adjusting seals shall be designed with a continuous compression cord to ensure contact between the UHMWPE guide and the gate in all positions.

.1 The sealing system shall maintain efficient sealing in any position of the slide and allow the water to flow only in the opened part of the gate.

.2 The guides shall be made of new virgin UHMWPE (ultra-high molecular weight polyethylene) to assure its correct mechanical properties and chemical resistance. The guide shall restrict leakage, prevent metal-to-metal contact between the frame and the slide, and provide long-term maintenance free operation. UHMWPE guides shall not be compressed by the retaining bolt to make a seal against the slide. Guides shall be self adjusting.

.3 The guides/seals shall extend to accommodate minimum 1-2/3 x the height of the slide.

.4 The top seal shall be the self-adjusting type, utilizing a cup shaped UHMWPE seal with twin contact surfaces and compression cord. The cup shaped seal with twin contact surfaces shall be designed with the outer seal acting as a wiper to remove debris from the slide when raising the gate thereby protecting the primary seal.

.5 All upward opening gates shall be provided with a resilient seal made of neoprene set into the bottom frame member to seal the bottom portion of the gate and form a flush-bottom. Gates designed with bottom seals attached to the slide shall not be acceptable.

.6 All downward opening gates shall be provided with self-adjusting type seals, utilizing a cup shaped UHMWPE seal with twin contact surfaces and compression cord. The cup shaped seal with twin contact surfaces shall be designed with the outer seal acting as a wiper to remove debris from the slide when raising the gate thereby protecting the primary seal.

.7 All UHMWPE seals must be bolted or otherwise mechanically fastened to the frame. Retaining bolts shall not act as a compression seal of the UHMWPE.

.8 As gates seals are susceptible to UV and chemical attack and degradation and premature replacement is undesirable, Gates that utilize rubber “J” seals or “P” seals are not acceptable.

2.5 LIFTING MECHANISM

.1 Manual operators of the types listed in the schedule or shown on the contract drawings shall be provided by the gate manufacturer.

.1 Operation. The gate is a manual stop plate. The stem shall consist of a stainless steel rod with handle built at the top for operator access at the operating floor elevation.

2.6 ANCHOR BOLTS

.1 Anchor bolts shall be provided by the contractor for mounting the gates and appurtenances.

.1 Quantity and location shall be determined by the gate manufacturer.

.2 If epoxy type anchor bolts are provided, the gate manufacturer shall provide the studs and nuts. Newly acquired, non-expired epoxy shall be used.

.3 Gate frame anchor bolts shall have a minimum diameter of 1/2-inch (12 mm)

2.7 MATERIALS

PART	MATERIAL
Frame, yoke, stem guides, slide, stem extension	Stainless steel ASTM A-240 type 304L
Side seals, stem guide liner	Ultra high molecular weight polyethylene (UHMWPE) ASTM D-4020
Compression cord	Nitrile ASTM D2000 M6BG 708, A14, B14, E014, E034
Bottom seal	Neoprene ASTM D2000 Grade 2 BC 510
Fasteners	ASTM F593 and F594 GR1 for type 304 and GR2 for type 316
Gasket (between frame and wall)	EPDM ASTM 1056

2.8 GATE SCHEDULE

.1 Refer to Gate Schedule located on Contract Drawing P0410.

PART 3 EXECUTION

3.1 INSTALLATION

.1 Gates and appurtenances shall be handled and installed in accordance with the manufacturer's recommendations.

.2 Manufacturer shall furnish an authorized service technician to inspect and verify proper installation, assist with field testing, startup and commissioning. The minimum number of days/trips shall be one day.

.3 All bolts shall be tightened and all items requiring lubrication shall be lubricated. Anti seize thread lubricant shall be liberally applied to the threaded portion of stainless steel anchor bolts during installation and tightening of nuts. Excess lubricant shall be thoroughly removed following final tightening.

3.2 INSTALLATION AND COMMISSIONING

.1 Installation shall comply with the manufacturer’s installation instruction, Section 44 00 00, and this section.

.2 Following the completion of each gate installation, the gates shall be operated through at least two complete open/close cycles, readjusted and reoperated as necessary, and left in a condition acceptable to the Engineer. If an electric or hydraulic operator is used, limit switches shall be adjusted following the manufacturer's instructions.

.3 Gates should be checked for leakage by the contractor (refer to section 2.01 “General Design” for approval criteria).

.4 An experienced, competent, and authorized representative of the stop plates manufacturer shall visit the site of the Work and inspect, check, adjust if necessary, and approve the equipment installation. In each case, the manufacturer's representative shall be present when the equipment is Field Leakage Tested in accordance with standard industry procedure. The manufacturer's representative shall revisit the jobsite as often as necessary until all trouble is corrected and the equipment installation and operation are satisfactory in the opinion of Engineer.

.5 Each manufacturer's representative shall furnish to Owner, through Engineer, a written report certifying that the equipment has been properly installed; is in accurate alignment; is free from any undue stress imposed by connecting hardware; and has been operated under full load conditions and that it operated satisfactorily.

.6 All costs for these services shall be included in the Contract Price.

END OF SECTION

INSULATION OF PROCESS PIPING

PART 1 GENERAL

1.1 SUMMARY

.1 This section includes providing pipe and equipment insulation for cold and hot piping, exhausts, flues, and equipment, to prevent heat loss or heat gain and injury to personnel upon contact.

1.2 RELATED SECTIONS

.1 The following Sections applies to the work of this Section. Other Sections of the Specifications, not referenced below, shall also apply to the extent required for proper performance of the scope listed herein.

.1 Divisions 09, 22 and 44

1.3 CODES, SPECIFICATIONS AND STANDARDS

.1 This section shall comply with the current editions of the following codes:

.1 National Building Code
.2 ASTM E84
.3 CAN/ULC S102
.4 MIL-I-24244C, Thermal Insulation Materials (corrosion inhibition and chloride requirements)
.5 ASTM C547 (Class 3), (Preformed Pipe Insulation)
.6 ASTM C592 (Class II) (Metal Mesh Covered Blanket Insulation)
.7 ASTM B 209 Aluminum and Aluminum Alloy Sheet and Plate
.8 ASTM C 533 Calcium Silicate Block and Pipe Thermal Insulation

1.4 SUBMITTALS

.1 Shop Drawings:

.1 The following shall be submitted in compliance with Section 01 33 00:
.2 Shop drawings of all thermal insulation, with manufacturer's data on materials, covering, jackets, and finish.

1.5 QUALIFICATIONS

.1 Installer: Authorized installer of manufacturer.

PART 2 PRODUCTS

2.1 GENERAL

.1 The contractor shall insulate all indicated surfaces.

.2 All components of the insulation, including covering, mastics and adhesives shall have a flame-spread rating of less than 25, and a smoke development rating of no greater than 50. Ratings shall be as established by tests in accordance with ASTM E 84 standards. The integrated insulation assemblies shall also conform to the above specifications. Insulation shall be applied in strict accordance with the manufacturer's instructions.

.3 Adhesive insulation materials and recovery jackets: composite fire and smoke hazard ratings shall not exceed 25 for flame spread and 50 for smoke developed. Adhesives shall be waterproof.

.4 Where heat tracing is required, the pipe shall be insulated with a complete integral conduit for the electric heat trace cable.

2.2 BASIC MATERIALS

.1 Heat tracing cable: The cable shall produce constant, predictable wattage per meter output without inrush currents. Metallic ground braiding is required for all heat tracing cable.

.2 The insulation system shall be capable of handling service temperatures from –45°C to 94 °C (In service).

.3 Where odorous air, water, sludge or chemical piping is located outside the building, but above the freezing depth (1.5m), the piping shall be insulated and heat traced as specified herein.

.4 Insulation Types:

.1 Fiberglass Pipe Insulation:

.1 Shall be applied to the hot water supply and return piping for the digester operation. The hot water operating temperature is in the range of 60°C to 100°C.

.2 Hot surface performance tested to 454°C in accordance with ASTM C411.

.3 A sufficient thickness shall be used to keep maximum surface temperature of pipe insulation below 60°C.

.4 Specification Compliance:

.1 ASTM C547 – Standard Specifications for Mineral Pipe Insulation

.2 ASTM C795, MIL-1-24244C, NRC 1.36

.3 National Fire Protection Association; NFPA 90A & 90B

.4 CGSB 51-GP.9M

.5 Fire Hazard Classification; UL 723, CAN/ULC-S102-M88, ASTM E84, NFPA 255

.5 Product Features:

.1 Water Vapour Absorption (ASTM C553): Less than 0.5% by weight

.2 Alkalinity and pH (CGSB-51-9M): Maximum alkalinity 0.5% (Na2O), pH maximum 10.0

.3 Bacteria Fungi Resistance (ASTM 665): Does not promote growth

.4 Hot Surface Performance: ASTM C411 – rated to 454°C (850°F)

.5 Linear Shrinkage (ASTM C356): Less than 2%

.6 Acceptable Fiberglass Pipe Insulation Systems:

.1 Manson Insulation, Owens Corning Canada, Johns Manville, or Agency Approved Equal

.2 Polyurethane Foam Sheet:

.1 Thermal conductivity shall not exceed 0.019 W/mK when the foam is new and cured. This value shall be based on a mean temperature of 25°C as determined in accordance with ASTM C518.

.2 Closed Cell Content 90-95% in conformance with MIL-I-24172 and ASTM C-591 completely filling the annular space between carrier pipe and jacketing.

.3 Density: 32 kg/m3 (2 pound/ft3)

.4 Hardness: 30 – 90

.5 Acceptable Suppliers:

.1 ITW Insulation Systems, Dow, or Agency Approved Equal

.3 Premolded Mineral Fiber:

.1 Rigid, sectional, sleeve type insulation with thermal conductivity (k-value) no less than 0.042 W/m°C (0.29 Btu-in./(hr·ft2·°F) forms with thermosetting binder suitable for a temperature range of 0°F to 850°F [-18°C to 454°C], and shall be provided in multiple layers. Fittings and valves shall be insulated with factory-made molded fiber fittings or built-up sections of pipe covering. The insulation shall conform to ASTM C547.

.2 Temperature Rating: 0°F to 850°F [-18°C to 454°C],

.3 Supply factory applied All Service Jacket (ASJ) vapour retarder jacket with Self-Sealing Lap (SSL) closure system

.4 Acceptable Supplier:

.1 Johns-Manville Inc., “Micro-Lok HP”

.2 Knauf Insulation GmbH, “Glass Mineral Wool”

.3 Manson Insulation Inc., “Alley K”,

.4 Owens-Corning or Agency Approved Equal

.5 PVC Jacketing:

.1 High-impact, seamless Polyvinylchloride (PVC)

.2 Class 12454-B compound conforming to ASTM

.3 1784, Type 1, Grade 1

.4 Acceptable Supplier:

.1 ITW Insulation Systems, DOW, or Agency Approved Equal

.6 Aluminum Jacket: [ASTM B209MASTM B209]:

.1 Aluminum Roll Jacketing: For straight run piping, wrought aluminum Alloy 3003, 5005, 1100, or 3105 to ASTM B209 with H-14 temper, minimum 0.4 mm thickness, with smooth mill finish. For air piping, the aluminum jacket shall have a nominal thickness of 0.6mm with an embossed finish.

.2 Fittings in insulated piping systems and equipment where indicated in the insulation schedule shall be provided with aluminum jackets of the same aluminum jacketing material as the piping systems. The jacket shall have a factory-applied moisture retarder of at least 3 mils [76 µm] permanently bonded to the interior surface and extending the full width of the jacket. The retarder shall consist of Polysurlyn or polyethylene film and kraft paper.

.3 Vapour Barrier: Provide factory applied vapour barrier, consisting of kraft paper with 1 mil thick low density polyethylene film, heat and pressure bonded to the inner surface of the aluminum jacketing.

.4 Fitting Covers: Material as for aluminum roll jacketing, premolded, one or two piece covers, which includes elbows, tee/valves, end caps, mechanical line couplings, specialty fittings, etc.

.5 Manufacturers and Products:

.1 RPR Products Inc; Insul-Mate, ITW Insulation Systems Canada Inc.- Childers., Industrial Insulation Group, LLC - Pabco., or Agency Approved Equal

PART 3 EXECUTION

3.1 PREPARATION

.1 Do not install covering before piping and equipment has been tested and approved.

.2 Ensure surface is clean, free of dirt, and dry prior to installation. Ensure insulation is dry before and during application. Finish with systems at operating conditions. To ensure a cohesive bond of foam on pipe surfaces, sandblast of apply chemical foam bonding compound if necessary.

3.2 INSULATION REQUIREMENTS SCHEDULE

.1 Piping Insulation Requirements

Service Type	Pipe Legend	Insulation Thickness	Temperature to be Maintained	Insulation	Heat Tracing	Finishing
Process and Channel Mixing Air (Blowers' suction and discharge piping within Buildings)	AA	50mm (Indoor)	10 to 50 ºC	Premolded Mineral Fiber	-	Aluminum
Potable Water & Non-Potable Water	SW, PW, NPW, HW	25mm (Indoor) & 50mm (Outdoor)	Anti-sweat (Indoor) & Above 0°C (Outdoor)	Polyurethane	3ºC Above Frostline	PVC (Indoor)
Rain Water Leader (Indoor)	RWL	25mm	Anti-sweat	Polyurethane		PVC
Sludge & Supernatant, (Outdoor, Above Frostline)		50mm	10 to 15 ºC	Fiberglass Pipe Insulation	Yes	Aluminum
Post Equalization Overflow/Bypass Pipe (Outdoor, Above Frostline)		50mm	10 to 15 ºC	Fiberglass Pipe Insulation	Yes	Aluminum

3.3 INSTALLATION

.1 General

.1 All insulation shall be installed by a qualified insulation contractor in strict accordance with the manufacturer's recommendations.

.2 Install in accordance with the manufacturer's instructions and as specified herein.

.3 Install insulation after the piping system has been pressure tested and leaks corrected.

.4 Apply insulation over clean finish painted and dry surfaces.

.5 Do not allow insulation to cover nameplates or code inspection stamps.

.6 Run insulation continuously through pipe hangers and supports, wall openings, ceiling openings, and pipe sleeves, unless otherwise shown on the Drawings.

.7 Install removable insulation sections on devices that require access for maintenance of equipment or removal, such as unions and strainer end plates.

.8 Use insulating cements, lagging adhesives, and weatherproof mastics recommended by the insulation manufacturer. All work shall be performed within the temperature ranges recommended by the insulation product

manufacturer. Insulation shall be kept clean and dry and shall remain in the factory container until it is installed. Packages or factory containers shall bear the manufacturer's stamp or label with the name of the manufacturer and description of materials.

.9 Seams of exposed insulation and jackets shall be in the least visible location.

.10 The insulation shall be installed in layers to obtain the specified thickness. Joints and seams between insulation sections or segments shall be tight and shall be staggered between layers. The insulation shall be fastened with stainless steel wire loops on 6 inch [150 mm] centers embedded into the outer layer. All cracks, voids, and depressions shall be filled with insulating cement suitable for the system operating temperatures. The surfaces to receive outer coverings shall be smooth and uniform. Flanges and expansion joints in exhaust piping shall not be insulated

.2 Connection to Existing Piping:

.1 Cut back existing insulation to remove the portion damaged by piping revisions. Install new insulation.

.3 Cold Surfaces:

.1 Provide continuous vapour seal on insulation on cold surfaces where vapour barrier jackets are used.

.4 Placement:

.1 Slip insulation on pipe or tubing before assembly, when practical, to avoid longitudinal seams.

.2 Insulate valves and fittings with sleeved or cut pieces of same material.

.3 Seal and tape joints.

.4 Insulation at Hangers and Supports: Install under piping, centered at each hanger or support.

.5 Heat Traced Piping:

.1 Apply insulation after heat-tracing Work is completed and approved.

.6 Vapour Barrier:

.1 Provide continuous vapour barrier at joints between rigid insulation and pipe insulation.

.2 Install vapour barrier jackets with pipe hangers and supports outside jacket.

.3 Do not use staples and screws to secure vapour sealed system components.

.7 Aluminum Jacket:

.1 Use a continuous friction type joint to hold jacket in place, providing a positive weatherproof seal over the entire length of the jacket. Jacketing shall be held in place with stainless steel securing bands uniformly spaced

at not more than 18 inches [457 mm] to produce tight joints without "bulging". The jacket shall overlap at least 2 inches [51 mm] at longitudinal and circumferential joints. Joints shall be overlapped and sealed with caulk to prevent moisture penetration, and longitudinal joints shall be placed to shed water. Exposed ends of pipe insulation shall be provided with covers constructed of the same material as the jacketing.

.2 Secure circumferential joints with preformed snap straps containing weatherproof sealant.

.3 On exterior piping, apply a coating over the insulation and vapour barrier to prevent damage when aluminum fitting covers are installed.

.4 Do not use screws or rivets to fasten the fitting covers.

.5 Install removable, prefabricated aluminum covers on exterior flanges and unions.

.6 Caulk and seal all exterior joints to make watertight.

.7 Elbows shall be jacketed with spirally wrapped aluminum strips or individual mitered segments or gores cut to fit the insulation.

.8 PVC Jacketing:

.1 Overlap jacketing a minimum of 50 mm. Seal and band longitudinal and circumferential joints and seams with sealing compound and pre-formed aluminum or stainless steel straps and fasteners.

.2 Make special provision, according to the manufacturer’s instructions, to allow for uniform expansion on jacket to avoid joint opening on piping with a 50 mm or greater layer of insulation.

.3 Provide removable sections at inspection openings, arranged to allow removal and replacement without cutting cover or retaining system.

.4 Design covers for flanges, fittings and expansion pieces with a hinged locking arrangement to for allow removal and replacement without cutting cover or retaining system.

3.4 FIELD FINISHING

.1 Apply a coating of insulating cement where needed to obtain a smooth and continuous appearance.

.2 Where pipe labels or banding are specified for a piping system they shall be applied to the finished insulation and not to the pipe.

END OF SECTION

PROCESS PIPING

PART 1 GENERAL

1.1 SUMMARY

.1 This section includes design, supply, fabrication, installation, testing, cleaning and placing into operation process piping systems including couplings, connections, expansion pieces, ancillary systems, and fittings.

1.2 GENERAL CLAUSES

.1 Comply with Division 01.

.2 Unless there are more restrictive requirements in respective Sections, provisions of this Section apply.

.3 Ensure that control panels and/or components provided as part of packaged equipment conform to requirements of the Specifications, Division 25 through 28 and Drawings.

.4 For control and electrical elements, use this Section in conjunction with the Drawings for conformance to style, quality, and product demonstrated and selected. Provide instrumentation and control devices as detailed in the Specifications and shown on the Drawings, including the Electrical Divisions 25 through 28.

.5 All equipment and controls to be CSA compliant and identified as such.

.6 Comply with laws, ordinances, rules, regulations, codes, and orders of authorities having jurisdiction relating to work.

.7 It is the Contractor's responsibility to ascertain from each Supplier the extent of work required for the complete installation of each piece of equipment, and to ensure that each Supplier has full knowledge of the required duty of the equipment to be installed.

.8 Be fully acquainted with all work under this Contract. At no time will any claim be considered due to misunderstanding of the work involved.

.9 Immediately upon receipt of the Start Work Order, issue a Purchase Order or Sub-Contract for designated equipment. Submit a copy of the Purchase Order or agreement to the Contact Administrator. Failure to order equipment in a timely fashion will not be considered as a reason to extend the Contract schedule.

1.3 SYSTEM DESCRIPTION

.1 It is the intent of all Sections of these Specifications to specify a complete and operating system that will perform its intended function(s). All devices, fittings,

valves and other appurtenances required to perform this function shall be considered as part of the Specifications, even if not explicitly identified.

.2 Design requirements:

.1 Provide heavy-duty mechanical equipment designed for continuous operation.

.2 Maximum vibration velocity (measured at equipment bearings): 1 mm/s.

.3 Co-ordination requirements:

.1 Equipment, such as pressure switches, may be shown on Process, Mechanical and/or Instrumentation Drawings. They may also be shown on Electrical Drawings due to wiring requirements. Provide these devices under Division 25, 26, and 44, respectively. Equipment and devices are wired according to the Electrical Drawings and Specifications.

.2 Coordinate requirements of equipment supplied with piping, structural supports, ventilation/cooling, electrical service, instrumentation and control interface, and other ancillaries specified in other Divisions.

1.4 REFERENCES

.1 American Society of Mechanical Engineers/American National Standards Institute:

.1 ASME Boiler and Pressure Vessel Code - Section VIII: Division 1.

.2 ASME B31.1 - Power Piping.

.3 ASME B31.9 - Building Services Piping.

.4 ASME/ANSI B16.1- Gray Iron Pipe Flanges and Flanged Fittings: Classes 25,125, and 250.

.5 ASME/ ANSI B16.5- Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24 Metric/Inch Standard.

.6 ASME B31.1 and B31.3 - Power Piping and Process Piping SET (B31.1-2007 Including 2008 and 2009 Addenda, B31.3-2008).

.7 ASME B32.1 - Metal Products.

.8 ANSI S1.13 - American National Standard Methods for the Measurement of Sound Pressure Levels In Air.

.2 Anti-Friction Bearing Manufacturers Association (AFBMA)

.3 ASTM International.

.1 ASTM A194 - Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both.

.2 ASTM C411- Standard Test Method for Hot-Surface Performance of

.3 High-Temperature Thermal Insulation.

.4 ASTM C335- Standard Test Method for Steady-State Heat Transfer Properties of Pipe Insulation.

.4 Canadian General Standards Board:

.1 CGSB 51-GP-52 MA-Vapour Barrier Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.

.5 Canadian Standards Association:

.1 CSA S244 - Welded Aluminum Design and workmanship (Inert Gas Shielded Arc Processes).

.2 CSA W47.1 - Certification of Companies for Fusion Welding of Steel Structures.

.3 CSA W47.22-M - Certification of Companies for Fusion Welding of Aluminum.

.4 CSA W59-M - Welded Steel Construction (Metal Arch Welding).

.5 Safety in Welding, Cutting and Allied Processes to be in accordance with CAN/CSA-W117.2.

.6 CSA Z107.56- Procedures for the Measurement of Occupational Noise Exposure.

.7 ANSI/CSA B149.6-15 Code for Digester Gas, Landfill Gas and Biogas Generation and Utilization Published 2015, as amended.

.8 ASTM A403, Wrought Austenitic Stainless Steel Piping Fittings.

.9 ASTM A312, Seamless and Welded Austenitic Stainless Steel Pipes.

.6 Manufacturer's Standardization Society

.1 MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation

.2 MSS SP-69 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation.

.7 Ontario Building Code

.8 Ontario Boilers and Pressure Vessels Act

.9 Standards Council of Canada/Compressed Gas Association

.1 CAN/CGA B149.6 - 15 Code for Digester Gas and Landfill Gas Installations (as amended).

.10 Technical Standards and Safety Authority (TSSA)

.1 TSSA Digester, Landfill & Biogas Approval Code TSSA-DLB-2016, as amended.

.2 TSSA, Pressure Vessels Branch.

1.5 CERTIFICATES

.1 Welding qualifications and procedures to be in accordance with CSA B51, TSSA, B31.1 and Section IX of the ASME Boiler and Pressure Vessels Code.

.2 Use qualified and licensed welders possessing Ontario certificates (TSSA) for each procedure to be performed.

.3 Each Welder will provide qualifications to Contract Administration including identification stamp issued by TSSA as well as provide welding procedures for review.

1.6 SUBMITTALS

.1 Shop Drawings:

.1 Submit shop drawings in accordance with Section 44 00 10 – Process General Requirements and Section 01 33 00 – Submittals.

.2 Piping systems, which transport fluids in excess of 35 degrees C, require plans and sectional views, or single line dimensioned isometrics, identifying movements due to thermal expansion and contraction. Locations of the expansion pieces, guides, and anchors, sway braces shall be identified. The resultant movements due to these thermal expansions and contractions shall be shown on the Shop Drawings.

.3 Provide details of expansion pieces including list of materials.

.4 Valve schedule and identification list.

.5 Sectional details of drains, traps, valves and valve operators including list of materials and current ANSI pressure-temperature ratings for valve bodies, seats and stem seals.

.6 Provide general layout of equipment including anchor bolt locations, direction of rotation for rotating equipment and electric motor terminal box locations.

.7 Cross-sectional details of equipment with complete materials test.

.8 For pumps, certified, non-witnessed characteristic curves of capacity versus head; efficiency; net positive suction head and power expressed in kilowatts.

.9 For fans and blowers at rated rpm and 110 percent of rated rpm, certified, non-witnessed characteristic curves of capacity versus static pressure (discharge pressure); efficiency and power expressed in kilowatts, noise and noise levels on the A weighted scale.

.10 Dimensional drawings of motors and details including full output power expressed in kilowatts, rpm and slip, motor nameplate details and motor test data where required.

.11 Instrument details.

.12 Control panel layouts.

.13 Electrical control schematics and loop diagram.

.2 Test Reports and Certificates

.1 Certified shop mechanical test run results for fans 10 m^3/s and larger or 37 kW and larger.

.2 Certified shop test results for pumps.

.3 Certified shop tests for electric motors.

.4 Manufacturer's representative signed report.

.5 Field test reports for piping systems.

.6 TSSA Inspection Report indicating conformance with CGA B105.

1.7 QUALITY ASSURANCE

.1 Welding procedure for stainless steel:

.1 All piping shall be subject to the visual examination requirements of the ASME/ANSI Code B31.1 and B31.3. A minimum sample of 5% of all welds shall be non-destructively examined as per requirements of ASME/ANSI B31.3 Normal Fluid Service. Non-destructive testing shall be paid for by the contractor.

.1 Should any weld fail the visual examination, the Contractor will be responsible to perform additional non-destructive radiographic testing up to an additional 10% of the piping system as selected by the Contract Administrator.

.2 Should any weld fail the radiographic testing, all welds made by the responsible welder will be tested at the expense of the contractor.

.2 The Contractor Administrator may, at their expense, test any weld completed on the project in addition to the welds tested as part of the contract requirements identified in this section. The contactor will be responsible to repair any failed weld and piping replacement depending on the extent and ability to make a satisfactory repair as determined by the Contract Administrator.

.3 Testing (to be completed in accordance with this section Part 3 - Execution):

.1 Give 24 hours written notice of date of tests.

.2 Insulate and/or conceal work only after testing is satisfactorily completed and witnessed.

.3 Conduct all tests in the presence of the Contract Administrator.

.4 Bear all costs of testing including retesting and correcting any deficiencies.

.5 Maintain test pressures for at least 4 hours unless otherwise specified.

.6 Leakage from pipes will be zero. No loss of pressure will be accepted.

.7 If leaks are detected in the pipe or any of the appurtenances connected thereto, make any necessary repairs and retest.

.8 Provide test equipment as required to complete testing per ANSI/ASTM B31.1 and B31.3.

.9 Prior to tests, isolate all equipment or other parts, which are not designed to withstand test pressures.

.10 Contractor shall document each individual test, including: test pressure, temperature, duration, date and time of day, test fluid, and signatures of Contract Administrator and Contractor's

representatives who witnessed the test, identification of piping system tested. Contractor shall provide a test plan and schedule to Engineer at start of work. The format of these records shall be approved by the Contract Administrator prior to the commencement of any field pressure testing.

1.8 PRODUCT DELIVERY, STORAGE AND HANDLING

.1 All materials and products shall be managed in accordance with the Process General Requirements (Section 44 00 10).

PART 2 PRODUCTS

2.1 GENERAL

.1 Refer to Drawings for piping systems specified in this Section.

.2 Pipe sizes shown are nominal sizes in mm. Actual pipe dimensions are in accordance with commercially available products, unless otherwise specified.

.3 Provide new pipe materials free from defects conforming to specified reference standard.

.4 Comply with new reference standard superseding specified standard.

.5 Supply the equipment complete in all respects including all other accessories and auxiliaries necessary to provide for a satisfactory installation.

.6 Where equipment is supplied with larger or smaller power requirements than that shown coordinate with the electrical requirements of Division 25 - 28 to ensure compatibility with electrical and control components so that a complete working system is in place without extra cost to the Contract.

.7 It is the Contractor’s responsibility to confirm the Electrical Rating and Area Classification required for all equipment installed within Division 44. The electrical rating shall be as per NFPA 820.

.8 All external piping and electrical connections to this equipment, and all concrete and foundation bases (excluding grouting and shimming) will be done under the respective Sections for such work.

.9 Install drains on bottom of horizontal pipe at low points in the piping system, drawings may not indicate all required drain points.

.10 Check dimensions associated with existing structures, equipment and piping in the field before fabrication and installation are started.

.11 Contractor shall coordinate with the operating authority for any tie-ins, shut-downs or other existing process interruptions required to carry out work.

.12 All piping materials, valves and appurtenances located within 2.0 meters of the top water level of all process tanks, vessels or reactors shall be fabricated in stainless steel.

.13 All piping materials and appurtenances including couplings (flanges, mechanical grooved end couplings, bolting, nuts, etc.) supports, valves and valve actuators submerged in liquids shall be stainless steel.

.14 The process drawings may not present all required couplings and expansion joints. The Contractor or coupling Supplier shall review the entire pipeline and configurations with pipe supports and submit their review for the Engineer's approval. As per the pipe stress analysis or coupling Supplier's recommendations, the pipe support locations and coupling/expansion joint type may be changed, but no extra cost to the Owner shall be permitted. unless additional couplings, expansion joints and supports are required ten (10) percent more than them shown on the process drawings. The process drawings, unless otherwise specified, do not present any required rigid coupling, but flexible couplings only.

.15 The Contractor shall provide the detailed piping layouts, sections and calculation sheets as the shop drawings stamped by professional engineer who shall coordinate the coupling installation with the coupling manufacturer. Present the fixed and sliding support locations with couplings on the layout for the Engineer's review.

.16 Provide one (1) flexible coupling at every 90-degree bends to allow for deflection.

.17 Provide flexible couplings where deflection would occur and one (1) rigid coupling within 1.0m from each valve and flanged instrument for maintenance.

.18 Maximum temperature variation of process and channel mixing air pipe from blower/compressor shall be 140°C (-30°C to 110°C) to calculate the maximum expansion/contraction in the pipeline considering 107°C± of blower discharge temperature. Assume that the temperature during the pipeline installation would be 0°C.

.19 One (1) pipe expansion joint shall be installed above structural expansion joint. Assume that there would be one (1) structural expansion joint every 20 m if the structural expansion joints are not shown on the process drawings with existing structures.

.20 Provide two (2) supports at both sides of a thermal expansion /contraction joint with 1.0 m spacing from the joint.

.21 Maximum temperature variation of water and sludge piping shall be in the range of 0°C to 10°C to calculate the maximum expansion/contraction in the pipeline.

2.2 TYPE 304 L STAINLESS STEEL (304SS)

.1 General

.1 ANSI/ASTM Rating: Class 150 FF

.2 Service Limits:

.1 1050 kPa at a temperature range of -40°C to 40°C.

.2 750 kPa at a temperature of 50°C

.2 Pipe

.1 Tubing: 6 to 12mm, Seamless stainless steel tube to A269 Grade TP 304.

.2 Size: 12 to 50 mm, TP 304L Schedule 40s with PE, fully annealed hydraulic tubing, electric fusion welded stainless steel, A312 TP 304L, Joint Eff. 0.80. Dimensions conforming to ANSI B36.19.

.3 Size: 65 to 600 mm, TP 304L Schedule 10s with BE, Electric fusion welded stainless steel, A312 TP 304L, Joint Eff. 0.80, with dimensions conforming to ANSI B36.19.

.4 All pipe shall be pickled and passivated as per ASTM 380.

.3 Nipple

.1 Size: 12 to 50 mm, TP304L Seamless stainless steel to A312 in 50, 80 and 100 mm lengths with ends as required. Use Schedule 80s for all threaded nipples, wall schedule to match pipe schedule for all plain and beveled end nipples.

.4 Swages

.1 Size: 19 to 150 mm, TP304L Seamless stainless steel to A3012. Use Schedule 80s for all threaded swages. Wall schedule to match pipe schedule for all plain and beveled end swages.

.5 Flanges (Welded)

.1 Size: 12 to 19 mm, TP 304L 150# Raised Faced socket welded stainless steel flanges to A182 Grade F304L.

.2 Size: 25 to 600 mm, TP 304L 150# Flat Faced stainless steel Lap joints, galvanized carbon steel A105 (unless located in a submerged or within 2m of the TWL location in which case the use of SS304L Lap joint is required), for use with stub ends.

.3 Stub Ends: 25 to 600 mm, Schedule 10s with beveled end, Lap-stubs, MSS Type A Short, A403 Gr. WP 304L.

.6 Flanges (Grooved)

.1 Size: 12 to 600 mm, TP 304L 150# Raised Faced stainless steel blind flanges to A182 Grade F304L.

.2 Size: 65 to 600 mm, Grooved-end to Flange adapter to accommodate proposed bolt hole pattern (ANSI B16.1 Cl. 125) to be Ductile Iron, or

Stainless steel if installed in submerged condition or within 2.0m of water level.

.7 Couplings

.1 Stainless Steel: Sizes 65 to 600 mm, grooved end cast type 304 stainless steel housing with EPDM gasket (Water) or Fluoroelastomer (Air). To be used where piping is submerged or within 2m of the TWL.

.2 Carbon Steel (C/S): Sizes 65 to 600 mm, grooved end cast type carbon steel housing with EPDM gasket (Water) or Fluoroelastomer (Air). Not to be used in submerged applications. Standard of Acceptance: Victaulic hot-dipped galvanized Style 07.

.8 Piping/Fitting Below Ground

.1 All underground stainless steel piping shall be wrapped with a petroleum based anti-corrosion tape.

.1 Anti-corrosion materials consisting of Denso Paste Primer or Priming Solution for cold temperature application, Denso Profiling Mastic or Mastic Blankets for profiling of irregular contours and Denso LT or Densyl tape, or approved alternative that complies with CSA Z-245-30, meets ISO 9001 and ISO 14001 and is CFIA Approved.

.2 Supplier Contact: Stuart Reece - Denso North America 416-291-3435, stuart@densona-ca.com, www.densona.com

.9 Fittings

.1 Sizes: 6 to 25 mm (O.D.), Type 316 stainless steel compression type fitting, Standard of Acceptance: Swagelok or approved equal.

.2 Sizes: 12 to 50 mm, Stainless steel socket weld 3000# stainless steel, A182, Grade F304L.

.3 Sizes: 65 to 600 mm, Schedule 10s stainless steel butt weld to A403 Grade WP 304L, ASME/ANSI B16.9.

.4 Sizes: 65 to 250 mm, Schedule 10s grooved end stainless steel to A403 Grade WP 304L. Standard of Acceptance: Victaulic hot-dipped galvanized Style 07.

.10 Unions

.1 Sizes: 12 to 50 mm, 150 # threaded 304 stainless steel unions, with dimensions to ANSI B16.3 for M.I. screwed fittings.

.11 Nuts and Bolts

.1 ASTM A-307 Grade B zinc chromate plated carbon steel heavy hexagonal head bolts. Type 316 stainless steel ASTM A-193 Grade B8 M (buried service, submerged service, outdoor service, or when installed within 2.0m of water level) with heavy hex nuts A194 Gr. 8.

.12 Gaskets

.1 3mm thick, full faced premium grade EPDM with punched holes to match class of flanges and fittings as required. Standard of Acceptance: Garlock 8314.

.13 Instrument Connections

.1

Connection	Pressure	Flow
Piping Connection	NPS 19 mm SW	NPS 12 mm FNPT
Instrument Connection	19 mm FNPT	NPS 12 mm FNPT
Block Valve	19 mm THD Ball Valve	12 mm THD Ball Valve
Temperature Instrument Connection: NPS 25 mm FNPT		

.2 Ball Valves: Threaded, Class 150 Ball Valve, bronze body, chrome plated stainless steel ball, PTFE Teflon adjustable packing, brass gland and PTFE Teflon Buna N seat with screwed ends and steel lever handle. Standard of Acceptance: Milwaukee BA-100, Valpres 171N.

.14 Needle Valves: 316 Stainless steel body with threaded ends, stem and bonnet, PTFE packing suitable for 6000# service. Standard of Acceptance: CFF/Needle Valve.

.15 Globe Valves: Cast iron construction, with flanged ends ANSI Class 125/150 to ASTM A126, Class B body, bronze trim and bronze disc. Standard of Acceptance: Crane Fig No. 351.

.16 Ball Valves: Cast 316 Stainless steel body, ASTM A351 Gr. CF8M, 316SS ball and stem, blow-out proof stem, reinforced PTFE seats, PTFE seals, 80 mm and smaller shall be lever operated 100 mm and larger shall be gear operated. Provide electric actuator where indicated. Standard of Acceptance: Neles-Jamesbury/7150-31-3600MTT-1 CFF 13

.17 Check Valves:

.1 Size: 12 – 50 mm, Check valve with bronze body to ASTM B62 with threaded bonnet, integral seat, renewable disc, swing type with bronze trim. Threaded or socket weld ends for Class 150 service. Standard of Acceptance: Crane/137, Nibco/T-433-B.

.2 Size: 65 – 200 mm, Dual plate wafer style check valve, Cast 316 SS body and disc to ASTM A351 Gr. CT8M, 316 SS trim, metal to metal seat, Inconel X spring. Standard of Acceptance: AMRI/2A66MR, Mueller/72-HHH-H-X, PMP 2025.

.3 Size: 65 – 200 mm, Ball style check valve with full faced flanged ends, nodular cast iron body c/w floating or sinking ball to match service. Metal core ball with nitrile rubber vulcanized coating. Bolted valve cover, 3mm (T) red rubber gasket, valves to be epoxy coated with 316SS Cover bolts,

rated to Class 125 service. Standard of Acceptance: GA Industries Figure 240-D, Xylem Flygt/HDL CV Type 5087.

.4 Size: 65 – 200 mm, Swing Check style check valve for low lift applications with full faced flanged ends, cast iron body bolted valve cover, weight and lever type with stainless steel shafts and double O-ring packings with grease fittings. Valves to be epoxy coated with 316SS Cover bolts, rated to Class 125 service. These valves shall be used for all sludge pipe services. Standard of Acceptance: Jenkins/477LJ, Pratt/Milliken Millcentric 801BBW, Apco 250.

.18 Butterfly Valves:

.1 Size: 65 to 510 mm, Resilient seated butterfly valve with offset disc and lug style body. Cast iron to ASTM A126 Class B body, 316 SS ASTM A743, Gr. CF-8M Disc, 316 SS ASTM A276 Shaft with EPDM seat. PTFE stainless steel coated bearing, EPDM shaft seal, 316 SS Trim, ANSI Class 125 lugged end connections. For sizes up to 65 mm supply with 10 position lever actuator, for sizes 80 mm and larger supply with manual gear actuator. Standard of Acceptance: Dezurick/BRS, *, I1, CI, EPDM, EPDM,S2,S2; BRAY 31-169; Val-Matic.

.19 Plug Valves:

.1 Sizes: 12 to 50 mm, Eccentric plug valve with cast iron body, resilient faced plug. Threaded ends to ANSI Class 150. Cast iron, ASTM A126 Class B body. 316L SS bearing, packing to be Buna-N filed TFE U-ring seal c/w neoprene plug facing. Lever actuator with SS bolting with grease fitting in body and externally adjustable packing. Standard of Acceptance: Val-Matic, Dezurik/PEC,*,T1,CI,NBR,CR,LV,SB,BXX005; Pratt/Milliken Millcentric 603E1.

.2 Sizes: 65 to 450 mm, Eccentric, full portplug valve with cast iron body, resilient faced plug. Flanged ends to ANSI Class 125/150. Cast iron, ASTM A126 Class B body. 316L SS bearing and plug, packing to be Buna-N filed TFE U-ring seal c/w neoprene plug facing. Fusion bonded epoxy coating. Lever actuator with SS bolting with grease fitting in body and externally adjustable packing. Standard of Acceptance: Val-Matic, Dezurik/PEC,*,F1,CI,NBR, CR, GS-6-HD*,BXX003; Pratt/Milliken Millcentric 601N1AG.

.3 Sizes: 65 to 300 mm, Eccentric plug valve with cast iron body, resilient faced plug. Ends to be flexible grooved ends (Style 31). Cast iron, ASTM A126 Class B body. 316 SS plug, 316L SS bearing, packing to be Buna-N filed TFE U-ring seal c/w neoprene plug facing. Lever actuator with SS bolting with grease fitting in body and externally adjustable packing. Standard of Acceptance: Val-Matic, Dezurik/PEC, *,VF, CI, NBR, CR, LV, SB, BXX005; Pratt/Milliken Millcentric 606SSN1

.20 Knife Gate Valve: 304 SS Valve body and gate c/w EPDM resilient seals and lugged body to ANSI B16.5 Class 150. For valves 200 mm and smaller provide handwheel actuator. For valves 250 mm and larger provide a fully enclosed grease packed bevel gear actuator complete with 90 degree mitre with 50mm nut

and crank. Maximum operating pull on the manual operator at 350 kPa pressure differential shall be 180 N. Actuator: 50-200 mm provide handwheel, 250mm and larger prove 90 deg. Mitre actuator. Standard of Acceptance: Trueline, Dezurik/KCB,*,F1 (Lug Style), S1, TBP, S1, EPDM;

.21 Duckbill Check Valves

.1 All rubber construction (Neoprene, Buna-N, EPDM or Viton).

.2 Flat-bottom, eccentric design with slip-on end and 304SS (or 316SS) clamping ring.

.3 Valve to have curved bill.

.4 Manufacturer shall have a minimum of 10 years experience in the design and manufacture of a flat-bottom, curved bill duckbill check valve.

.5 Acceptable Manufacturer: Tideflex

.22 Vent and Drain Valves: Bronze body, chrome plated stainless steel ball valve with PTFE teflon adjustable packing, brass gland and PTFE teflon Buna-N seat. Screwed or threaded ends to ANSI Class 150 c/w steel lever handle. Standard of Acceptance: Neles-Jamesbury/7150-31-3600MTT-CFF 13.

.23 Air Release Valves: Wastewater Combination Air Valves shall be single body, double orifice automatic float operated valves to AWWA C512, designed to exhaust large quantities of air during the filling of a piping system and close upon liquid entry. The valve shall open during draining or if a negative pressure occurs. The valve shall also release accumulated air from a piping system while the system is in operation and under pressure. The valve shall perform the functions of both Air Release and Air/Vacuum Valves and furnished as a single body or dual body type as indicated on the plans. The valve should be suitable for operation in wastewater applications. Body and cover material made of Ductile Iron ASTM A-536 grade 65-45-12 ductile iron. Valve body to have holiday free interior and exterior, holiday free, Fusion Bonded Epoxy Coating, applied at the manufacturer's facility in accordance with AWWA C550. Stainless steel or polycarbonate float. Working pressure range shall be minimum 75 kPa to 1,035 kPa (11psi to 150 psi). Threaded (NPT) intake and discharge ends. Size in accordance with drawings. Valve shall come complete with backwash accessories, which shall consist of an inlet shut-off valve, a blow-off valve, a clean water inlet valve, rubber supply hose and quick disconnect coupling. Standard of acceptance: DeZurik/APCO or Val-Matic

2.3 TYPE 316 L STAINLESS STEEL (316SS)

.1 General

.1 ANSI/ASTM Rating: Class 150 FF

.2 ANSI B36.19

.3 Service Limits:

.1 1050 kPa at a temperature range of -40°C to 40°C.

.2 750 kPa at a temperature of 50°C

.2 Pipe (Above ground)

.1 Tubing: 6 to 12mm O.D., Seamless stainless steel tube to A269 Grade TP 316 with a minimum USS #16 gauge. Fittings shall be of the mechanical compression type.

.2 Tubing: 12 to 25 mm O.D., Seamless stainless steel tube to A269 Grade TP 316 with a minimum USS #14 gauge. Fittings shall be of the mechanical compression type.

.3 Size: 12 to 50 mm, TP 316L Schedule 40s with plain ends, fully annealed hydraulic tubing, electric fusion welded stainless steel, A312 TP 316L, Joint Eff. 0.80. Dimensions conforming to ANSI B36.19. All threaded fittings shall be Class 3000 threaded end type and comply with ANSI B16.11.

.4 Size: 65 to 600 mm, TP 316L Schedule 10s with bevelled ends, Electric fusion welded stainless steel, A312 TP 316L, Joint Eff. 0.80, with dimensions conforming to ANSI B36.19.

.5 All pipe shall be pickled and passivated as per ASTM 380.

.3 Pipe (Buried/Below Ground)

.1 Size: 19 to 325 mm, TP 316L Schedule 40s with beveled ends. Electric fusion welded stainless steel, A312 TP 316L, Joint Eff. 0.80, with dimensions conforming to ANSI B36.19.

.2 Biogas Application

.1 For Biogas applications there shall be no buried fittings (threaded or flanged) permitted.

.2 All pipe to be continuously sloped to condensate drains and shall be installed having a minimum 2% slope.

.3 Pipe to be identified and colour coded in accordance with CSA B149.6 Section 8.7.

.4 Exterior piping stall be insulated as per Specification 44 05 40.

.5 No flexible connections, flanged couplings or otherwise shall be used in the below grade piping.

.6 Transition couplings shall be provided 1m from the building/foundation wall, connecting the interior piping and the exterior piping. The transition coupling shall be:

.7 Standard of Acceptance: Straub Grip L (SS 316 L) restrained coupling with SS 316 insert

.8

.3 All underground stainless steel piping shall be wrapped with a petroleum based anti-corrosion tape.

.1 Anti-corrosion materials consisting of Denso Paste Primer or Priming Solution for cold temperature application, Denso Profiling Mastic or Mastic Blankets for profiling of irregular contours and Denso LT or Densyl tape, or approved alternative that complies with CSA Z-245-30, meets ISO 9001 and ISO 14001 and is CFIA Approved.

.2 Installation shall conform to manufacturers execution procedure.

.4 Nipple

.1 Size: 12 to 50 mm, TP316L Seamless stainless steel to A312 in 50, 80 and 100 mm lengths with ends as required. Use Schedule 80s for all threaded nipples, wall schedule to match pipe schedule for all plain and beveled end nipples.

.5 Swages

.1 Size: 19 to 150 mm, TP316L Seamless stainless steel to A3012. Use Schedule 80s for all threaded swages. Wall schedule to match pipe schedule for all plain and beveled end swages.

.6 Flanges (Welded)

.1 Size: 12 to 19 mm, TP 316L 150# Raised Faced socket welded stainless steel flanges to A182 Grade F316L.

.2 Size: 25 to 600 mm, TP 316L 150# Flat Faced stainless steel Lap joints for use with stub ends. Weld neck flanges are also acceptable.

.3 Stub Ends: 25 to 600 mm, Schedule 10s with beveled end, Lap-stubs, MSS Type A Short, A403 Gr. WP 316L.

.7 Flanges (Grooved)

.1 Size: 12 to 600 mm, TP 316L 150# Raised Faced stainless steel blind flanges to A182 Grade F316L.

.2 Size: 65 to 600 mm, Grooved-end to Flange adapter to accommodate proposed bolt hole pattern (ANSI B16.1 Cl. 125) to be Stainless steel.

.8 Couplings

.1 Stainless Steel: Sizes 65 to 600 mm, grooved end cast type 316 stainless steel housing with EPDM gasket (Water) or Fluoroelastomer (Air).

.9 Fittings

.1 Sizes: 6 to 25 mm (O.D.), Type 316 stainless steel compression type fitting, Standard of Acceptance: Swagelok or approved equal.

.2 Sizes: 12 to 50 mm, Stainless steel socket weld 3000# stainless steel, A182, Grade F316L.

.3 Sizes: 65 to 600 mm, Schedule 10s stainless steel butt weld to A403 Grade WP 316L, ASME/ANSI B16.9.

.4 Sizes: 65 to 250 mm, Schedule 10s grooved end stainless steel to A403 Grade WP 316L. Standard of Acceptance: Victaulic hot-dipped galvanized Style 07.

.10 Unions

.1 Sizes: 12 to 50 mm, 150 # threaded 316 stainless steel unions, with dimensions to ANSI B16.3 for M.I. screwed fittings.

.11 Nuts and Bolts

.1 ASTM A-307 Grade B zinc chromate plated carbon steel heavy hexagonal head bolts. Type 316 stainless steel ASTM A-193 Grade B8 M (buried service, submerged service, outdoor service, biogas service or when installed within 2.0m of water level) with heavy hex nuts A194 Gr. 8 to ANSI B18.2.1.

.12 Gaskets

.1 3.17 mm thick, full faced premium grade EPDM or Neoprene with punched holes to match class of flanges and fittings as required. Standard of Acceptance: Garlock 8314.

.13 Instrument Connections

.1

Connection	Pressure	Flow
Piping Connection	NPS 19 mm SW	NPS 12 mm FNPT
Instrument Connection	19 mm FNPT	NPS 12 mm FNPT
Block Valve	19 mm THD Ball Valve	12 mm THD Ball Valve
Temperature Instrument Connection: NPS 25 mm FNPT		

2.4 PVC PIPING (PVC-1)

.1 General

.1 This specification includes the PVC piping for process chemicals and other process related functions, refer to Division 33 for PVC in buried applications. Refer to ANSI B16.5 for service ratings and fitting dimensions.

.2 All PVC piping for water service shall be CSA-900 certified.

.3 Cutting and installation shall be in accordance with the manufacturers' recommendations.

.4 Solvent weld all piping contained within the PVC-1specification.

.2 Pipe

.1 Size: 12 to 200 mm, PVC Type 1, Grade 1 Schedule 80s Class 12454-B conforming to ASTM D1785 and CSA B137.3.

.3 Flanges

.1 Size: 12 to 200 mm, Socket welded PVC Schedule 80, ANSI/ASTM D2467, Class 12454-B with ratings and dimensions as per ANSI B16.5 Class 150 flange.

.4 Fittings

.1 Socket welded PVC Schedule 80, ANSI/ASTM D2467 Class 12454-B to ANSI B16.5.

.5 Unions

.1 Sizes: 12 to 65 mm, Socket welded PVC Schedule 80, ANSI/ASTM D2467 Class 12454-B, PVC Type 1 with Buna-N/Vitron/EPDM O-ring seal depending on service application.

.6 Nuts and Bolts

.1 Bolts: ASTM A-307 Grade B zinc chromate plated carbon steel heavy hexagonal head bolts, galvanized.

.2 Nuts: ASTM A-563 Grade A zinc chromate plated carbon steel heavy hexagonal head bolts, galvanized.

.7 Gaskets

.1 3mm thick, full faced premium grade EPDM with punched holes to match class of flanges and fittings as required. Standard of Acceptance: Garlock 8314.

.8 Instrument Connections

.1

Connection	Pressure	Flow
Piping Connection	NPS 19 mm SW	NPS 12 mm SW
Instrument Connection	NPS 19 mm FNPT	NPS 12 mm FNPT
Bleed Valve	NPS 19 mm Ball Valve SW x THD	
Block Valve	19 mm THD Ball Valve SW	12 mm Ball Valve SW x THD
Temperature Instrument Connection: NPS 25 mm FNPT		

.9 Ball Valves: SW, Class 150 Ball Valve, PVC true union ball valves c/w PTFE seats, Vitron seals, for sizes 25mm and smaller provide round handle operator, for sizes up to 150 mm provide lever operator. To be used for drain and venting applications. Standard of Acceptance: Nibco/Chemtrol U45TB-V, or Spears equivalent.

.10 Check Valves: PVC True union ball type check valve c/w PTFE seats, Vitron seals for Class 150 service. For sizes 25mm and smaller provide round handle operator, for sizes up to 150 mm provide lever operator. End connections as specified. Standard of Acceptance: Nibco/Chemtrol S/U 45BC-V, or Sprears equivalent.

2.5 TEFLON TUBING (PP1)

.1 Pipe: Sizes : 6 to 25 mm, Pure Teflon PFA tubing with a minimum wall thickness of 1.0mm, per ASTM D 6867-03. Service pressure: 1050 kPa; Service temperature: -40 °C to 40 °C. For Aluminum Sulfate, Sodium Hypochlorite and Sodium Bisulfate service.

.2 Fittings: Pure Teflon PFA fittings suitable for service pressure. Standard of Acceptance: ChemFlare.

2.6 POLYETHYLENE TUBING (PP2)

.1 Pipe: LDPE Tubing with a minimum wall thickness of 0.063mm.

.2 Fittings: Pure Teflon fittings suitable for service. Standard of Acceptance: Swagelok.

2.7 PUDDLE FLANGES AND PIPE SLEEVES

.1 Puddle flanges and sleeves shall be provided at locations where pipes pass through concrete, masonry or other structure shall be stainless steel type 304L Schedule 40s with an annular fin welded continuously at midpoint of pipe penetrations. The fin shall be constructed of 6.35mm steel plate (min.) and shall have diameters as follows:

.1 Pipe diameter: 75 to 300 mm; Puddle flange dia.: Pipe dia. plus 50 mm.

.2 Pipe diameter: 350 to 550 mm; Puddle flange dia.: Pipe dia. plus 100 mm.

.3 Pipe diameter: 600 and larger mm; Puddle flange dia.: Pipe dia. plus 150mm.

.2 Puddle flanges shall be provided with adequate clearances to suite the process arrangement and provide sufficient space for installation of the required connection. Flanges shall be the same specification as the piping.

.3 Sleeves shall be completed flush with the interior and exterior of the wall and extend 100 mm above the finished floor elevation. Sleeve sizing shall provide a minimum of 6 mm of annular space between the penetrating pipe and the sleeve. Where sleeve penetrate walls into process vessels, these are to be provided with modular mechanical seal.

.1 Modular Mechanical Seals: EPDM rubber seals c/w 316 SS hardware and reinforced nylon polymer pressure plates. Standard of Acceptance: LS-316 Link -Seal Modular Seal.

2.8 HEAT TRACING

.1 All electrical heat-tracing applications shall be designed to maintain the process temperatures of 10°C with an exposure temperature of -40°C) using self-regulating cables. As a minimum, the heat-tracing shall provide 80 mm pipe and smaller with 25 mm thick insulation, 4 watts/0.3 m, and 100 mm pipe and larger with 50 mm thick insulation, 8 watts/0.3 m.

.1 Self-regulating heating cable shall vary its power output relative to the temperature of the surface of the pipe or the vessel. The cable shall be designed such that it can be crossed over itself and cut to length in the field.

.2 Self-regulating heating cable shall be designed for a useful life of 20 years or more with “power on” continuously, based on the following useful life criteria:

.1 Retention of at least 75 percent of nominal rated power after 20 years of operation at the maximum published continuous exposure (maintain) temperature.

.2 Retention of at least 90 percent of nominal rated power after 1000 hours of operation at the maximum published intermittent exposure temperature. The testing shall conform to UL 746B, IEC 60216-1.

.3 A warranty against manufacturing defects for a period of 10 years shall be available.

.4 All cables shall be capable of passing a 2.2 kV dielectric test for one minute after undergoing a 1.0 kg-0.7 m impact (IEC/IEEE 60079-30-1:2015, clause 5.1.5.1).

.2 Process Temperature Maintenance

.1 The heating cable shall consist of two 16 AWG or larger nickel-plated copper bus wires, embedded in a self-regulating polymeric core that controls power output so that the cable has a temperature identification number (T-rating) of T4 (275°F or 135°C) without use of thermostats.

.2 A ground-fault protection device set at 30 mA, with a nominal 100-ms response time, shall be used to protect each circuit.

.3 The heating cable shall have a tinned copper braid wire with a cross-sectional area being equal to or greater than conductor cross-sectional area. The braid shall be protected from chemical attack and mechanical abuse by a fluoropolymer outer jacket.

.4 Standard of Acceptance: Raychem QTVR-CT self-regulating heater or approved equivalent.

.3 Terminations for Nonhazardous and Hazardous Class I, Div 2 Locations

.1 All connection kits used to terminate heating cables—including power connectors, splices, tees, and connectors—shall be approved for the respective area classification and approved as a system with the particular type of heating cable in use. Under no circumstances shall terminations be used which are manufactured by a vendor other than the cable manufacturer.

.2 In order to keep connections dry and corrosion resistant, connection kits shall be constructed of nonmetallic, electrostatic, charge-resistant, glass-filled, engineered polymer enclosure rated TYPE 4X. The connection kit stand shall allow for up to four inches (100 mm) of thermal insulation.

.3 Terminals shall be the spring clamp wire connection type to provide reliable connection, maintenance-free operation, and ease of reentry.

.4 Heating cable terminations shall use cold-applied materials and shall not require the use of a heat gun, torch, or hot work permit for installation.

.5 Components shall be rated to a minimum installation temperature of –40°C, minimum usage temperature of –60°C, and maximum pipe temperature of 60°C.

.6 Standard of Acceptance: The connection kit system shall be Raychem JBM-100-L-A connection kit complete with integral LED power indicating light to serve as complete power, splice, or tee connection for up to three industrial parallel heating cables or approved equivalent.

2.9 FLEXIBLE ADAPTER COUPLINGS FOR UNDERGROUND APPLICATION

.1 Flexible couplings are to be fusion bonded epoxy coated carbon steel couples with ANSI 304 hardware. Gaskets for be compatible with contacting materials. To be sized to allow coupling of different OD piping in transition between pipe types. Standard of Acceptance: Robar 1506 or approved equivalent.

.2 Flanged to Plain End flexible sleeve type couplings:

.1 Type: Flanged cylindrical centre ring, companion flange, one follower ring, resilient gasket, and connecting bolts.

.1 Acceptable manufacturers:

.1 Robar 7808.

.2 Romac 501 & 400

.3 Blair Smith 400 Series

.4 GE Multi-Joint 3000 Plus to be used at Headworks to IPS Raw Sewage piping connection to splitter box.

.3 Provide necessary amount and appropriate size of restraining rods and gussets as recommended by manufacturer.

.4 Mechanical Joint Restraint Glands:

.1 Use flexible sleeve-type coupling with restraining rods (3 x 16mm dia. Minimum), and gussets welded to pipe. Provide sufficient restraint to resist pressure equal to twice system test pressure. Restraint Glands to be cast ductile iron Grade 70-50-5, compliant with AWWA/ANSI C110/A21.10/11. 16 mm set screws with knurled cup-point, 4140 steel, Rockwell ‘C’ scale 45-47.

.5 Do not use Type I flexible couplings in pipe systems which undergo thermal expansion and contraction; do not use these couplings at structural joints.

2.10 RIGID AND FLEXIBLE COUPLINGS FOR AIR, WATER AND SLUDGE PIPES

.1 Rigid couplings shall be required for maintenance of valves and flanged instruments; one (1) rigid coupling within 1.0m from each valve and flanged instrument for maintenance. Rigid couplings shall be also applied to the pipeline wherever the clearance for welding or flange connections is not sufficient.

.2 Flexible couplings shall be provided for the air, water and sludge pipes located inside the buildings to allow for deflection and minor axial movement.

.3 As the Contract Drawings may not present all flange or coupling connections, the Contractor shall determine the location of flange or coupling connections. Submit the shop drawing to present the connection type and locations.

Item	Size Range (mm)	Application	Description
Flexible Couplings	All sizes	Potable and non-potable lines	Victaulic Style 232S, 316L.
	All sizes	Process air AND sludge	Victaulic Style 77 and W77 c/w fusion bonded epoxy. W77 with AGS roll groove.
Rigid Couplings	40 mm to 500 mm	Potable and non-potable lines	Victaulic Style 489 and W489, 316L. W489 with AGS roll groove.
	600 mm & larger		Victaulic Style W89 c/w NSF approved coating. AGS roll groove.
	50 mm to 600 mm	Process air and sludge	Victaulic Style 89 and W89 c/w fusion bonded epoxy. W89 with AGS roll groove.
	750 mm and larger		Victaulic Style W07 c/w fusion bonded epoxy. AGS roll groove.
Coating on Couplings	All sizes	The colour of Fusion bonded epoxy to be similar to pipe colour.	

.4 Other acceptable products for couplings in addition those listed in the table above:

.1 Straub couplings may be acceptable for the process air, odorous air lines, water and sludge lines, but not for underground application.

.2 Refer to Section 11170 – Pipeline Pressure and Leakage Testing to comply with the pressure requirements. 1.2 of safety factor shall be applied to test pressure.

.3 Straub axial restraint pipe couplings;

.1 No deflection nor axial movement.

.2 All component material shall be of stainless steel 316L.

.4 Straub (Straub-Flex) non-axial restraint pipe couplings;

.1 More Straub couplings and supports may be required to provide the required thermal axial movement. The Contract Drawings are developed based on Victaulic expansion joints.

.2 Those shall be furnished with a strip insert to allow for the required expansion. It is a distance between pipe ends, but required axial movement. Refer to Clause 2.1.7.4 herein for expansion calculation.

.3 Allow for deflection and some axial movement.

.4 All component material shall be of stainless steel 316L.

.5 The Contractor and coupling Supplier shall confirm the gasket seal requirements for couplings; liquid and temperature.

.1 Potable and non-potable water lines:

.1 Grade “E” EPDM: UL Classified in accordance with NSF/ANSI/CAN 61 for cold and hot water service and NSF/ANSI/CAN 372 with temperature range of –34°C to +110°C

.2 Sludge lines

.1 Grade “E” EPDM: UL Classified in accordance with NSF/ANSI/CAN 61 for cold and hot water service and NSF/ANSI/CAN 372 with temperature range of –34°C to +110°C

.3 Sewer and raw wastewater lines

.1 Grade “T” Nitrile, flush seal type with temperature range of –29°C to +82°C

.4 Process lines

.1 Grade “L” Silicone: Dry heat, air without hydrocarbons and certain chemical services with temperature range of –34°C to +177°C

2.11 PIPE HANGERS, SUPPORTS, AND GUIDES

.1 Pipe connections to equipment shall be supported, anchored, and guided to minimize stresses and loads on equipment flanges and equipment. Supports and hangers shall comply with the requirements of Division 22 and/or as shown in the drawings. Hangers, supports, and guides shall be designed and installed in compliance with ANSI/ASME B31.3 and with MSS-SP-58, MSS-SP-69 and as shown in the drawings.

2.12 FLEXIBLE CONNECTORS AND DUAL PIPE COUPLINGS

.1 Flexible connectors shall be installed in piping connections to engines, blowers, compressors, and other vibrating equipment in accordance with the requirements of the ANSI B31.1. Flexible connectors shall be provided in all piping connections to engines, blowers, compressors, vibrating equipment, and where indicated. Flexible connectors for service temperatures up to 90 °C shall be flanged reinforced neoprene or butyl rubber spools, rated for working pressures of 275 to 1050 kPa or reinforced flanged rubberized duck, as best suited for the application.

For temperatures above 90 °C, flexible connectors shall be flanged braided Type316 stainless steel spools with inner corrugated stainless steel hose rated for minimum 1050 kPa working pressure unless indicated otherwise. Connectors shall be minimum of 200 mm face to face between flanges. Material selection shall be proposed by the manufacturer based on the application.

.2 Dual pipe couplings, separated by an 18-inch pipe spool unless otherwise indicated, shall be installed on the suction and discharge of all pumps - inboard of the isolation valves. Dual pipe couplings, separated by not less than two pipe diameters nor more than 1.5m, shall be installed on all piping where it exits a structure. Couplings shall be restrained where required. Dual flexible pipe joints may be used where indicated in buried pipe applications in lieu of dual pipe couplings. Flexible connectors are not permitted where dual pipe couplings are specified.

2.13 EXPANSION JOINTS FOR AIR, WATER AND SLUDGE PIPES

.1 Linear Expansion Only:

.1 Thermal Expansion/Contraction Joints: Victaulic Style 231S Non-Restrained flexible expansion coupling. Stainless steel 304 or 316L same as pipe material. Shoulders and two (2) restraint rings for 400 mm and larger size couplings.

.2 Refer to Clause 2.10 for gaskets and alternatives.

.2 Linear, Angular, and Lateral Movement:

.1 Straub (Straub-Flex) non-axial restraint pipe couplings with strip inserts.

.2 Straub-Flex 1 & 2 couplings shall be installed on the air and sludge pipes between AGS tanks and operation building to allow for both axial movement and deflection. No alternative.

.3 Refer to Clause 2.10 for gaskets.

PART 3 EXECUTION

3.1 INSTALLATION

.1 All piping systems and process appurtenances shall be fabricated, installed, inspected and tested according to the following:

.1 For all liquids: the Fabrication, Assembly and Erection shall be as per ASME B31.3 for Normal Fluid Service.

.2 For all air piping: Fabrication, Assembly and Erection shall be as per ASME B31.1 for Power Piping.

.3 For all biogas piping: Fabrication, Assembly and Erection shall be consistent with the requirements of CSA-B149.6-2022 as amended.

.4 All water distribution piping shall be installed as per Part 7 of the Ontario Building Code.

.5 All application specific installations shall meet the requirements of the applicable governing authority including the Technical Standards and Safety Authority (TSSA) and the specific regulations under TSSA (i.e. Boilers and Pressure Vessels Act, Digester, Landfill & Biogas Approval Code etc.).

.2 Installation General:

.1 Piping shall be cleaned of all foreign materials. If the piping is suspected of containing materials other than those required for testing, commissioning and operation, the Contractor will be responsible to drain and CCTV the pipe to confirm the internal condition.

.2 No backing rings will be allowable.

.3 Branch connections and reinforcing pads shall be as per section Chapter V of B31.3.

.4 Pipes, fittings, and appurtenances shall be installed in accordance with the manufacturer's installation instructions.

.5 Protect installed work from dust, contamination and damage from other construction activities prior to substantial completion. Cover open ended pipes following erection and until connections and terminations are complete. Provide appropriate care to new and existing piping, equipment, instrumentation and appurtenances to maintain their respective protective coatings, painting, and pickled/passivated surfaces from contamination during construction. Contactor shall be responsible to repair or replace damaged process piping and equipment as determined by the Contract Administrator.

.3 Connecting Dissimilar Piping System

.1 Provide dielectric fittings and/or adapting flanges and couplings to connect dissimilar metals such as steel and stainless steel.

.4 Drains

.1 Services: All.

.2 Horizontal pipes: 25 mm drains point with Schedule 40S Type 304L stainless steel NPS pipe, manual ball valve, nipple and a plug. Valves are supplied under this section. For piping smaller than 25 mm, provide drain and vents that are line size.

.3 Nipples shall extend 80mm beyond pipe insulation.

.4 Locations:

.1 Install drain point on bottom of horizontal pipe at low points in process piping system in order to drain the lines or equipment.

.2 Where indicated on Drawings. Drawings may not indicate all required drain point locations.

.5 Vents shall be provided at high points in the piping system to bleed off/purge air. Vents shall be constructed in the same manner as drains.

.6 Vents, Drains and Instrument connections shall be constructed using ‘Olets (Weldolets, Coupolet, Nipolet, Thredolet, etc.).

.7 Existing Pipe, Channel and Vessel Cleaning

.1 Flush existing pipe, channel and Vessels, scheduled to be reused where connected to new piping, free of waste material. Clean existing pipe with high-pressure pipeline washing equipment.

.2 Provide required fittings, temporary pipe connections and other similar items for high pressure wash cleaning.

.3 Complete all cleaning to the Contractors requirements, as per their Health and Safety Plan, in order to complete work.

.4 Submit cleaning procedures to Engineer for review well in advance of work.

.8 Cleaning

.1 Pipe cleaning: In accordance with Section 44 05 00 and Division 01.

.2 Replace equipment damaged during initial operating period due to foreign material not removed from piping systems.

.3 Clean piping systems of slag and foreign material by blowing with clean compressed air before connecting piping to valves, meters, instruments, and equipment.

.4 Additional cleaning requirements for all air piping systems:

.1 Clean piping system free of dust, dirt and debris after successful pressure testing of piping system.

.2 Clean pipe in sections so that air velocity in each pipe section being cleaned is minimum 8 m/sec.

.9 Pipe Sleeves and Wall/Floor Penetrations

.1 All sleeves, holes and pipe chases, penetrations in general through walls and floors shall be large enough to accommodate the thickness of insulation specified.

.2 Penetrations through fire separations shall be provided with adequate annular space for fire stopping. The integrity of the fire rating shall be maintained.

.3 The annular space between the pipe and sleeve shall be adequately sized to be sealed with Rockwool insulation and caulked with waterproof fire resistant non-hardening mastic.

.10 Field Testing

.1 All process pipe testing shall be completed in accordance with ANSI/ASTM B31.3 -Chapter VI, as applicable and ANSI/ASTM B31.1 for compressed air systems. Non-metallic piping shall be tested in accordance with B31.3 in adherence with the manufacturer’s rated capacities.

.2 The process piping system shall be completed by preparing the piping for testing in accordance with B31.3 Section 345.5.

.3 Biogas piping shall be tested in accordance with CSA B149.6-20.

.4 All instrumentation shall be removed prior to testing.

.5 All piping system valves and appurtenances not rated for the test pressure shall be removed or isolated prior to the test.

.6 The test shall be applied incrementally, air shall be purged during filling and the initial pressurization, equipment vents shall be opened to avoid pressure buildup beyond the testing segment.

.7 Following testing all piping systems shall be drained, all temporary blanks and temporary shall be removed. Disconnect all testing equipment.

.8 Repair all deficiencies as required and re-test.

.9 Reconnect all appurtenances and instruments that removed for testing.

.10 Replace all gaskets that where in-place for temporary blanks, blinds, etc.

.11 Return all valving to the normal operating condition.

.12 Clean all temporary strainers and other consumable items and install permanent items.

END OF SECTION

SUBMERSIBLE SEWAGE PUMPS

PART 1 GENERAL

1.1 SUMMARY

.1 This section includes design, supply, fabrication, installation, testing and placing into operation submersible sewage pumps and associated appurtenances.

1.2 RELATED SECTIONS

.1 Section 01 33 00 - Submittals

.2 Division 26 – Electrical

.3 Section 26 29 20 – Variable Frequency Drives

.4 Section 44 00 10 – Process General Requirements

.5 Section 44 05 50 – Process Piping

.6 Section 25 05 01 – Control Panels

1.3 SUBMITTALS

.1 Submit shop drawings and product data in accordance with Section 01 33 00 – Submittals.

.2 Indicate:

.1 Manufacturer's data, including materials of construction, equipment weight, connections, fittings, control assemblies and ancillaries. Identify whether factory or field assembled.

.2 Wiring and schematic diagrams.

.3 Dimensions and recommended installation.

.4 Data regarding pump and motor characteristics and performance inclusive of guaranteed performance curves showing that the equipment meets the specified requirements of head, capacity and horsepower for the specific application.

.5 Motor data.

.6 Provide characteristic curves for variable speed pumps for both actual maximum pump speed and for speed required to obtain minimum pump flow specified.

.7 Use Tag numbers for all equipment as indicated and specified.

.8 A copy of this specification with addenda updates, and all referenced sections with addenda updates, with each paragraph check marked to show specification compliance or marked to show deviations.

.3 The pump supplier shall review the contract drawings and specifications to ensure the pump application and sizing is acceptable and notify the Engineer immediately regarding any concerns.

1.4 MAINTENANCE DATA

.1 Provide maintenance data for incorporation into manual specified in Section 01 33 00 – Submittals.

.2 Data to include:

.1 Manufacturers name, type, model, capacity, head, serial number and performance curves.

.2 Mill certifications confirming hardness of rotor.

.3 Applicable operation and maintenance information as specified in section 01 33 00.

.4 Installation certification form.

.5 Training Certification form.

PART 2 PRODUCTS

2.1 GENERAL

.1 All pumping equipment furnished under this Section shall be of a design and manufacture that has been used in similar applications, and it shall be demonstrated to the satisfaction of the Owner that the quality is equal to equipment made by that manufacturer specifically named herein.

.2 Pumps, complete with motor, V-belt or couplings, necessary guards and all other specified accessories and appurtenances shall be furnished by the pump manufacturer to ensure compatibility and integrity of the individual components, and provide the specified warranty for all components.

.3 The process piping arrangements have been designed using the pumps listed as “approved manufacturer”. Pumps listed as “alternates” may require modifications to the piping arrangements, connections or concrete bases currently shown on the contract drawings. The contractor assumes all responsibility for said adjustments or extension of the work necessary for the accommodation of the alternate suppliers named.

.4 All submersible pumps shall be supplied with a thermal overload and leak detection relay (110V). Relay is to be provided loose to the contractor for installation as detailed on the contract drawings.

.5 Pump supplier to provide all accessories for pump installation including upper guide bar holders (316SS), cable hook (304SS), horizontal regulator hanger (304SS), holder clamp for lifting cable (316SS) and lifting cable assembly. For the

onsite pumping station the supplier shall also include the side mount lifting davit base and lifting davit.

2.2 PUMP LIFTING SYSTEM

.1 All pumps to be complete with sliding guide and brackets, stainless steel cable and quick leak-proof disconnect to discharge piping, allowing for withdrawal of pumps.

.2 Provide stainless steel cable or galvanized chain for each pump accessible from roof access hatches along with associated chain/cable hook.

.3 Provide 50mm (RPS/SP) and 80mm (IPS) diameter schedule 40 stainless steel pipes to act as guide rails for pumps.

2.3 INTERMEDIATE SEWAGE PUMPS ISP-1160, ISP-1260, ISP-1360, ISP-1460

.1 Pumps:

.1 Number of pumps: Four

.2 Function: to pump raw, screened sewage after the headworks pretreatment at a controlled variable rate to the new WWTP.

.3 Pumps shall be specifically designed to pump raw sewage, biosolids, or other media containing solids and/or rags and other fibrous materials without clogging.

.4 Pumps shall be submersible non-clog wastewater pumps designed to handle raw, unscreened sanitary sewage.

.5 Each pump shall be equipped with a submersible electric motor, Nema-B design induction type with squirrel cage rotor, shell type design and be housed in an air filled, watertight chamber. The motor shall be capable to withstand at least 15 evenly spaced starts per hour and also be designed for continuous duty while handling pump media up to 40°C. Three thermal switches shall be embedded in the stator end coils, one per phase winding, to monitor the stator temperature. The motor shall be:

.1 Maximum speed = 1185 RPM

.2 Maximum horse power = 45 kW (60 hp)

.3 Power: 600 V/60 HZ/3 Phase

.4 Suitable for VFD use.

.6 Major pump components shall be grey cast iron. ASTM A-48, Class 35B, with smooth surfaces devoid of blow holes or other irregularities. All exposed nuts shall be of ANSI Type 316 stainless steel. An approved sewage resistant coating shall protect all metal surfaces coming into contact with the pumpage other than stainless steel or brass.

.7 Impeller shall be of Hard iron, ASTM A-48 Class 35B, dynamically balanced, semi-open, multi-vane, back swept, screw-shaped, non-clog design. The screw shaped leading edges of the impeller shall be hardened to RC 45 and shall be capable of handling solids, fibrous materials, heavy

sludge and other matter normally found in wastewater. The impeller shall be capable of momentarily moving axially upwards a distance of 15mm to allow larger debris to pass through and immediately return to normal operating position.

.8 The pump/motor assembly shall have CSA approval as one unit, per CSA Standard C22.2-108. The pump/motor unit must also be approved by CSA for service in Class 1, Division I, groups D hazardous locations.

.9 The pumps shall meet the following characteristics:

.1 Discharge connection: 300 mm.

.2 Design duty point: 250 L/s at 18 m TDH.

.3 Minimum shut-off head: 5.5 m.

.4 Minimum overall efficiency at duty point: 78%.

.5 Two of the four pumps specified shall be supplied with a mix flush valve.

.10 The pump system shall be Flygt model NP-3202.090LT impeller code 342mm c/w 3 mini CAS II relays to be delivered to Division 25/26.

2.4 RAW SEWAGE SUBMERSIBLE PUMPS RSP-6110 AND RSP-6210 (ON-SITE PUMPING STATION)

.1 Pumps:

.1 Number of pumps: Two

.2 Function: to pump hauled sewage at a controlled variable rate to the new Intermediate Sewage Pumping Station.

.3 Pumps shall be specifically designed to pump raw unscreened sewage, biosolids, or other media containing solids and/or rags and other fibrous materials without clogging.

.4 Pumps shall be submersible non-clog wastewater pumps designed to handle raw, unscreened sanitary sewage.

.5 Each pump shall be equipped with a submersible electric motor, Nema-B design induction type with squirrel cage rotor, shell type design and be housed in an air filled, watertight chamber. The motor shall be capable to withstand at least 15 evenly spaced starts per hour and also be designed for continuous duty while handling pump media up to 40°C. Three thermal switches shall be embedded in the stator end coils, one per phase winding, to monitor the stator temperature. The motor shall be:

.1 Maximum speed = 1750 RPM

.2 Maximum horse power = 8.2 kW (11.0hp)

.3 Power: 600 V/60 HZ/3 Phase

.4 Suitable for VFD use.

.6 Major pump components shall be grey cast iron. ASTM A-48, Class 35B, with smooth surfaces devoid of blow holes or other irregularities. All exposed nuts shall be of ANSI Type 316 stainless steel. An approved

sewage resistant coating shall protect all metal surfaces coming into contact with the pumpage other than stainless steel or brass.

.7 Impeller shall be of hard iron, ASTM A-48 Class 35B, dynamically balanced, semi-open, multi-vane, back swept, screw-shaped, non-clog design. The screw shaped leading edges of the impeller shall be hardened to RC 45 and shall be capable of handling solids, fibrous materials, heavy sludge and other matter normally found in wastewater. The impeller shall be capable of momentarily moving axially upwards a distance of 15mm to allow larger debris to pass through and immediately return to normal operating position.

.8 The pump/motor assembly shall have CSA approval as one unit, per CSA Standard C22.2-108. The pump/motor unit must also be approved by CSA for service in Class 1, Division I, groups A, B, C or D hazardous locations.

.9 The pumps shall meet the following characteristics:

.1 Discharge connection: 150 mm.

.2 Design duty point: 64 L/s at 8.5 TDH.

.3 Minimum shut-off head: 5.2 m.

.4 Minimum overall efficiency at duty point: 75%.

.5 One of the two pumps specified shall be supplied with a mix flush valve.

.10 The pump system shall be Flygt model NP-3127.930 MT Impeller code 438 200 mm Adaptive c/w 2 mini CAS II relays to be delivered to Division 25/26.

2.5 TEMPORARY SUMP PUMP SS-2112

.1 Pumps:

.1 Number of pumps: One

.2 Function: to pump mixed liquor/sludge from AGS tanks when tanks have to be evacuated for servicing. One pump will service the three tanks.

.3 Pumps shall be specifically designed to pump raw unscreened sewage, biosolids, or other media containing solids and/or rags and other fibrous materials without clogging.

.4 Pumps shall be submersible non-clog wastewater pumps designed to handle raw, unscreened sanitary sewage.

.5 Each pump shall be equipped with a submersible electric motor, Nema-B design induction type with squirrel cage rotor, shell type design and be housed in an air filled, watertight chamber. The motor shall be capable to withstand at least 15 evenly spaced starts per hour and also be designed for continuous duty while handling pump media up to 40°C. Three thermal switches shall be embedded in the stator end coils, one per phase winding, to monitor the stator temperature. The motor shall be:

.1 Maximum speed = 1800 RPM

.2 Maximum horse power = 4.1 kW (5.5 hp)

.3 Power: 260 V/60 HZ/3 Phase

.4 Suitable for VFD use.

.6 Major pump components shall be grey cast iron. ASTM A-48, Class 35B, with smooth surfaces devoid of blow holes or other irregularities. All exposed nuts shall be of ANSI Type 316 stainless steel. An approved sewage resistant coating shall protect all metal surfaces coming into contact with the pumpage other than stainless steel or brass.

.7 Impeller shall be of grey iron, ASTM A-48 Class 35B, dynamically balanced, semi-open, multi-vane, back swept, screw-shaped, non-clog design. The screw shaped leading edges of the impeller shall be hardened to RC 45 and shall be capable of handling solids, fibrous materials, heavy sludge and other matter normally found in wastewater. The impeller shall be capable of momentarily moving axially upwards a distance of 15mm to allow larger debris to pass through and immediately return to normal operating position.

.8 The pump/motor assembly shall have CSA approval as one unit, per CSA Standard C22.2-108. The pump/motor unit must also be approved by CSA for service in Class 1, Division I, groups A, B, C or D hazardous locations.

.9 The pumps shall meet the following characteristics:

.1 Discharge connection: 150 mm.

.2 Design duty point: 37.5 L/s at 7 m TDH.

.3 Minimum shut-off head: 5.45 m.

.4 Minimum overall efficiency at duty point: 39.5%.

.10 The pump system shall be Flygt model N3102LT3Adaptive4p or approved equivalent c/w 1 mini CAS II relays to be delivered to Division 25.

.11 Pump shall be equipped with three (3) discharge elbows and three (3) sets of all lifting accessories listed in 2.2 to allow for one pump to service the three AGS tanks.

PART 3 EXECUTION

3.1 INSTALLATION

.1 Follow the manufacturer's recommended installation details and procedures supplemented by details on the drawings.

.2 Install in a neat, workmanlike manner so that connections and disconnections can be easily made with parts accessible for inspections, maintenance and repairs.

.3 Install at correct elevations, true, square, plumb and level and provide all shims required.

.4 Apply protection so that anchor bolts, shims and miscellaneous metals are fully corrosion protected.

.5 Contractor shall prove the pump's discharge port connection to process lines are made in a free supported state without need to apply vertical or horizontal pressure to align piping with pump nozzle.

.6 The installation and initial operation of all components shall be certified in accordance with 01 91 23 Equipment Installation and Start Up and shall be subject to the complete commissioning process.

3.2 TESTING

.1 After completion of installation, the pumps shall be completely tested to demonstrate compliance with operating requirements as specified. Testing and final acceptance shall be completed by pump manufacturer.

3.3 FIELD QUALITY CONTROL

.1 After completion of installation, representative of pump manufacturer shall complete inspection and supervise startup of the equipment and provide to contract administrator a written startup and commissioning report confirming that the equipment is installed and operating in accordance with manufacturers standards, and that the warranty is in effect until one year following the date of substantial completion.

.2 Provide materials, labour, liquid and ancillary equipment necessary to fulfil tests.

.3 Test to demonstrate that:

.1 Pumps and equipment run free from heating, or vibration.

.2 Operation meets requirements of these specifications.

.3 Pumps and pumping are free and clear of debris and obstructions.

.4 Replace equipment found defective.

.1 Repeat test until equipment is accepted by contract administrator.

END OF SECTION

PROGRESSIVE CAVITY PUMP

PART 1 GENERAL

1.1 SUMMARY

.1 The work of this section includes the design, supply, delivery, site storage, fabrication, installation, start up, testing, and placing into operation two (2) new Thickened Sludge Transfer Pumps (THK-TWAP-3123 and -3223) including pump, motors, fittings associated appurtenances, integration with the local control panel and remotely located variable speed drive and control panel.

.2 The pumps shall integrate seamlessly with the Huber supplier incline plate thickener. The supply must coordinate with the pre-selected equipment supplier to integrate the pump suction flange arrangement with the thickened sludge hopper of the Huber Inclined Plate thickener. Supply all the necessary parts and accessories indicated on the drawings, specified or otherwise required for a complete, properly integrated and operating installation and shall be the latest standard product of a manufacturer regularly engaged in the production of similar equipment.

.3 Coordinate with all other sections and divisions to ensure no conflicts in the work.

1.2 RELATED SECTIONS

.1 Section 01 33 00 - Submittals

.2 Division 26 – Electrical

.3 Section 26 29 20 – Variable Frequency Drives

.4 Section 44 04 00 – Process Piping

.5 Section 25 05 01 – Control Panels

1.3 SUBMITTALS

.1 Submit shop drawings and product data in accordance with Section 01 33 00 – Submittals.

.2 Indicate:

.1 Manufacturer’s data, including materials of construction, equipment weight, connections, fittings, control assemblies and ancillaries. Identify whether factory or field assembled.

.2 Wiring and schematic diagrams.

.3 Dimensions and recommended installation.

.4 Data regarding pump and motor characteristics and performance inclusive of guaranteed performance curves showing that the equipment meets the

specified requirements of head, capacity and horsepower for the specific application.

.5 Motor data.

.6 Universal joint warranty.

.7 Provide characteristic curves for variable speed pumps for both actual maximum pump speed and for speed required to obtain minimum pump flow specified.

.8 Use Tag numbers for all equipment as indicated and specified.

.9 A copy of this specification with addenda updates, and all referenced sections with addenda updates, with each paragraph check marked to show specification compliance or marked to show deviations.

.3 The pump supplier shall review the contract drawings and specifications to ensure the pump application and sizing is acceptable and notify the Engineer immediately regarding any concerns.

1.4 REFERENCES

.1 The following is a list of standards which are explicitly listed as references. Other codes and standards may apply.

.1 American Bearing Manufacturers Association (ABMA)

.2 Institute of Electrical and Electronics Engineers (IEEE): 112 Standard

.3 American Society of Mechanical Engineers(ASME)

.4 ASME B31.3 Process Piping

.5 ASME B16.1 and B16.5

.6 National Electric Code (NEC).

.7 Ontario Electric Code (OEC).

.8 Ontario Building Code (OBC)

.9 National Electrical Manufacturers Association (NEMA): MG 1, Motors and Generators

.10 The Canadian Standards Association (CSA).

.11 National Fire Protection Association (NFPA): 820, Standard for Fire Protection in Wastewater Treatment and Collection Facilities.

1.5 MAINTENANCE DATA

.1 Provide maintenance data for incorporation into manual specified in Section 01 33 00 – Submittals.

.2 Data to include:

.1 Manufacturers name, type, model, capacity, head, serial number and performance curves.

.2 Mill certifications confirming hardness of rotor.

.3 Applicable operation and maintenance information as specified in section 01 33 00.

.4 Installation certification form.

.5 Training Certification form.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Delivery of Materials: Products shall be delivered in original, unbroken packages, containers, or bundles bearing the name of the manufacturer.

.2 Store products indoors or in weather protected area until installation. Protect from construction traffic and damage.

.3 Protection of Equipment: Equipment shall be boxed, crated, or otherwise protected from damage and moisture during shipment, handling, and storage. Equipment shall be protected from exposure to corrosive fumes and shall be kept thoroughly dry at all times.

1.7 SERVICES OF MANUFACTURER

.1 Inspection, Startup, Field Adjustment: An authorized representative of the manufacturer shall visit the site for not less than 3 full days to furnish the indicated services.

.2 Provide start-up services during the initial equipment installation.

.3 Instruction of Owner's Personnel: The authorized service representative shall also instruct the Owner's personnel in the operation and maintenance of the equipment including step-by-step troubleshooting procedures with necessary test equipment for not less then 1 full day and/or as required by Division 01.

.4 Maintenance data shall be provided for the incorporation into the operations and maintenance manuals specified in Division 01 78 00.

PART 2 PRODUCTS

2.1 GENERAL

.1 The pumps shall be positive displacement progressing cavity type pumps, complete with electric motors, and all specified appurtenances, as shown on the plans and specified herein.

.2 The pumping units shall be of the self-priming, positive displacement, progressing cavity type specifically designed for pumping bulk liquid or polymer solutions, as specified and/or wastewater sludge.

.3 The pump, motor and control equipment shall be suitable for installation within a Class 1/Division II, Group D environment.

.4 The pumps shall be specifically designed and selected for continuous duty pumping of liquids with the specified properties.

.5 The pumps shall be of the compact, close-coupled design. The gear reducer shall be sized for a minimum service factor of 1.5 and designed with a thrust load capability of 150 percent of the actual thrust load.

.6 The pumps, along with associated drive appurtenances, shall be mounted on common fabricated steel baseplates.

.7 Manufacturers must currently have installations for the same liquids and of the same model pump unit, in service for a minimum of three years.

2.2 OPERATING CONDITIONS

.1 Thickened Sludge Transfer Pump

.1 Tags: THK-TWAP-3123 and - 3223
.2 Media: Thickened Waste Activated Sludge
.3 Solids Concentration: 1 to 5%
.4 Operating Temperature: Up to 60ºC
.5 Viscosity: Well flowable
.6 Pump Location: Thickener Room
.7 Quantity: 2
.8 Operation Mode: intermittent
.9 Operating Flow rate of each pump: 1 – 8 L/s
.10 Maximum operating discharge head of pump: 16m
.11 Suction Arrangment: Coordinate with Huber. Rectangular Flanged 250mm x 150mm (10” x 6”) clear opening.

2.3 PUMP CONSTRUCTION

.1 Materials:

.1 Rotor: Sludge Applications - Hardened tool steel. Alum Applications – 316 stainless steel.
.2 Stator: Buna N
.3 Pump Body: Cast Iron
.4 Shaft Sealing: Burgmann MG1 Q1Q1VGG with quench design.

.2 Rotor and Stator:

.1 Each pump shall be a one stage design employing a convoluted rotor operating in a similarly convoluted stator. The convolutions shall be configured to form a cavity between the rotor and stator, which shall progress from the pump's inlet to discharge port with the operation of the rotor. The fit between the rotor and stator at the point of contact shall

compress the stator material sufficiently to form a seal and to prevent leakage from the discharge back to the inlet end of the pumping chamber. The stator shall be molded with a seal integral to the stator elastomer. Gaskets or "O" rings may not be used to form this seal. Stators for sludge pumps shall have Buna elastomer. The sludge pump rotors shall be constructed of harded tool steel. Alum pump rotors shall be constructed of 316SS without chroming.

.2 Smart stators shall be replaceable without dismantling the pump suction piping, or discharge piping. Stators that require dismantling of the pipe work and additional space for axial/horizontal removal shall not be allowed. Smart pump designs shall incorporate a retensioning feature to compensate for wear. No special tools shall be required.

.3 Smart rotor shall be replaceable without dismantling the pump suction piping, or discharge piping. Rotors that require dismantling of the pipe work and additional space for axial/horizontal removal shall not be allowed. No special tools shall be required.

.3 Rotor and Drive Train: The rotor drive train shall be warranted for three (3) years from acceptance and shall consist of the following:

.1 Each pump rotor shall be driven through a positively sealed and lubricated pin joint. The pin joint shall have replaceable bushings, constructed of air-hardened tool steel of 57-60 HRc, in the rotor head and coupling rod. The pin shall be constructed of high speed steel, air hardened to 60-65 HRc. The joint shall be grease lubricated with a high temperature (450□ F), PTFE filled synthetic grease, covered with Buna N sleeve and positively sealed with hose clamps constructed of 316 stainless steel. The universal joints shall carry a separate warranty of 10,000 operating hours. This warranty shall be unconditional in regards to damage or wear. Undersized pins to accommodate optional bushing are not acceptable

.4 Casing: A 150-pound (ANSI B16.5) flanged connection shall be provided at both the inlet and discharge ports. The suction and discharge casings shall each be provided with a 3/8-inch (or larger) tap to permit installation of pressure instruments.

.5 Bearings: Each pump shall be provided with oil lubricated thrust and radial bearings, located in the gearmotor, designed for all loads imposed by the specified service.

.6 Shaft Sealing: Shaft shall be sealed using a single internal mechanical seal as specified in Section 2.31. The shaft shall be solid through the sealing area, but of a two part design which allows the rotating unit to be removed from the pump without disassembly of the gearmotor bearings. Seal materials shall be solid silicon carbide faces with 316 stainless steel metal parts and Viton elastomers. It also should have a quench to lubricate the seal with water.

.7 Motors: Gear motors or gear reducers shall be designed in accordance with AGMA 6019-E (Class II). Motors shall be high efficiency, TEFC motors, SF 1.15, Inverter duty motors and shall meet the requirements of NEMA MG1 Part 31.

.8 The motor shall be:

.1 Maximum speed = 1700RPM

.2 Maximum horse power = 3.7kW (5.0hp)

.3 Power: 575 VAC/60HZ/3 Phase

.4 Suitable for VFD use.

2.4 ACCESSORIES

.1 Run Dry Protection: The stator shall be fitted with a sensor sleeve and thermistor sensor. A controller shall also be provided and shall be supplied to the contractor for installation in the associated control panel or junction box. The controller shall monitor the stator temperature and activate a shutdown and alarm sequence if the stator temperature reaches the adjustable limit on the controller. The controller shall include a manual local and remote reset function. Input to the controller shall be 1x115VAC/60 Hz.

.1 Provide STP-3 Dry Run Protection Sensor and Omron Controller.

.2 Lifting Lugs: Provide suitably attached for all equipment assemblies and components weighing over 45 kg.

.3 Contractor to provide Anchor Bolts: Type 316 stainless steel sized by equipment manufacturer and as specified in Section 05 50 00. Anchor bolts required for equipment drives, bases, and accessories shall be provided under this Section. Coordinate required spec with final shop drawings.

.4 Pump Base: Pump and motor shall be mounted on a common fabricated steel base furnished by the pump manufacturer. Modifications to the concrete equipment pads to suit the equipment arrangement to be provided by the contractor as per the structural details and Division 05 specifications.

2.5 STANDBY COMPONENTS

.1 One set of special tools shall be provided to service the pumps. In addition, the following shall be provided for each pump size (as appropriate for type of drive provided):

1 – stator assembly with TSE sensor sleeve

1 – rotor

1 - set universal joint assembly and mechanical seal

.2 Standby components shall be tagged and stored.

2.6 MANUFACTURER

.1 The pumps shall be manufactured by:

.1 Netzsch Model Nemo NM038BO02S1201L06-SK372.1F-100LP; or,

.2 Moyno.

.3 Or approved equivalent.

PART 3 EXECUTION

3.1 GENERAL

.1 Install the equipment including supports, and other appurtenances following the manufacturers/suppliers recommendations and to suit existing building structure to ensure equipment is not supported by connected piping or connected piping is not supported by equipment. Accurately place the anchor bolts, as per the manufacturers design, using templates furnished by the manufacturer and in accordance with Section 05 50 00 and in coordination with seismic requirements identified in Section 44 02 40.

.2 The Contractor shall install the pumps in accordance with the manufacturer's written instructions and as directed on site by the Manufacturer's representative. The Contractor shall be responsible for coordinating related items, not covered in this section of the specifications, such as piping, fittings, additional valves, supports, motor controls and wiring.

.3 Follow the manufacturer's recommended installation details and procedures supplemented by details on the drawings.

.4 Install in a neat, workmanlike manner so that connections and disconnections can be easily made with parts accessible for inspections, maintenance and repairs.

.5 Install at correct elevations, true, square, plumb and level and provide all shims required.

.6 Apply protection so that anchor bolts, shims and miscellaneous metals are fully corrosion protected.

.7 Contractor shall install pumping equipment on concrete pad and make final alignments thereon.

.8 Contractor shall prove the pump's suction and discharge port connections to process lines are made in a free supported state without need to apply vertical or horizontal pressure to align piping with pump nozzles.

.9 The pumps shall not, under any conditions be allowed to sit out-of-doors unprotected. During actual installation of each unit, blower package shall be covered with a waterproof material in the event of any precipitation and also at all

times that construction does not require exposure of the equipment. Covering shall be securely anchored.

.10 Pump and motor alignment shall be performed by representatives of the blower manufacturer. Prior to initial starting of the pumps, a written report shall be supplied to the Contract Administrator by the blower manufacturer's service representative verifying alignment and motor rotation direction of each unit and certify that the blower is properly installed.

.11 The Pump and accessories shall be installed, tested, adjusted and installation certified by the supplier.

3.2 FIELD TESTING

.1 After installation of all equipment has been completed and as soon as conditions permit, the manufacturer shall provide one (1) trip (one 8 hour day) to conduct an acceptance test under actual operating conditions, to determine the operation is satisfactory and free from excessive vibration as defined by the manufacturer. The test shall consist of 3 hours operation of each pump with readings taken and recorded at 30-minute intervals.

.2 All equipment shall be adjusted and checked for alignment, clearances, supports, and adherence to safety standards.

.3 Provide manufacturer's services and Manufacturer's Certificate of Proper installation, Manufacturer's representation shall provide supervision of equipment installations, field inspection of equipment before startup and the completion of the Certificate of Proper Installation exclusive of specified services for commissioning and training.

3.3 COMMISSIONING

.1 Attend during commissioning of the process system, which includes the equipment specified in this and related sections to ensure the equipment functions as intended in the process system.

END OF SECTION

CHEMICAL METERING SYSTEM AND STORAGE

PART 1 GENERAL

1.1 DESCRIPTION

.1 This section covers the requirements for the supply, installation and testing for the following equipment, including all associated appurtenances:

- .1 One complete pre-packaged, self-contained, and fully assembled and tested feed equipment skid package for aluminum sulfate solution.
- .2 Two (2) chemical horizontal tanks for the storage of aluminum sulfate solution.
- .3 Chemical piping and valves, including secondary containment.
- .4 Custom stainless-steel cabinet for chemical fill station.

.2 The equipment provided under this section shall be fabricated, assembled, erected, and placed in proper operating condition in full conformity with drawings, specifications, engineering data, instructions, and recommendations of the equipment manufacturer, unless exceptions as otherwise noted by the Engineer.

.3 All material and equipment shall be new, of the best quality and as specified and shown on the drawings. The Contactor shall be responsible for, and shall replace at its own expense, any work and material improperly fabricated or constructed to the satisfaction of the Engineer.

.4 All appurtenances, fittings, and accessories necessary for the proper functioning of all the equipment or reasonably inferable from the drawings shall be supplied and installed with the equipment, whether indicated on the drawings or specified herein, or not.

1.2 RELATED SECTIONS

.1 Section 44 00 10 - General Requirements

.2 Section 44 05 50 - Process Piping

.3 Division 25 – Instrumentation

.4 Division 26 - Electrical

1.3 REFERENCES, CODES AND STANDARDS

.1 American Society of Testing Materials (ASTM).

.1	D638	Tensile Properties of Plastics
.2	D883	Standard Definitions of Terms Relating to Plastics
.3	D1505	Density of Plastics by the Density-Gradient Technique
.4	D1525	Test Method for Vicat Softening Temperature of Plastics

.5 D1693 ESCR Specification Thickness 0.125" F50-10% Igepal

.6 D1998 Standard Specification for Polyethylene Upright Storage Tanks

.7 F412 Standard Terminology Relating to Plastic Piping Systems

.2 ANSI Standards: B-16.5, Pipe Flanges and Flanged Fittings

.3 ARM: Low Temperature Impact Resistance (Falling Dart Test Procedure).

1.4 SITE CONDITIONS

.1 The following site operating conditions shall be assumed for all design calculations:

.1 40°C maximum/+5°C minimum ambient air temperature

.2 30°C maximum/0°C minimum chemical temperature

.3 95% maximum relative humidity (non-condensing)

.2 Chemical tanks and pump skid to be installed indoors in a concrete secondary containment area located in the Operations Building lower level.

.3 Alum dosing location shall be the three (3) aerobic granular sludge tanks' effluent launders, above the water level.

.4 Refer to the Contract Drawings for further details.

1.5 CONDITIONS OF SERVICE

.1 Provide equipment and appurtenances suitable for handling 30-60% Aluminum Sulfate Solution with specific gravity 1.3 – 1.35 at 20°C in solution with pH<3.

1.6 SUBMITTALS

.1 In accordance with Section 01 33 00 – Submittals.

.2 The shop drawing submission shall include, but not be limited to, the following:

.1 Dimensional chemical system panel layout.

.2 Pump output curves for each pump.

.3 Basic design details for each piece of equipment, including sizing calculations, control panel layout, control schematics and wiring diagram(s).

.4 Detailed engineering drawings of each tank with port sizes, connections and locations, fittings, accessories, restraints and supports.

.5 Tank and Fitting Material

.1 Resin Manufacturer Data Sheet

.2 Fitting Material

.3 Gasket style and material

.4 Bolt material

.6 Details of tank manways, flexible connections, and vents.

.7 Data confirming that the material of equipment is resistant to the chemicals used.

.8 For each major component include the name of Manufacturer, type and model of equipment and net weight.

.9 Descriptions of the materials of construction of the major components. Provide sufficient detail to show the general construction pertinent to the proper review of the equipment.

.10 A precise list of all electrical requirements for the equipment including all controls, monitoring equipment and instruments shall be given including all power characteristics and materials of construction.

.11 The Supplier shall indicate a list of spare parts, which they would recommend be purchased and individual prices for each item.

.12 All ancillary equipment to be provided by the Supplier shall be listed.

.13 Special accessories or tools for the adjustment or removal of parts required for any piece of equipment shall be listed and furnished as part of the supply.

.14 Manufacturer's warranty.

.15 Tank Factory Test Report

.1 Material, specific gravity rating at 600 psi @ 100 degrees F. design hoop stress.

.2 Wall thickness verification.

.3 Fitting placement verification.

.4 Visual inspection

.5 Impact test

.6 Gel test

.7 Hydrostatic test

.3 Design of tanks and tank anchoring is to be certified by a Professional Engineer licensed to practice in the Province of Ontario. Design calculations to follow applicable Canadian Building Code Standards and Ontario Building Code Standards.

.4 The fabricator shall submit to the Engineer upon request, complete data on materials, method of fabrication, quality control, catalyst-curing system, type and minimum thickness of the chemical-resistant veil (barrier) on the tank interior, and all other pertinent data on materials, fabrication etc. The fabricator shall be responsible for the design, selection of suitable materials and quality control, etc. to construct tank suitable in all respects for the application specified herein.

.5 Provide unloading procedure, installation, operations and maintenance data for incorporation into operation manual specified in Section 01 33 00 - Submittals.

PART 2 PRODUCTS

2.1 GENERAL

.1 Provide and install alum chemical metering system and storage tanks as indicated on the Drawings.

.2 Provide one (1) chemical feed system (c/w three pumps) for aluminum sulfate that is capable of operating 24 hours per day 365 days per year.

.3 One (1) high density polyethylene piping panels with fiberglass supports, pre-mounted, pre-piped, pre-wired and 24-hours pressure tested with local and remote control.

.4 Chemical piping and chemical carrier piping for the dosing of aluminum sulfate in the aerobic granular sludge tanks' effluent launders, as shown on the Contract Drawings.

.5 Provide two (2) singe wall horizontal storage tanks suitable for 30% - 60% Aluminum Sulfate solution.

2.2 ALUM METERING PUMPS

.1 Alum metering pump requirements:

Pump Tag No.	Pump Qty.	Capacity (L/h) per pump	Discharge Head (m)	Location of Pumps	Control Feature
ALU-AFP-3112 ALU-AFP-3212 ALU-AFP-3312	3 (2 duty, 1 standby)	Min – 0.075 Max – 60	Max - 100	Indoors, Chemical Containment Area in Operations Building Lower Level	4-20mA control from SCADA, 4-20mA feedback to SCADA

.2 The diaphragm metering pumps will include, but not limited to the following:

.1 Chemical metering pumps shall be Mechanically Actuated Diaphragm, positive displacement, motor driven, metering pump.

.2 Chemical metering pump shall be driven by a microprocessor controlled stepper motor providing a minimum of 1000:1 turndown ratio. The stepper motor is to be coupled to a flat, PTFE diaphragm via a gear assembly. The drive assembly shall be a maintenance free design.

.3 The pump shall operate at 100% stroke length throughout the pumps entire capacity range.

.4 Solenoid-driven pumps, hydraulically actuated diaphragm pumps and those with a lost motion spring return will not be accepted.

.5 The liquid end & valve design shall provide for ease of maintenance. Ball checks shall be cartridge type design.

.6 The pump shall be able to measure actual flow through the head to monitor the dosing process without need for additional measuring equipment.

.3 The enclosure will include, but not limited to the following:

.1 Drive mechanism and microprocessor shall be housed in a corrosion resistant, plastic UV stabilized enclosure.

.2 The pump design shall include provisions for optional positioning of the control interface/display, for right/left side and front mounting.

.3 Pump enclosure rating shall be to IP65 and NEMA 4X standards.

.4 The pump design shall include an integral removable click stop mounting plate, to allow for flat base or wall mounting.

.4 The pump drive will include, but not limited to the following:

.1 The pump's stroke length will always be 100%. No adjustment to the stroke length, to regulate flow, or for other reasons, is acceptable.

.2 An integral variable speed stepper motor shall be used to ensure the pump discharge phase extends throughout the full period between suction intervals.

.3 Variable frequency drives shall not be accepted.

.4 The motor shall be integral, supplied with power cord and plug.

.5 The drive mechanism shall not require regular field service or external lubrication.

.5 The interface will include, but not limited to the following:

.1 User interface/display shall be backlit LCD with selectable on-site positioning for either side or front mounting.

.2 The interface shall provide a selection of metered output to be displayed in liters per hour (l/h) or gallons per hour (gph). Pumps displaying percent (%) of output only will not be accepted.

.3 The interface should include a turn and push knob (click wheel) for easy navigation.

.4 The interface menu shall include 25 language selections and provide easy navigation of all configuration and operational functions.

.5 The interface shall include a lock function to protect against unauthorized changes.

.6 A built in counter shall be included to provide a running total of, accumulated strokes, cumulative hours of operation and dosing flow.

.7 A priming button shall be provided on the interface. The priming button shall initiate a time selectable prime cycle operating at full capacity without need of attenuating the pumps output setpoint.

.8 A system of white, red, yellow and green LCD shall indicate pump status and alarm conditions.

.6 The liquid end will include, but not limited to the following:

.1 The process diaphragm shall be PTFE, PTFE coated diaphragms are not acceptable.

.2 Head and valves body material shall be (PVDF) with (Ceramic) ball material.

.3 Wetted gasket material shall be EPDM.

.4 Suction and discharge valve design shall incorporate double ball arrangement. Spring-loaded valves shall be available as an option. Direction of flow shall be clearly marked on each check valve to ensure correct installation.

.5 Head design shall incorporate integral priming valve.

.6 A back-plate with separation chamber shall have a safety lip seal and drain hole.

.7 Metering Pump Control

.1 Analog: Pump shall include direct interface provisions for analog control. Both direct and reverse acting 0/4-20mA input configurations are to be acceptable inputs. The menu configuration shall permit pump maximum output multipoint scaling. The pump shall include a local alarm for loss of input signal.

.2 Pulse: The pump shall include direct interface provisions for pulse output devices. In pulse control mode, the pump shall be configured to deliver a volume of product per incoming pulse. The pump speed shall attenuate the delivery rate based on the frequency of pulses generated by the external device.

.3 Batch: In batch mode the pump shall respond to deliver a menu configurable quantity of liquid after receiving a remotely provided contact input.

.4 Cycle timer: The configuration menu of the cycle timer shall permit the user to prescribe batch volume, timed sequence start point and the time between each successive timed delivery cycle.

.5 Week timer: The pump shall be equipped with a real-time clock and a seven-day internal week timer. The configuration menu shall permit the user to prescribe up to 16 procedures with batch volume, dosing time, start time and weekdays.

.8 Acceptable suppliers are as follows: Grundfos by SPD Sales.

2.3 ALUM FEED SYSTEM

.1 The alum feed system shall be provided as a complete system by a supplier with at least five (5) years experience in Municipal chemical dosing systems.

.2 Contractor shall provide all chemical piping, fitting, and valves between chemical system and the identified dosage locations as indicated on the Contract Drawings.

.3 The Contract Process Drawings may not present all chemical piping.

.4 Where the chemical pipe is located outside the concrete containments, it shall be installed with dual containment using clear HDPE piping as second containment.

.5 Provide one (1) aluminum sulfate feed system, including three (3) metering pumps and accessories pre-mounted on the HDPE chemical panel with fiberglass supports with pump skid and instruments. If bolts are used, stainless steel SS316 must be used. The Contractor shall provide the supports and anchorage in the shop drawing.

.6 Pump accessories pre-mounted on each panel shall include, but not be limited to the following:

- .1 One (1) back pressure valve
- .2 One (1) pressure relief valve (multifunctional valve from Grundfos)
- .3 Isolation ball valves for the pump panel, quantity as per drawings.
- .4 One (1) lot of PVC isolation ball valves, tubing and fittings

.7 Accessories supplied loose shall include:

- .1 The Manufacturer shall coordinate with the Contractor, the required length for input & output signal cables which shall be supplied by the Manufacturer.

2.4 ALUM STORAGE TANKS

.1 Provide two (2) horizontal chemical storage tanks for Aluminum Sulfate.

.2 Chemical Storage Tank shall be designed in accordance to ASME D638 Specifications, ANSI Standards B-16.5 Pipe Flanges and Flanged Fittings, and UBS Code: Uniform Building Code.

.3 Design Requirements:

Parameter	**Aluminum Sulfate**
Number of Tanks	2
Minimum Capacity per Tank	830 L
Maximum Length	4.8 m

Parameter	**Aluminum Sulfate**
Maximum Overall Height/Width/Diameter	1.7 m
Tank Material	High-Density Crosslinked Polyethylene
Construction	Rotationally molded in one piece
Ball Valves	Standard PVC, true union ends, EPDM seals

.4 Each tank to include the connections listed below.

Tank Port	**Number of Ports**	**Type/Location**	**Size**	**Connection Details**
Chemical suction	1	Flanged/Bottom of the Tank	50mm	As per Contract Drawings
Chemical filling	1	Flanged/Top of the Tank	80mm	Connect to exterior cabinet (as per Drawings).
Manway	1	Threaded/Top of the Tank	Minimum 533mm (21”) in diameter	As per Contract Drawings
Vent	1	Flanged/Top of the Tank	100mm	As per Contract Drawings
Overflow	1	Flanged/Lateral Top of Tank (above 100% level)	100mm	As per Contract Drawings
Ultrasonic Level Sensor	1	Flanged/Top of the Tank	50mm	Riser with flange for ultrasonic level control

.5 The ports should accommodate the pipe sizes shown in the Contract Drawings. All connections should be airtight with EPDM gaskets.

.6 Tank connections to be made of PVC SCH 80 fittings as per Section 44 05 50.

.7 Tanks to include molded-in clear strips (entire tank height), graduated in “Litres”; the strips should be positioned to monitor tank content.

.8 Provide a minimum of three (3) molded-in lifting lugs. Tank shall be capable of being lifted into position as a unit.

.9 Tank, lifting lugs tie-down lugs, connections and other tank accessories are to be designed by tank manufacturer, based on static load, live load and earthquake load for Napanee region as per OBC, with various levels of Alum solution in tank. The tank units shall be configured to allow direct tank base retention for seismic load conditions. The base retention unit shall be anchor bolted to an appropriate structure and not require additional spacer blocks.

.10 Anchor Bolts. Contractor to supply and install eight (8) anchor bolts per tank. Bolts to be 19 mm diameter anchor bolts, HILTI KWIK Bolt 3 316SS or approved equal.

.11 Acceptable manufacturers: Assmann, Polyprocessing, ACO Containers, or approved equivalent.

2.5 ALUM FILL STATION CABINET

.1 Custom design stainless steel (ASTM A276, Type 316) NEMA 4X exterior weatherproof fill station cabinet as indicated on contract drawings. Weatherproof corrosion resistant cabinet shall include the following:

.1 Double leaf front access doors complete with piano hinges.

.2 Lockable and tamper proof, provide 2 locks;

.2 The chemical fill station cabinet shall house:

.1 The chemical storage tank level indicator display.

.2 Controls for the chemical storage tank motorized inlet valves.

.3 Tank fill alarm indicator.

.4 Cam-lock adapter and manual isolation valve for tank filling connection.

.3 Design fill station cabinet to withstand all environmental loads including snow, wind and seismic. Design all anchorage to containment curb and structure based on most critical load cases.

.4 Field measure and coordinate with architectural finish prior to submitting shop drawings for the cabinet. All submitted shop drawings shall be sign and stamped by a Professional Engineer licence in the Province of Ontario. Loads used for design shall be clearly stated on the shop drawings.

PART 3 EXECUTION

3.1 FACTORY TESTING CHEMICAL STORAGE TANKS

.1 Material Testing

.1 Perform gel and low temperature impact tests in accordance with ASTM D 1998 on condition samples cut from each polyethylene chemical storage tank.

.2 Degree of Crosslinking. Use Method C of ASTM D 1998- Section11.4 to determine the ortho-xylene insoluble fraction of crosslinked polyethylene gel test. Samples shall test at no less than 60 percent.

.2 Tank Testing

.1 Dimensions: Take exterior dimensions with the tank empty, in the vertical position. Outside diameter tolerance, including out-of-roundness, shall be per ASTM D 1998. Fitting placement tolerance shall be +/- 1/2-in vertical and +/- 1 degree radial. Visual: Inspect for foreign inclusions, air bubbles, pimples, crazing, cracking, and delamination.

.2 Hydrostatic test: Following fabrication, the bottom tanks, including inlet and outlet fittings, shall be hydraulically tested with water by filling to the top sidewall for a minimum of 1/2 an hour and inspected for leaks. Following successful testing, the tank shall be emptied and cleaned prior to shipment.

.3 Tank to be tested for leakage at the factory prior to delivery. Written report is to be sent to Contractor and to the Engineer prior to delivery.

3.2 DELIVERY AND STORAGE

.1 Contractor is to coordinate equipment delivery to construction site with Manufacturer. Unloading and storage prior to installation at site is the responsibility of the Contractor.

3.3 INSTALLATION AND INSPECTION

.1 The chemical dosing pumps, storage tanks and other chemical system shall be installed as indicated on the Contract Drawings, in accordance with the Manufacturer's recommendations and as approved by the Engineer.

.2 The Contractor shall provide a dual containment clear HDPE pipe where the pipe runs outside the containment in the building.

.3 Prior to start-up, a factory trained service representative employed directly by the Manufacturer shall inspect, operate, test, adjust and troubleshoot the installation. This work will ensure that the equipment has been installed properly, lubricated adequately, checked for soundness and ready to be started.

.4 The factory trained representative, mentioned above, will certify that the equipment is ready for operation before use.

.5 In addition, the factory trained representative shall instruct the owner's operation personnel in the proper operation and maintenance of the equipment supplied.

.6 Provide for additional supervision of installation by equipment Supplier as required.

.7 Arrange with the Contract Administrator a mutually agreeable date when the representative should be on site.

.8 Submit a report, signed by the Manufacturer's representative, describing in detail the inspection, tests, and adjustments made, quantitative results and suggestions for precautions to be taken to ensure proper maintenance. The report must verify that the equipment conforms to all specifications.

.9 Inspection to include checking for:

.1 Cracks and other damaged or defective parts.

.2 Completeness of installation as specified and as recommended by the Manufacturer.

.3 Correctness of setting, alignment and relative arrangement of various parts of the system.

3.4 MECHANICAL TESTING AND CERTIFICATION

.1 After start-up and prior to final acceptance, the Contractor shall conduct Engineer-witnessed performance tests on the equipment.

.1 Prepare calibration curves for each of the pumps at 8 mA through 20 mA flow signals using a minimum of 16 different data points.

.2 Prepare tables to record the test results for each calibration curve. Have table reviewed by the Engineer prior to testing. Submit the results to the Engineer for review.

.3 Conduct the calibration curve testing using the intended design flow rates.

.2 A field service representative will start the chemical dosing pumps to perform all mechanical functions that the pumps are designed to perform. Tests will be scheduled with the Contract Administrator at least two (2) weeks prior to the planned test date.

.3 The factory trained representative shall submit to the Engineer a written report stating that the equipment has been checked and is suitable for operation.

.4 Hydrostatic test: Following installation of storage tanks, including inlet and outlet fittings, shall be hydraulically tested with water by filling to the top sidewall for a minimum of 24 hour and inspected for leaks.

3.5 SUPERVISION OF INSTALLATION AND COMMISSIONING

.1 Test and commission the equipment in accordance with Section 01 91 13 Commissiong Requirements and Section 01 91 23 Equipment Installation and Start Up.

.2 At the completion of satisfactory installation, each unit shall be started by the General Contractor under the supervision of the Supplier and in cooperation with the plant operations staff. All controls and alarms shall be checked and tested to ensure proper control and equipment protection.

.3 Equipment will only be accepted after receipt of a satisfactory report submitted by the Manufacturer's representative(s).

.4 When the installation and operation is satisfactory, the Supplier shall certify in writing to the General Contractor that the unit is available for operation.

.5 Modify or replace equipment or materials failing required tests.

.6 Perform additional testing required due to changes of materials, and/or failure of materials or construction to meet specifications at no extra cost to the Owner.

.7 As a minimum, allow the following:

.1	Installation Inspection	1 trip, 1 day
.2	Startup/Commissioning	1 trip, 2 days

3.6 STORAGE

.1 Prior to the installation, the chemical dosing pumps and systems and accessories should be protected and stored indoors in a dry area, in accordance with the Manufacturers recommendations.

3.7 MAINTENANCE

.1 Provide maintenance on Supplier's equipment as required by the Supplier from the date of delivery to the initial start-up.

3.8 TRAINING

.1 The manufacturer of the chemical systems shall furnish the services of a competent and experienced operator of the equipment, who is directly employed by the manufacturer, to instruct the Owner's operating personnel in the proper operation and maintenance of the equipment. In accordance with Section 01 91 41 - Commissioning Training.

3.9 WARRANTY

.1 Each unit shall be new and shall carry the full Manufacturer's warranty on parts, service, and performance. The warranty shall include replacement of all defective equipment and shall extend two (2) years beyond date of completion.

.2 Corrective Work. Any location where corrosion is evident shall be considered a failure of the material or the protection system. Before starting corrective work, the Manufacturer shall submit to the Engineer for review an analysis of the cause of the failure and details of the proposed corrective work. The Manufacturer shall make repairs acceptable to the Engineer at all points where failures are observed within the Warranty Period.

.3 Inspection. Each unit shall be inspected at the end of the warranty period by representatives of the Owner, the Engineer, and the Manufacturer to identify any failures that may have occurred. The Manufacturer shall establish the date of each inspection and shall notify the Owner at least 30 days in advance. The scheduled inspection shall not relieve the Manufacturer from the obligation to perform corrective work whenever needed.

.4 The Manufacturer shall prepare and deliver to the Owner an inspection report covering each inspection, indicating the number and type of failures observed, material and part where materials have failed, the percentage of the surface area where corrosion protection system failure has occurred, and the names of the persons making the inspection. Colour photographs illustrating each type of failure shall be included in the report.

END OF SECTION

AUTOMATIC REFRIGERATED SAMPLER

PART 1 GENERAL

1.1 WORK OF THIS SECTION

.1 The work of this section includes providing an automatic refrigerated wastewater samplers and all necessary piping, pumps, connections, controls, mounts, valves, motors, and appurtenances, complete and operable.

1.2 RELATED SECTIONS

.1 Section 013300 Submittals

.2 Section 019113 Commissioning Requirements

.3 Section 019133 Commissioning Forms

.4 Section 019141 Commissioning Training

1.3 SUBMITTALS

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

1.4 COMMISSIONING AND TRAINING

.1 Commissioning, Training and closeout documents are to be carried out in accordance with Sections 019113, 019133, and 019141.

1.5 SYSTEM DESCRIPTION

.1 Performance Requirements

.1 Sample cooling: maintain sample liquid at 4°C (39°F) in ambient temperature to 50°C (122°F) maximum; accurate to ±0.8°C (±1.5°F).

.2 Sample volume: programmable in 10 mL increments from 10 to 10,000 mL. Sample volume repeatability ±5% of 200 mL sample volume with: 4.6 m (15 ft.) vertical lift, 4.9 m (16 ft.) of 3/8- in vinyl intake tube, single bottle, full bottle shut-off at room temperature and 1524 m (5000 ft.) elevation.

.3 Pacing intervals: selectable in single increments from 1 to 9,999 flow pulses or 1 to 999 hours in 1 minute increments. Accepts 4-20mA input from an external device to pace the sampler.

.4 Vertical lift: 8.5 m (28 ft.) using 8.8m (29 ft.) maximum of 3/8-in. vinyl intake tube at sea level at 20 to 25°C (68 to 77°F).

.5 Sample volume accuracy: ±5% of 200 mL sample volume with: 4.6 m (15 ft.) vertical lift, 4.9 m (16 ft.) of 3/8- in. vinyl intake tube, single bottle, full bottle shut-off at room temperature and 1524 m (5000 ft.) elevation.

.6 Sample transport velocity: 0.9 m/s (2.9 ft./s) at 4.6 m (15 ft.) vertical lift (16 ft. of 3/8-in. vinyl intake tubing at 70°F at 5000 ft. elevation).

.7 Pump flow rate: 4.8 L/min (1.25 gpm) at 1 m (3 ft.) vertical lift with 3/8-in intake tube typical.

1.6 CERTIFICATIONS

.1 Controller: CE/CSE

.2 Cabinet: UL/CSA/CE

1.7 ENVIRONMENTAL REQUIREMENTS

.1 Operational Criteria

.1 Ambient operating temperature with controller compartment heater: 5 to 50 °C.

.2 Headworks Influent Sampler: Class 1 Division 1 Group D.

.3 UV Effluent Sampler: Unclassified.

PART 2 PRODUCTS

2.1 AUTOMATIC SAMPLER

.1 The automatic sampler shall consist of a controller and all weather refrigerator.

.2 Tubing:

.1 Pump tube: 0.95 ID x 0.16 OD cm (3/8 ID x 5/8 in. OD)

.2 Intake tube: 9.5 mm (3/8 in.) ID vinyl or Teflon® lined polyethylene 25 ft. lengths

.3 Weighted strainer constructed of 316 stainless steel and Teflon

.3 The controller housing of the automatic sampler shall be submersible, watertight, dust-tight, corrosion- and ice-resistant to NEMA 4X, 6, IP68 standards.

.4 The Graphics Display shall be 1/4 VGA, Color; self-prompting/ menu-driven program.

.5 The desiccant cartridge, which prevents moisture from accumulating inside the controller electronics area, shall be visual and accessible externally from the side of the controller; the replacement of the desiccant shall not require tools or disassembly of controller from base.

.6 The pump shall use spring loaded rollers and be accessible by a clear hinged cover with single thumbscrew.

.7 The Refrigerated cabinet shall be insulated with 3-inch rigid foam insulation on the walls, 6 inches on the bottom and 5 inches on top. The cover for the controller compartment shall also be insulated.

.8 The cabinet shall have a heavy duty compressible gasket on controller compartment lid, compressor compartment lid and refrigeration compartment door.

.9 The refrigeration components and copper plumbing shall be corrosion protected with conformal coating.

.10 The thermal control system shall be digital microprocessor-based and responds to a system of temperature sensors that continually monitor the evaporator plate, controller compartment air temperature, and refrigerated compartment air temperature.

.11 An air sensing thermostat shall be capable of maintaining sample liquid within specified limits.

.12 The power requirement is 115 Vac, 60 Hz.

.13 The sampler shall be equipped with the following communication protocol:

.1 USB and RS485 (Modbus)

.14 The membrane switch keypad user interface shall be self-prompting/menu driven program with 2 multiple function soft keys.

.15 Sampling pacing modes shall include Time Weighted, Flow Weighted, Time Table, Flow Table, and Event.

.16 Internal software shall be protected by a 7 amp fuse.

.17 Diagnostics: View event and alarm logs.

.18 A program lock shall be provided for access code protection to prevent tampering of program and system settings.

.19 The sampler shall be configured for composite sampling, and shall be equipped with a 5.5 gallon sample bottle and full bottle shut-off control.

.20 Sampling features are to include:

.1 Dual programming: Up to 2 sample programs can be run sequentially, in parallel, or according to day of week scheduling; enabling a single sampler to function like multiple samplers

.2 Cascade sampling: for two samplers in combination—the first sampler, at the completion of the program, initiates the second.

.3 Status Screen: Communicates what program is running, if there are any missed samples, when the next sample will be taken, how many samples remain, number of logged channels, time of last measurement, memory available, number of active channels, if alarms were triggered, when alarms were triggered, active sensors and cabinet temperature

.21 Datalogging

.1 Sample History: Stores up to 4000 entries for sample time stamp, bottle number and sample status (success, bottle full, rinse error, user abort, distributor error, pump fault, purge fail, sample timeout, power fail and low main battery)

.2 Measurements: Stores up to 325,000 entries for selected measurement channels in accordance with the selected logging interval

.3 Event Log: Stores up to 2000 entries. Records Power On, Power Fail, Firmware Updated, Pump Fault, Distributor Arm Error, Low Memory Battery, Low Main Battery, User On, User Off, Program Started, Program Resumed, Program Halted, Program Completed, Grab Sample, Tube Change Required, sensor communication errors, cooling failed, heating failed, thermal error corrected

.22 Automatic shutdown modes:

.1 Multiple bottle mode: after complete revolution of distributor arm (unless continuous mode is selected).

.2 Composite mode: after preset number of samples have been delivered to composite container, from one to 999 samples, or upon full container.

.23 Sample distribution modes include single bottle composite, multi-bottle composite, multi-bottle discrete, bottles per sample, samples per bottle or a combination of bottles per sample and samples per bottle

.24 The sample collection cycle is optionally repeated from one to three times if a sample is not obtained on the initial attempt.

.25 Controller to be able to receive 0/4 – 20 mA signal from external instruments and be equipment with four low voltage, contact closures and four relay controlled by alarms

.26 Standard equipment shall include:

.1 Controller: high impact injection-molded ABS/PC plastic

.2 All weather cabinet: linear low density polyethylene with UV-inhibitors

.3 Pump enclosure: corrosion-resistant polycarbonate door, high impact-resistant plastic, polyphenylene sulfide track complete with heating elements to prevent the sample bottles and tubing from freezing, capable of maintaining a 5°C internal temperature with a minimum external temperature identified above.

.4 Intake strainers in standard size, high velocity, or low profile for shallow depth applications. All 316 stainless steel.

.5 Exterior dimensions shall not exceed 51” H x 30” W x 32” D.

.6 Controller compartment heater

.7 Bottle kits

.8 20m of 3/8” ID, 5/8” OD medical grade silicone suction line with stainless steel strainer and quick release stainless steel coupling.

.9 AC battery back up

.10 Cables and interfaces (as required for programming and/or data acquisition

.11 Anchor brackets

2.2 MODE OF OPERATION

.1 The sampler is to be set up as a composite sampler and programmed to take one 24-hour sample every week using an integrated signal with the SBR discharge sequencing programmer.

.2 Timing of sample is to be programmable on date and time of day.

2.3 STANDARD OF ACCEPTANCE

.1 Hach Model AS950, All-Weather Refrigerated Sampler including refrigerated sampler complete with sampler controller, transition assembly, refrigerated assembly, bottle tray, composite bottle, intake tubing and strainer.

PART 3 EXECUTION

3.1 INSTALLATION AND COMMISSIONING

.1 Install sampler and accessories in accordance with Section 44 05 00 and this specification.

.2 Install sampler and accessories in accordance with manufacturer's recommendations

.3 Provide training and commissioning in accordance with Division 1.

END OF SECTION

PARSHALL FLUME

PART 1 GENERAL

1.1 SUMMARY

.1 This section includes the provision and installation of Parshall Flumes.

1.2 RELATED SECTIONS

.1 The work of the following sections applies to this Section, those referenced below and others required for proper performance of this work.

.1 Division 25 and 26

1.3 REFERENCES

.1 ASTM D 638 – Standard Test Method for Tensile Properties of Plastics.

.2 ASTM D 790 – Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.

.3 ASTM D 1941-91(2001) – Standard Test Method for Open Channel Flow Measurement of Water with the Parshall Flume

.4 ASTM D 2583 – Test Method for Indentation Hardness of Rigid Plastics by Means of a Barcol Impressor.

.5 ISO 9826-92 – Measurement of Liquid Flow in Open Channel – Parshall and SANIIRI Flumes.

.6 United States Department of the Interior, Bureau of Reclamation, Water Measurement Manual.

1.4 SUBMITTALS

.1 Shop Drawings:

.1 The following shall be submitted in compliance with Section 01 33 00:

.2 Product Data: Test results of representative fiberglass reinforced plastic laminate.

.3 Shop Drawings:

.1 Critical dimensions, jointing and connections, fasteners and anchors.

.2 Materials of construction.

.3 Sizes, spacing, and location of structural members, connections, attachments, openings, and fasteners.

.4 Samples: 8-inch square sample of representative fiberglass reinforced plastic laminate.

.5 Manufacturer’s installation instructions.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Store products indoors or in weather protected area until installation. Protect from construction traffic and damage.

PART 2 PRODUCTS

2.1 MANUFACTURER

.1 The product shall be manufactured by TRACOM, Virtual Polymer Compounds (VPC), or Open Channel Flow (OCF).

.2 Warranty: Flumes shall be warranted to be free of defects in workmanship and materials for a period of two years from substantial performance.

2.2 PARSHALL FLUMES

.1 Flume Type: Provide flumes of the following types:

.2 Size: 457.2mm (18 inch).

.3 Construction:

.1 One-piece construction. Plus the additional wingwalls.

.4 Materials:

.1 Fiberglass reinforced plastic.
.2 Gloss inside surfaces, free of irregularities.
.3 Minimum 3/16 inch wall thickness.
.4 Minimum 30% glass by weight.
.5 Isophthalic polyester resin.
.6 .Removable pultruded fiberglass bracing at top of flume with T-304 stainless steel hardware.
.7 2 inch (minimum) top and end stiffening flanges.
.8 Molded-in stiffening ribs, maximum 12 inch center to center spacing.
.9 15 mil Isophthalic U.V. resistant gel coat on all surfaces, white interior, grey exterior.
.10 Anchor clips, pre-drilled with a 3/4 inch hole, pultruded fiberglass construction.
.11 Tensile strength (ASTM D 638): 14,000 PSI.
.12 Flexural strength (ASTM D 790): 27,000 PSI.
.13 Flexural modulus (ASTM D 790): 1,000,000 PSI.
.14 Barcol hardness (ASTM D 2583): 50.

.5 Laminated, high visibility staff gauge:

.1 Graduated in 2mm increments.

.6 Ultrasonic mounting bracket:

.1 Horizontally and vertically adjustable stainless steel.

.2 2 inch NPT coupling for ultrasonic mounting bracket (bracket by others).

.7 End Connections:

.1 Inlet and outlet wingwalls (45 degree angle type or as recommended by the manufacturer for the channel).

PART 3 EXECUTION

3.1 EXAMINATION

.1 Verify that the flume dimensions are correct and project conditions are suitable for installation. Do not proceed with installation until condition deficiencies have been corrected.

3.2 INSTALLATION

.1 Install products in accordance with engineer's instructions, plans, blueprints, etc.

.2 Ensure that the product is installed plumb and that the upstream floor is level.

.3 Set the flume at the elevation indicated on the design drawings.

.4 Embed the flume in concrete; pour concrete in maximum 6 inch lifts; internally line and brace the flume as necessary to ensure bowing or distortion does not occur.

.5 For additional installation instructions refer to the Flume supplier.

3.3 ADJUST AND CLEAN

.1 Clean surfaces in accordance with the manufacturer's instructions.

.2 Remove trash and debris, and leave the site in a clean condition.

END OF SECTION

PRESELECTED EQUIPMENT

PART 1 GENERAL

1.1 DEFINITIONS

.1 Preselected Equipment Supplier: The party under separate contract with the Contract Administrator to furnish the Products or special services specified herein.

.2 Preselected Equipment Suppliers:

.1 Headworks Screening and Vortex Grit Removal: Claro Environmental Technologies

.2 Secondary and Tertiary Treatment Systems: Aqua-Aerobics Systems Inc.

.3 UV Disinfection Equipment: Trojan Technologies

.4 Waste Activated Sludge Thickeners: Huber Technology

.3 Tender Documents, Drawings/Contract Drawings means all documents, specifications, plans, profiles, drawings, sketches or copies thereof, used or prepared for, or in connection with, the Work and are included in the Contract Documents as Appendices clearly labeled and identified.

.4 Preselected Equipment Contracts: Purchase Agreements with Preselected Equipment Suppliers that include the services specified herein and Novated by the Contractor.

.5 Preselected Equipment and Systems: Equipment, structural platform systems, electrical and instrumentation systems supplied by the Preselected equipment Supplier and installed by the Contractor

.6 Preselected Engineering Services: Design of piping systems and electrical and instrumentation systems by the Preselected equipment Supplier that are to be supplied and installed by the Contractor.

.7 Preselected Equipment Supplier Drawings: Shop drawings and design drawings provided by the Preselected Equipment Supplier, these are also included in the Contract Documents as an Appendix.

1.2 REFERENCES

.1 All sections of this contract Divisions 01 through 44.

.2 Section 44 50 10 – Screening and Vortex Equipment

.3 Section 44 50 30 – WAS Thickener

.4 Section 44 50 40 – AGS and Tertiary Treatment Systems

.5 Section 44 50 50 – UV Disinfection

1.3 INTENT

.1 This Section covers the review of Preselected Equipment Supplier drawings; receipt of equipment direct delivery from the Preselected Equipment Suppliers storage; installation; commissioning of all Preselected equipment; and, provision and installation of various process piping, electrical and instrumentation systems designed by the Preselected Equipment Suppliers.

.2 In general, the Preselected Equipment Supplier will provide the following work:

.1 Prepare and deliver Preselected Equipment Supplier Drawings.

.2 Design and fabricate the specified Preselected equipment as per consultant pre-selection specifications.

.3 Design of various process piping, electrical and instrumentation systems

.4 Arrange and pay for delivery of Preselected equipment and material to the Site and/or the Contract Administrator's storage facilities, as instructed by the Contract Administrator/Consultant.

.5 Maintain equipment in accordance with its own instructions and recommendations prior to delivery to the Site and/or the Contract Administrator's storage facilities.

.6 Provide written instructions and recommendations for unloading/handling, long term storage, and maintenance of equipment.

.7 Deliver bill of materials to the Contract Administrator.

.8 Inspect deliveries jointly with the Contract Administrator, the Consultant and the Contractor.

.9 Supervision of unloading of Preselected equipment.

.10 Complete shop tests and Certified Factory Acceptance Testing and arrange for the Contract Administrator/Consultant to witness tests.

.11 Complete the PLC software programming required to achieve full operation of automatic equipment, where specified.

.12 Calibrate instruments and submit calibration certificates of instruments supplied as part of the Preselected package.

.13 Provide written instructions and recommendations for assembly and installation.

.14 Supervise and certify the installation of Preselected equipment, various process piping, field devices and instruments.

.15 Assist with startup and commissioning of Preselected packages.

.16 Provide operator training prior to equipment operation and services during the warranty period.

.17 Correct Preselected equipment deficiencies where applicable and with direction of original equipment manufacturer, as identified by the Contract Administrator.

.18 Prepare and submit equipment operation and maintenance manuals.

.19 Prepare and submit electronic copies of the PLC application programs with documentation.

.20 Supply tools and spare parts.

.3 In general, the Contractor shall provide the following Work:

.1 Review all Preselected Equipment Supplier Drawings provided by each Preselected Equipment Supplier and compare. It should be noted that the Supplier' shop drawings have been pre-purchased.

.2 Plan and coordinate equipment delivery from the Contract Administrator's storage or from the Preselected Equipment Supplier, where the delivery date is scheduled during construction.

.3 Plan and coordinate receipt of Preselected equipment at Site.

.4 Inspect deliveries jointly with the Contract Administrator, the Consultant and the various Preselected Equipment Suppliers.

.5 Review Preselected Equipment Suppliers' bills of materials and notify the Contract Administrator of any discrepancies with the reviewed shop drawings or problems anticipated in the installation of the equipment.

.6 Handle Preselected equipment and material including receiving, unloading, uncrating and on-Site storage before installation in accordance with the Preselected Equipment Supplier's instructions and directions.

.7 Maintain Preselected equipment in accordance with the Preselected Equipment Supplier's instructions and directions until installation and commissioning.

.8 Install Preselected equipment, piping, instruments, field devices and control panels, including components shipped loose, in accordance with the Preselected Equipment Supplier's reviewed shop drawings and installation instructions.

.9 Supply and install field wiring to ensure a complete and fully functional system.

.10 Supply and install power to Preselected equipment and field devices to ensure a complete and fully functional system.

.11 Plan and coordinate supervision of installation, inspection, testing, commissioning, training and other services provided by the Preselected Equipment Suppliers.

.12 Assist with testing, startup and commissioning of Preselected equipment.

.13 Correct any installation deficiencies identified by the Contract Administrator/Consultant and/or the Preselected Equipment Suppliers.

.14 Provide warranty services for the installation of Preselected equipment.

1.4 PRESELECTED EQUIPMENT

.1 The Contractor shall review the Preselection contract documents and drawing submittals, to determine the exact extent of the Work required to install the Preselected Equipment. Refer to the Appendices to the Specifications for the Preselected Contracts and drawing submittals.

.2 The Contractor shall take directions from the Preselected Equipment Suppliers regarding the intricacies of installations, the extent of Work required, and coordination requirements.

.3 The costs for the preselected equipment have been secured and letters of intent have been attached in the Appendices. The Contractor shall carry the costs of the preselected equipment in the Tender price.

.4 The Contractor shall plan and coordinate the following:

.1 Equipment delivery from the Preselected Equipment Suppliers and on-Site storage of equipment upon its delivery.

.2 Inspection of equipment deliveries, testing, commissioning, training and other field services provided by Preselected Equipment Suppliers.

1.5 SUBMITTALS

.1 The Supplier shop drawings have been pre-purchased. The Contractor shall be responsible to review and re-submit the shop drawings included in Appendices of this contract to ensure that the design and shop drawings match.

.2 Show the layout, location, and identification of materials and equipment provided by the Contractor for installation of Preselected Products.

PART 2 PRODUCTS

2.1 EQUIPMENT

.1 All materials and equipment as per System #1 & System #2 – Quotation as modified by addendums are to be supplied F.O.B. construction site.

.2 The contractor shall refer the equipment preselection specification for the equipment manufacturer’s product responsibilities.

PART 3 EXECUTION

3.1 INSTALLATION - GENERAL

.1 The Contractor shall install Products in conformance with the Preselected Equipment Supplier‘s Product shop drawings, design drawings, installation instructions and on-Site supervisors’ directions.

.2 The Contractor shall obtain verification that all Preselected equipment has been installed in accordance with the Manufacturer’s instructions and documentation from the Supplier. Refer to the Manufacturer’s Certificate of Proper Installation.

.3 The Contractor shall provide all interconnecting structures, equipment, piping complete with fittings, manual valves and electrical power and wiring, conduits,

instrumentation, finish painting and accessories required for the components of the Preselected Equipment Supplier's equipment to be installed with the equipment provided under the contract. The Contractor shall verify with each Preselected Equipment Supplier what is being supplied by the Supplier and what is to be provided by the Contractor for a complete and functional system. The Contractor shall refer to the Preselected Equipment Suppliers' shop drawings and design drawings found in the Appendices to the Contract Documents.

.4 The Contractor shall provide foundation pads for the Preselected Equipment as shown on the Contract Drawings including the Preselected Equipment Supplier Drawings. Verify the exact dimensions and configuration of all pads, including penetrations, with the Preselected Equipment Suppliers' Product drawings.

.5 Anchor Bolts:

.1 Where not provided by the Preselected Equipment Supplier, the Contractor shall provide anchor bolts, fasteners, washers, and templates needed for the complete installation of the Preselected Equipment.

.2 The Contractor shall size and locate anchor bolts in accordance with the Preselected Equipment Supplier's Product drawings and installation instructions.

.3 The Contractor shall supply the anchor bolt pattern templates and install the anchor bolts both in existing and new concrete slabs.

.6 The Contractor shall properly align, plumb and level, with no stresses on connecting piping or conduit, the Owner's Preselected equipment.

.7 The Contractor shall verify the correct installation of all Preselected electrical installation prior to starting up any electrical equipment including but not limited to direction of motor rotation before starting equipment drives.

.8 The Contractor shall verify the operability and safety of the electrical system needed to operate Preselected Equipment. Check the electrical system for continuity, phasing, grounding, and proper functions.

.9 Unloading, equipment, installation, start-up and commissioning of equipment to be as per manufacturer's specifications, instructions, and as per approved shop drawings.

.10 Provide all connections, fittings, piping, valves, power and control wiring, electrical and instrumentation equipment, etc. to render the systems complete and operational.

3.2 CONTORLS AND INSTRUMENTATION

.1 Collect and file all test reports that are provided with each instrument and submit to Consultant as on arrival of each instrument. The Contractor shall advise the Consultant of any missing instrument test report.

.2 In the event of damage to instrument and/or control panels during shipment report the details of such damage to Consultant and the Preselected Equipment Suppliers.

.3 Install instruments and control panels as shown in installation detail drawings supplied by the Supplier and the Contract Drawings

.4 Provide or Site fabricate instrument pipe stands/brackets for all standalone type installation.

.5 Provide concrete plinth for floor mounted panels and make arrangements for cable entry in coordination with panel shop drawing.

.6 Install instruments and provide impulse tubing, Instrument isolation valves and associated fittings in accordance with instrument installation details. Provide signal and power supply cables as required.

.7 Provide cable tags and wire numbers as specified in the Contract Drawings and Documents.

.8 Provide local electrical power ON/OFF switch for field instruments requiring 120 V AC power supplies.

.9 Configure/setup all transmitters/indicators.

.10 Conduct loop test for all loops (Analog and Digital). Submit loop test report using sample loop test report provided.

.11 Analog loops shall be tested using 4-20 mA signal generator with values recorded at 0, 25, 50, 75, and 100 percent of span, rising and falling. The loop shall include field transmitter/indicator, cable, PLC and HMI.

.12 Where instruments are found defective or out of calibration the Contractor shall inform the Preselected Equipment Supplier and the Consultant. Upon receipt of authorization from the Preselected Equipment Supplier remove the instrument by disconnecting associated cables/impulse tube and return the instruments to the Preselected Equipment Supplier. Once the repaired instrument has been reinstalled by the Contractor, the Contractor shall carry out necessary steps to make the instrument ready for loop check.

.13 The Contractor shall coordinate the installation, the placing and location of system components, their connections to the process equipment panels, cabinets and devices, under the direction of the Preselected Equipment Supplier. Contractor shall be responsible to insure that all field wiring for power and signal circuits are correctly done and provide for all necessary system grounding to insure a satisfactory functioning installation. The Contractor shall schedule and coordinate work under this Section with that of the electrical work specified under applicable Sections of Division 16 – Electrical.

.14 Submit reports as listed below and as per the Electrical Common Work Requirements Specification 26 05 00.

.1 System Problem Report
.2 Sample I/O Test Report
.3 Loop Status Report
.4 Instrument Calibration Report
.5 I & C Valve Adjustment Sheet
.6 Performance Test Sheet
.7 Reliability Test – Repair Report

3.3 FIELD FINISHING

.1 Products will be delivered with prime and finish coat(s) applied.

.1 The Contractor shall touch up or repair damage to coatings resulting from handling, storage, installation, testing, and startup.
.2 If finish coats are damaged extensively after transfer, the Contractor shall completely repaint.
.3 The Contractor shall touch up, repair, or complete the repainting to match the colour of the original paint, and the paint used shall be fully compatible with applied primers and finish.

3.4 PRODUCT PROTECTION

.1 Immediately after installation, until substantial performance of the Work, the Contractor shall lubricate components in accordance with the Preselected Equipment Suppliers' instructions.

.2 The Contractor shall follow the Preselected Equipment Suppliers' instructions for protection and maintenance during storage, and after installation until the date of Substantial Performance.

.3 The Contractor shall furnish incidental supplies including lubricants, cleaning fluids, and similar products as needed for protecting and maintaining the Preselected Equipment Suppliers' Products.

3.5 TEST AND INSPECTION

.1 The Contractor shall assist the Preselected Equipment Suppliers in performing tests and inspections of installed Products in accordance with the requirements shown herein, Section 01 91 13 – Commissioning Requirements, and the Preselected Equipment Suppliers' instructions.

END OF SECTION

SCREENING & VORTEX GRIT REMOVAL EQUIPMENT

PART 1 GENERAL

1.1 REFERENCE

.1 Section 10 – Napanee WPCP, quotation Documents for supplying, delivering and commissioning pre-selected equipment systems – System #1 & 2 – Screening and Vortex Grit Removal Equipment.

.2 The contractor shall novate the purchase agreement between the Owner (Town of Greater Napanee) and the equipment supplier (Claro Environmental Technologies). Via the Novation agreement the contractor will become responsible for the equipment purchase agreement, installation and commissioning of the equipment.

1.2 PRE-SELECTED EQUIPMENT

.1 Claro Environmental Technologies & Equipment has been pre-selected to supply, deliver and commission the Fine Screening Equipment and the Vortex Grit Removal Equipment as per the preselection specification documentation included Section 10. Contractor shall contact Pro Aqua Inc. (Scott Lenhardt, scott@proaquasales.com, 905-330-9244) the representative of the equipment manufacturer Claro Headworks equipment (Peter Lipert Jr., pjr@claroglobal.ca, 1-514- 562-4575) to obtain a final quotation price and delivery period, and to verify and confirm the materials, equipment and commissioning services that will be supplied as per their preselected equipment obligations. The quotation and delivery period for the above mentioned equipment is to be entered in the Form of Tender of the General Contract in the "Schedule of Pre-Selected Equipment".

1.3 APPROVALS

.1 Equipment and materials to be CSA certified. Where there is no alternative to supplying equipment which is not CSA certified, obtain special approval from Electrical Inspection Department prior to installation of equipment.

.2 Factory assemble control panels and component assemblies.

1.4 SUBMITTALS

.1 Provide Shop Drawings stamped by a Professional Engineer licensed to practice in the Province of Ontario.

.2 Shop Drawings shall be provided in digital platforms that can be imported into Revit or Solidworks for use during the detailed design.

.3 Complete assembly and installation drawings, together with wiring diagrams, detailed specifications, and data covering materials used, parts, devices, and other

accessories forming a part of the equipment furnished, shall be submitted in accordance with Division 01 Specifications.

.4 Electrical connection diagrams and schematics identifying all items requiring electrical control or power for operation of the equipment shall be submitted for review. Submittals shall verify each applicable feature in this specification.

.5 The data and specifications for each unit shall include, but shall not be limited to, the following:

.1 Catalogue cuts or equipment data sheets showing Equipment Supplier's complete descriptive information and product literature, Equipment make and model, materials of construction.

.2 Dimensioned drawings for each process unit and accessories (General Arrangement Drawings), showing plans, elevation and appropriate cross sections of the complete process unit, including recommended location of local control panels, any lifting locations and type, materials of construction, overall weights, weights of largest components requiring removal for maintenance, clearance required around unit for maintenance access.

.3 Installation Instructions specific to the project.

.4 Drawings indicating all structural connections, clearances to structures and indicate loads transferred through connections.

.5 Process Control Narrative for the proposed control system, which shall detail operation mode, control strategy, default parameter setting and alarms. Operating description for the local control panel covering all logic and sequences of operation.

.6 Electrical requirements and all electrical and mechanical components, including catalogue data on ancillary electrical components including limit switches.

.7 Data indicating range and required setting of indicators, instruments, timers and other related devices.

.8 Submit Equipment Testing and Commissioning Plan, and Operating and Maintenance Manual, specific to the project, including the recommended procedures for off-loading, handling and storage of equipment until installed, lubrication, trouble-shooting guide, and safety issues.

.6 Distribution of supplied information:

.1 Upon notification of the award, the successful proponent shall prepare and submit, within the time period identified in the submittal forms, the above listed documents to the owner's representative for review and integration in the detailed design. The successful supplier shall provide a single technical contact person who will be available to provided detailed design recommendations.

1.5 STANDARDS

.1 All equipment and materials in accordance with the latest issue of all appropriate Standards and Codes, including, but not limited to the following:

.1 AFBMA - Load Ratings and Fatigue Life for Ball Bearings
.2 AGMA – American Gear Manufacturer's Association
.3 ANSI – American National Standards Institute
.4 ASME – American Society of Mechanical Engineers
.5 ASTM – American Society for Testing and Materials
.6 CEC – Canadian Electrical Code
.7 CEMA – Canadian Electrical Manufacturers Association
.8 CSA – Canadian Standards Association
.9 CWB – Canadian Welding Bureau
.10 IEC – International Electrotechnical Commission
.11 NEC - National Electrical Code
.12 NEMA – National Electrical Manufacturer's Association
.13 NFPA – National Fire Protection Association
.14 NFPA – National Fluid Power Association
.15 OSHA – Occupational Safety and Health Administration
.16 SSPC – Steel Structures Painting Council
.17 UL (cUL) – Underwriter's Laboratories Inc.

PART 2 PRODUCTS

2.1 EQUIPMENT

.1 All materials and equipment as per System #1 & System #2 – Quotation as modified by addendums are to be supplied F.O.B. construction site.

.2 The contractor shall refer the equipment preselection specification for the equipment manufacturer's product responsibilities.

PART 3 EXECUTION

3.1 INSTALLATION

.1 Unloading, equipment, installation, start-up and commissioning of equipment to be as per manufacturer's specifications, instructions, and as per approved shop drawings.

.2 Provide all connections, fittings, piping, valves, power and control wiring, electrical and instrumentation equipment, etc. to render the systems complete and operational.

3.2 START-UP AND COMMISSIONING

.1 Complete the start-up and commissioning as per the requirements of Division 01 of this contract.

END OF SECTION

WAS INCLINED PLATE THICKENER SYSTEM

PART 1 GENERAL

1.1 REFERENCE

.1 Section 10 – Napanee WPCP, quotation Documents for supplying, delivering and commissioning pre-selected equipment systems – System #3 – WAS Thickener System.

.2 The contractor shall novate the purchase agreement between the Owner (Town of Greater Napanee) and the equipment supplier (Huber Technology). Via the Novation agreement the contractor will become responsible for the equipment purchase agreement, installation and commissioning of the equipment.

1.2 PRE-SELECTED EQUIPMENT

.1 Huber Technology has been pre-selected to supply, deliver and commission the WAS Thickener System as per the quotation document in Section 10 including all addendums listed hereafter. Contractor shall contact Pro Aqua Inc. (Scott Lenhardt, scott@proaquasales.com, 905-330-9244) the representative of the equipment manufacturer Huber Technology (David Tomowich., 1-704- 949-1010) to obtain a final quotation price and delivery period, and to verify and confirm the materials, equipment and commissioning services that will be supplied as per this quotation. The quotation and delivery period for the above-mentioned equipment is to be entered in the Form of Tender of the General Contract in the "Schedule of Pre-Selected Equipment".

1.3 ADDENDUM TO PRE-SELECTED EQUIPMENT

.1 The following changes and/or clarifications have been made to the documents used in the pre-selection of equipment submission contained in Section 10 for System #3 – WAS Thickener System:

.1 All equipment shall be rated for Class I, Division II, Group D environment.

1.4 APPROVALS

.1 Equipment and materials to be CSA certified. Where there is no alternative to supplying equipment which is not CSA certified, obtain special approval from Electrical Inspection Department prior to installation of equipment.

.2 Factory assemble control panels and component assemblies.

1.5 SUBMITTALS

.1 Provide Shop Drawings stamped by a Professional Engineer licensed to practice in the Province of Ontario.

.2 Shop Drawings shall be provided in digital platforms that can be imported into Revit or Solidworks for use during the detailed design.

.3 Complete assembly and installation drawings, together with wiring diagrams, detailed specifications, and data covering materials used, parts, devices, and other accessories forming a part of the equipment furnished, shall be submitted in accordance with Division 01 Specifications.

.4 Electrical connection diagrams and schematics identifying all items requiring electrical control or power for operation of the equipment shall be submitted for review. Submittals shall verify each applicable feature in this specification.

.5 The data and specifications for each unit shall include, but shall not be limited to, the following:

.1 Catalogue cuts or equipment data sheets showing Equipment Supplier's complete descriptive information and product literature, Equipment make and model, materials of construction.

.2 Dimensioned drawings for each process unit and accessories (General Arrangement Drawings), showing plans, elevation and appropriate cross sections of the complete process unit, including recommended location of local control panels, any lifting locations and type, materials of construction, overall weights, weights of largest components requiring removal for maintenance, clearance required around unit for maintenance access.

.3 Installation Instructions specific to the project.

.4 Drawings indicating all structural connections, clearances to structures and indicate loads transferred through connections.

.5 Process Control Narrative for the proposed control system, which shall detail operation mode, control strategy, default parameter setting and alarms. Operating description for the local control panel covering all logic and sequences of operation.

.6 Electrical requirements and all electrical and mechanical components, including catalogue data on ancillary electrical components including limit switches.

.7 Data indicating range and required setting of indicators, instruments, timers and other related devices.

.8 Submit Equipment Testing and Commissioning Plan, and Operating and Maintenance Manual, specific to the project, including the recommended procedures for off-loading, handling and storage of equipment until installed, lubrication, trouble-shooting guide, and safety issues.

.6 Distribution of supplied information:

.1 Upon notification of the award, the successful proponent shall prepare and submit, within the time period identified in the submittal forms, the above listed documents to the owner's representative for review and integration in the detailed design. The successful supplier shall provide a single

technical contact person who will be available to provided detailed design recommendations.

1.6 STANDARDS

.1 All equipment and materials in accordance with the latest issue of all appropriate Standards and Codes, including, but not limited to the following:

.1 AFBMA - Load Ratings and Fatigue Life for Ball Bearings
.2 AGMA – American Gear Manufacturer's Association
.3 ANSI – American National Standards Institute
.4 ASME – American Society of Mechanical Engineers
.5 ASTM – American Society for Testing and Materials
.6 CEC – Canadian Electrical Code
.7 CEMA – Canadian Electrical Manufacturers Association
.8 CSA – Canadian Standards Association
.9 CWB – Canadian Welding Bureau
.10 IEC – International Electrotechnical Commission
.11 NEC - National Electrical Code
.12 NEMA – National Electrical Manufacturer's Association
.13 NFPA – National Fire Protection Association
.14 NFPA – National Fluid Power Association
.15 OSHA – Occupational Safety and Health Administration
.16 SSPC – Steel Structures Painting Council
.17 UL (cUL) – Underwriter's Laboratories Inc.

PART 2 PRODUCTS

2.1 EQUIPMENT

.1 All materials and equipment as per System #3 – Quotation as modified by addendums are to be supplied F.O.B. construction site.

.2 The contractor shall refer the equipment preselection specification for the equipment manufacturer's product responsibilities.

PART 3 EXECUTION

3.1 INSTALLATION

.1 Unloading, equipment, installation, start-up and commissioning of equipment to be as per manufacturer's specifications, instructions, and as per approved shop drawings.

.2 Provide all connections, fittings, piping, valves, power and control wiring, electrical and instrumentation equipment, etc. to render the systems complete and operational.

3.2 START-UP AND COMMISSIONING

.1 Complete the start-up and commissioning as per the requirements of Division 01 of this contract.

END OF SECTION

AEROBIC GRANULAR SLUDGE AND TERTIARY TREATMENT SYSTEMS

PART 1 GENERAL

1.1 REFERENCE

.1 Section 10 – Napanee WPCP, quotation Documents for supplying, delivering and commissioning pre-selected equipment systems – System #4 – Tertiary Treatment System.

.2 The contractor shall novate the purchase agreement between the Owner (Town of Greater Napanee) and the equipment supplier (Aqua-Aerobics Systems Inc.). Via the Novation agreement the contractor will become responsible for the equipment purchase agreement, installation and commissioning of the equipment.

.3 The Nereda AGS is subject to the Non-Disclosure Agreement signed by the prequalified contractors. It is incumbent on the Contractor to maintain discretion with regards to the sharing of the contract information and design drawings.

1.2 PRE-SELECTED EQUIPMENT

.1 AQUA-AEROBICS SYSTEMS Inc. has been pre-selected to supply, deliver and commission the Nereda Aerobic Granular Sludge and Tertiary Treatment Systems as per the purchase agreements and preselected equipment documents in Section 10 including all addendums listed hereafter. Contractor shall contact ACG-Envriocan (Mahkameh Kassehchi, mahkameh@g-envirocan.ca, 416-873-5307) the representative of the equipment manufacturer Aqua-Aerobics Systems Inc. (Mike Swartz, mswartz@aqua-aerobic.com, 815-639-44) to obtain a final quotation price and delivery period, and to verify and confirm the materials, equipment and commissioning services that will be supplied as per this quotation. The quotation and delivery period for the above-mentioned equipment is to be entered in the Form of Tender of the General Contract in the "Schedule of Pre-Selected Equipment".

1.3 APPROVALS

.1 Equipment and materials to be CSA certified. Where there is no alternative to supplying equipment which is not CSA certified, obtain special approval from Electrical Inspection Department prior to installation of equipment.

.2 Factory assemble control panels and component assemblies.

1.4 SUBMITTALS

.1 Provide Shop Drawings stamped by a Professional Engineer licensed to practice in the Province of Ontario.

.2 Shop Drawings shall be provided in digital platforms that can be imported into Revit or Solidworks for use during the detailed design.

.3 Complete assembly and installation drawings, together with wiring diagrams, detailed specifications, and data covering materials used, parts, devices, and other accessories forming a part of the equipment furnished, shall be submitted in accordance with Division 01 Specifications.

.4 Electrical connection diagrams and schematics identifying all items requiring electrical control or power for operation of the equipment shall be submitted for review. Submittals shall verify each applicable feature in this specification.

.5 The data and specifications for each unit shall include, but shall not be limited to, the following:

.1 Catalogue cuts or equipment data sheets showing Equipment Supplier's complete descriptive information and product literature, Equipment make and model, materials of construction.

.2 Dimensioned drawings for each process unit and accessories (General Arrangement Drawings), showing plans, elevation and appropriate cross sections of the complete process unit, including recommended location of local control panels, any lifting locations and type, materials of construction, overall weights, weights of largest components requiring removal for maintenance, clearance required around unit for maintenance access.

.3 Installation Instructions specific to the project.

.4 Drawings indicating all structural connections, clearances to structures and indicate loads transferred through connections.

.5 Process Control Narrative for the proposed control system, which shall detail operation mode, control strategy, default parameter setting and alarms. Operating description for the local control panel covering all logic and sequences of operation.

.6 Electrical requirements and all electrical and mechanical components, including catalogue data on ancillary electrical components including limit switches.

.7 Data indicating range and required setting of indicators, instruments, timers and other related devices.

.8 Submit Equipment Testing and Commissioning Plan, and Operating and Maintenance Manual, specific to the project, including the recommended procedures for off-loading, handling and storage of equipment until installed, lubrication, trouble-shooting guide, and safety issues.

.6 Distribution of supplied information:

.1 Upon notification of the award, the successful proponent shall prepare and submit, within the time period identified in the submittal forms, the above listed documents to the owner's representative for review and integration in the detailed design. The successful supplier shall provide a single technical contact person who will be available to provided detailed design recommendations.

1.5 STANDARDS

.1 All equipment and materials in accordance with the latest issue of all appropriate Standards and Codes, including, but not limited to the following:

.1 AFBMA - Load Ratings and Fatigue Life for Ball Bearings
.2 AGMA – American Gear Manufacturer's Association
.3 ANSI – American National Standards Institute
.4 ASME – American Society of Mechanical Engineers
.5 ASTM – American Society for Testing and Materials
.6 CEC – Canadian Electrical Code
.7 CEMA – Canadian Electrical Manufacturers Association
.8 CSA – Canadian Standards Association
.9 CWB – Canadian Welding Bureau
.10 IEC – International Electrotechnical Commission
.11 NEC - National Electrical Code
.12 NEMA – National Electrical Manufacturer's Association
.13 NFPA – National Fire Protection Association
.14 NFPA – National Fluid Power Association
.15 OSHA – Occupational Safety and Health Administration
.16 SSPC – Steel Structures Painting Council
.17 UL (cUL) – Underwriter's Laboratories Inc.

PART 2 PRODUCTS

2.1 EQUIPMENT

.1 All materials and equipment as per System #4 – Quotation as modified by addendums are to be supplied F.O.B. construction site.

PART 3 EXECUTION

3.1 INSTALLATION

.1 Unloading, equipment, installation, start-up and commissioning of equipment to be as per manufacturer's specifications, instructions, and as per approved shop drawings.

.2 Provide all connections, fittings, piping, valves, power and control wiring, electrical and instrumentation equipment, etc. to render the systems complete and operational.

3.2 START-UP AND COMMISSIONING

.1 Complete the start-up and commissioning as per the requirements of Division 01 of this contract.

END OF SECTION

ULTRA-VIOLET DIESINFECTION SYSTEM

PART 1 GENERAL

1.1 REFERENCE

.1 Section 10 – Napanee WPCP, quotation Documents for supplying, delivering and commissioning pre-selected equipment systems – System #5 – Ultra-Violet Disinfection System.

.2 The contractor shall novate the purchase agreement between the Owner (Town of Greater Napanee) and the equipment supplier (Trojan Technologies). Via the Novation agreement the contractor will become responsible for the equipment purchase agreement, installation and commissioning of the equipment.

1.2 PRE-SELECTED EQUIPMENT

.1 Trojan Technologies has been pre-selected to supply, deliver and commission the Ultra-Violet Disinfection System as per the quotation document in Section 10 including all addendums listed hereafter. Contractor shall contact H2Flo (Yianni Siamandouros, yianni@h2flow.com, 1-416-835-8851) the representative of the equipment manufacturer Trojan Technologies (Alyse Hickey, ahickey@trojantechnologies.com, 804-774-8011) to obtain a final quotation price and delivery period, and to verify and confirm the materials, equipment and commissioning services that will be supplied as per this quotation. The quotation and delivery period for the above-mentioned equipment is to be entered in the Form of Tender of the General Contract in the "Schedule of Pre-Selected Equipment".

1.3 APPROVALS

.1 Equipment and materials to be CSA certified. Where there is no alternative to supplying equipment which is not CSA certified, obtain special approval from Electrical Inspection Department prior to installation of equipment.

.2 Factory assemble control panels and component assemblies.

1.4 SUBMITTALS

.1 Provide Shop Drawings stamped by a Professional Engineer licensed to practice in the Province of Ontario.

.2 Shop Drawings shall be provided in digital platforms that can be imported into Revit or Solidworks for use during the detailed design.

.3 Complete assembly and installation drawings, together with wiring diagrams, detailed specifications, and data covering materials used, parts, devices, and other accessories forming a part of the equipment furnished, shall be submitted in accordance with Division 01 Specifications.

.4 Electrical connection diagrams and schematics identifying all items requiring electrical control or power for operation of the equipment shall be submitted for review. Submittals shall verify each applicable feature in this specification.

.5 The data and specifications for each unit shall include, but shall not be limited to, the following:

.1 Catalogue cuts or equipment data sheets showing Equipment Supplier's complete descriptive information and product literature, Equipment make and model, materials of construction.

.2 Dimensioned drawings for each process unit and accessories (General Arrangement Drawings), showing plans, elevation and appropriate cross sections of the complete process unit, including recommended location of local control panels, any lifting locations and type, materials of construction, overall weights, weights of largest components requiring removal for maintenance, clearance required around unit for maintenance access.

.3 Installation Instructions specific to the project.

.4 Drawings indicating all structural connections, clearances to structures and indicate loads transferred through connections.

.5 Process Control Narrative for the proposed control system, which shall detail operation mode, control strategy, default parameter setting and alarms. Operating description for the local control panel covering all logic and sequences of operation.

.6 .Electrical requirements and all electrical and mechanical components, including catalogue data on ancillary electrical components including limit switches.

.7 Data indicating range and required setting of indicators, instruments, timers and other related devices.

.8 Submit Equipment Testing and Commissioning Plan, and Operating and Maintenance Manual, specific to the project, including the recommended procedures for off-loading, handling and storage of equipment until installed, lubrication, trouble-shooting guide, and safety issues.

.6 Distribution of supplied information:

.1 Upon notification of the award, the successful proponent shall prepare and submit, within the time period identified in the submittal forms, the above listed documents to the owner's representative for review and integration in the detailed design. The successful supplier shall provide a single technical contact person who will be available to provided detailed design recommendations.

1.5 STANDARDS

.1 All equipment and materials in accordance with the latest issue of all appropriate Standards and Codes, including, but not limited to the following:

.1 AFBMA - Load Ratings and Fatigue Life for Ball Bearings

.2 AGMA – American Gear Manufacturer's Association
.3 ANSI – American National Standards Institute
.4 ASME – American Society of Mechanical Engineers
.5 ASTM – American Society for Testing and Materials
.6 CEC – Canadian Electrical Code
.7 CEMA – Canadian Electrical Manufacturers Association
.8 CSA – Canadian Standards Association
.9 CWB – Canadian Welding Bureau
.10 IEC – International Electrotechnical Commission
.11 NEC - National Electrical Code
.12 NEMA – National Electrical Manufacturer's Association
.13 NFPA – National Fire Protection Association
.14 NFPA – National Fluid Power Association
.15 OSHA – Occupational Safety and Health Administration
.16 SSPC – Steel Structures Painting Council
.17 UL (cUL) – Underwriter's Laboratories Inc.

PART 2 PRODUCTS

2.1 EQUIPMENT

.1 .1 All materials and equipment as per System #5 – Quotation as modified by addendums are to be supplied F.O.B. construction site.

PART 3 EXECUTION

3.1 INSTALLATION

.1 Unloading, equipment, installation, start-up and commissioning of equipment to be as per manufacturer's specifications, instructions, and as per approved shop drawings.

.2 Provide all connections, fittings, piping, valves, power and control wiring, electrical and instrumentation equipment, etc. to render the systems complete and operational.

3.2 START-UP AND COMMISSIONING

.1 Complete the start-up and commissioning as per the requirements of Division 01 of this contract.

END OF SECTION