NEW PIER 8 WWPS, FORCEMAIN, SEWER, AND STORAGE TANK SPECIFICATIONS

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DIVISION 1
GENERAL REQUIREMENTS

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SECTION 01000
GENERAL REQUIREMENTS

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SECTION 01000
GENERAL REQUIREMENTS

1 GENERAL

1.1 SECTION INCLUDES

.1 This section covers the mobilization, demobilization, provided to the Contractor and other general requirements of the Contract.

1.2 DEFINITIONS

.1 In these Specifications, the references to 'Engineer' and 'Contract Administrator' shall mean the "Consultant" as defined in Definition 4 to the CCDC 2-2008 Stipulated Price Contract.

.2 In these Specifications, the references to 'the City of Hamilton (City)', shall mean the "Owner" as defined in Definition 12 to the CCDC 2-2008 Stipulated Price Contract.

1.3 MOBILIZATION AND DEMOBILIZATION

.1 Supply and erect all signs, barricades, flashers, delineators, flag persons, and such other protection as may be required to protect the public during construction.

.2 Provide fence and hoarding as required to define Contractor's working area.

.3 Move onto site and set up offices, storage facilities, sanitary facilities, fencing and hydro.

.4 Provide all necessary access to the project including haul roads as required and restoration of surface to original condition after haul roads are removed.

.5 Move off site and remove Contractor's offices, storage facilities, and all temporary facilities and leave the site clean and tidy.

.6 Include all the costs for mobilization, demobilization in Lump Sum Breakdown under this Specification Section. The payment for mobilization shall not exceed 60 per cent of the mobilization/demobilization items. The payment can be included in the first payment certificate issued for the Contract subject to the Owner or Engineer being satisfied that full mobilization has been carried out. If the Owner or Engineer is not so satisfied, then an adjustment to the payment certificate that reflects the degree of mobilization, in the opinion of the Owner or Engineer, will be made.

.7 The payment for demobilization shall become due following Substantial Performance/Completion of the Works and subject to the Owner or Engineer

being satisfied that full demobilization has been carried out. If the Owner or Engineer is not so satisfied, then an adjustment to the payment certificate that reflects the degree of demobilization, in the opinion of the Owner or Engineer will be made.

1.4 GEOTECHNICAL INVESTIGATION

.1 Geotechnical investigation has been carried out in the Contract area. A copy of the report is provided in the Appendices.

.2 It is to be clearly understood that the information was accumulated for design purposes only and any interpretation placed on it by the Contractor is solely the responsibility of the Contractor. If additional boreholes are required by the contractor it will be completed by the Contractor and included in their bid.

.3 The Owner and Engineer accept no responsibility for the accuracy of the borehole information. Claims arising from the interpretation of available information will not be considered.

1.5 REQUIREMENTS OF AUTHORITIES AND AGENCIES

.1 The Owner will obtain the changes to the Drinking Water Works Permit for the permanent works from the Ministry of the Environment. All fees will be borne by the Owner.

.2 The Owner will obtain building permit and site plan approval from the City of Hamilton and the Hamilton Conservation Authority. All fees will be borne by the Owner.

.3 The Contractor shall apply for, obtain and pay for all permits required for the project except where otherwise noted, including but not limited to:

.1 Plumbing permit.

.2 Technical Standards and Safety Authority (TSSA).

.1 Field certification of equipment.

.3 Electrical Safety Authority (ESA). The Contractor shall apply for a review of the installation.

.1 Field certification of equipment.

.4 Ministry of Transportation Encroachment Permit

.4 The Contractor shall notify the Ministry of Labour of the commencement of construction by mailing a "Notice of Project", as necessary, in accordance with the latest version of the Occupational Health and Safety Act.

.5 The Contractor shall arrange for all other regular inspections and final inspections required.

.6 Where electrical enclosures and panels do not have CSA and/or ULC labels, the Contractor shall arrange for each such electrical enclosure or panel to be inspected by CSA or special inspectors.

.7 The Contractor shall be solely responsible, without limitations, for any delays arising from the Contractor's failure to plan for the required inspections and to ascertain the availability of the Permit/Approval/Licensing Inspectors to complete the required inspections for the Works under this Contract. The related costs and expenses incurred by the Contractor shall be borne by the Contractor, with no change in the Contract Price and/or Contract Time

1.6 NATURE OF SITE

.1 The Contractor shall make a careful examination of the Site and shall take all such steps as are necessary to ascertain the conditions under which the Works are to be carried out. No extra money shall be payable to the Contractor due to soil and/or groundwater conditions adversely affecting the Contractor's work or any other matter affected by the characteristics of the Site.

1.7 DAMAGE TO EXISTING UTILITIES AND STRUCTURES

.1 Any adverse impact and damage by the Contractor's vehicles shall be dealt with immediately and without any cost to the Owner.

.2 Obtain the necessary drawings and perform any necessary sub-surface investigations to determine the exact number and location of all existing utility services, structures, underground pipes, cables, utilities and other similar items.

.3 The locations for existing structures and underground pipes, cables, utilities, and other similar items as shown on the Contract Drawings do not relieve the Contractor of this responsibility.

.4 Take the necessary steps to ensure that no damage is caused to existing structures, buildings, foundations, roads, sidewalks, property, utility services, and other similar items during the progress of the Work.

.5 If any damage is caused, repair and make good such damage at no additional cost within a reasonable time and to the complete satisfaction of the Engineer.

1.8 OCCUPYING THE SITE

.1 Use only those areas designated by the Owner for the access, except in so far as is necessary for the execution of the Works, and in so doing, do not unnecessarily obstruct the normal traffic of, to, from or about the Site; and do not unreasonably

allow any vehicles or materials to stand in front of, or near to, any buildings on the Site or any access thereto.

.2 Areas shown as construction limits are areas to be used by the Contractor for construction, storage, access and temporary facilities.

.3 Confine operations within areas designated for construction, storage and access as shown on the Contract Drawings and/or as directed by the Engineer.

.4 Limit access to and from the site as instructed by the Engineer.

.5 Maintain safe access to any existing facilities for the operations staff at all times.

.6 Do not occupy or use any of the operational facility (restricted Areas) for a longer period than is necessary for the execution of any part of the works to be undertaken in those areas. Occupy an area not greater than the minimum required for that part of the works.

1.9 CONTRACTOR USE OF PREMISE

.1 Arrange with the Owner and Engineer for storage areas and access to the Works.

.2 Make arrangements with the Owner and the Engineer if additional areas are required. Obtain written agreements and submit copies to the Engineer.

.3 Confine operations within working limits for construction, storage and access.

.4 Carry out the construction of the Works in such a manner that a minimum of inconvenience is caused to the Owner and occupants of properties adjacent to the Works.

.5 Store materials separately on the Site at locations agreed upon with the Engineer, suitably protected to prevent their deterioration or the intrusion of foreign matter. In the opinion of the Engineer, remove any material which has deteriorated or been damaged immediately from the Site at no additional cost to the Owner.

.6 During construction of the facilities, liaise with the Engineer and the Owner to schedule work to minimize the impact on the station operations.

.7 Obtain written approval from the Engineer for work to the existing facilities. The Owner will operate any valve, switch, or other controls on existing facilities.

.8 Obtain written approval or confirmation of arrangement from the Engineer for access to conduct works outside the contract limits, within the other contractor's contract limits.

1.10 OWNER OCCUPANCY

.1 The Owner will occupy premises during entire construction period for execution of normal operations.

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

.3 Maintain free access and parking for the Owner.

1.11 PARTIAL OWNER OCCUPANCY

.1 Schedule and substantially perform designated portions of Work for Owner's occupancy prior to Substantial Performance of entire Works.

.2 The Owner will occupy designated areas to ensure effluent compliance.

1.12 OWNER FURNISHED ITEMS

.1 Incorporate existing equipment and materials as shown in the Contract Drawings.

.2 Selected as-constructed drawings of the existing facilities are included in the Appendices.

1.13 CONSTRUCTION PROGRESS SITE MEETING FREQUENCY

.1 Construction progress site meetings shall be scheduled one every two weeks. Site meeting frequency shall be weekly if the performance and schedule are not to the satisfaction of the Engineer and/or Owner, at no additional cost to the Contract.

1.14 SITE RECORDS

.1 The Engineer will provide one set of reproducible contract drawings at the beginning of the project for record drawings. Contractor to provide sets of white prints, as required, for each phase of the work. Mark thereon all changes as work progresses and as changes occur including Change Orders. (This shall include changes to existing systems, control systems and low voltage control wiring, etc.)

.2 On a weekly basis, transfer information to reproducibles, revising reproducibles 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.

.5 Store record documents and samples in field office apart from documents used for construction.

.6 Label record documents and file in accordance with Specification Section number. Label each document "CONSTRUCTION RECORD" in neat, large, printed letters.

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

.8 Keep record documents and samples available for inspection by the Contract Administrator on a monthly basis. This will be reviewed as part of the monthly progress payment application with monies withheld for incomplete record drawings.

.9 Contractor shall transfer all items in Request for Quotations (RFQ) and Request for Proposals (RFP) to the record drawings. Referrals to the RFQs and RFPs is not acceptable on the record drawings.

.10 Failure to update and maintain record drawings shall result in a delayed release of holdback payments to the Contractor in full until this is completed. Refer to Section 01780 – Closeout Submittals for additional requirements.

2 PRODUCTS – NOT APPLICABLE

3 EXECUTION – NOT APPLICABLE

END OF SECTION

SECTION 01060
REGULATORY REQUIREMENTS

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3 EXECUTION – NOT APPLICABLE 3

SECTION 01060
REGULATORY REQUIREMENTS

1 General

1.1 DESCRIPTION

.1 This Section covers the regulations, standards and considerations governing this Contract.

1.2 CODES AND STANDARDS

.1 Comply with all provisions of the rules, regulations and orders of Federal, Provincial and Municipal government agencies applicable to the work under the Contract.

1.3 LABOUR

.1 Ensure all monies due to the Workplace Safety and Insurance Board have been paid in full on the Contractor's behalf and that of his subcontractor's.

.2 Furnish a certificate to this effect issued by the Board before final release of monies owing the Contractor by the Owner and provide regular updates of the WSIB certificate with payment certificate submissions.

.3 The Contractor must apply for WSIB renewal certificates within the following WSIB designated period of time specified below:

.1 February 15 – February 19

.2 May 15 – May 19

.3 August 15 – August 19

.4 November 15 – November 19

Failure to obtain renewal certificate during the designated time period specified above will result in refusal for the Contractor to perform work given that there is no renewal certificate in effect.

.4 Pay fair wages to employees and have hours of work conforming to the local municipal fair wage by-law, if any, and in conformity with laws and regulations of the Province of Ontario.

.5 Conform to the current Occupational Health and Safety Act and Regulations, City's Health and Safety Policies, and any or all other Acts

and By-laws in force to ensure the safety of all workers and others engaged on the Site at all times.

.6 For the purpose of the current Occupational Health and Safety Act and Regulations, the Contractor will be designated the Constructor.

.7 The Contractor will be held in strict conformance with all regulations enacted by the Federal and Provincial Governments in conjunction with the Workplace Hazardous Materials Information System.

1.4 PERMITS

.1 The Owner will obtain the Approvals for the permanent works from the Ministry of the Environment. All fees will be borne by the Owner.

.2 Apply for, obtain, and pay for all other permits that are required for the project from the applicable authorities. The Owner will provide a clean set of Contract Drawings and Specifications for each such application. Refer to Section 01330 – Submittal Procedures.

.3 Adhere to and comply with all restrictions, inspections, construction requirements, etc. required by the permit issuing authorities.

1.5 HOURS OF WORK

.1 Normal working hours are considered to be 7:00 a.m. to 7:00 p.m. of any weekday that meets with the approval of the Engineer and providing that operations are conducted so as not to create a nuisance or disturb the peace unnecessarily.

.2 Comply at all times with the Local Noise By-law. The Contractor shall be responsible for obtaining any noise-by law exemption that may be required for equipment that must be kept in continuous operation.

.3 Obtain written approval of the Engineer if hours other than normal working hours are required or desired at least four days in advance of the contemplated change.

.4 Whenever, in the judgement of the Engineer, it may be necessary or expedient to conduct work at night or on weekends, holidays, or after or before normal working hours, the Contractor without any additional or extra cost to the Contract, shall perform the work.

1.6 RESPONSIBILITY OF THE CONTRACTOR

.1 The Contractor is to keep itself informed of governmental rules, regulations and orders.

.2 The Contractor is responsible for the implementation of regulatory requirements of any sub-contract he/she may enter into. Ensure that the requirements of this article are a part of any subcontract he may enter into.

.3 Furnish, in cooperation with the Owner, any information required by such governmental agencies.

1.7 SUBMITTALS

.1 Submit to the Engineer before starting that section of work where it pertains, copies of all permits and approvals required by any government agency, road authority, authority, or utility company.

2 PRODUCTS – NOT APPLICABLE

3 EXECUTION – NOT APPLICABLE

END OF SECTION

SECTION 01110
SUMMARY OF WORK

1 GENERAL 1

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3 EXECUTION – NOT APPLICABLE 4

SECTION 01110
SUMMARY OF WORK

1 GENERAL

1.1 WORK COVERED BY CONTRACT DOCUMENTS

.1 Work of this contract comprises general construction associated with the new wastewater pumping station wet well and building, sanitary storage tank, odour control system, sewers, forcemains, and associated works.

.2 This clause is not intended to define the scope of the contract. Use it only as a general guide to the extent of the work. The work includes:

.1 Mobilization

.2 Site preparation including construction of site access roadways, installation of fences, hoarding, gates, tree protection and the Contractor's laydown area.

.3 Excavation including, but not limited to, trucking and disposal of surplus soil and rock, installation of shoring systems and dewatering.

.4 Shut down of the existing pumping station and sewers from the existing buildings on Pier 8. Shut down of the sewer on Burlington St E. Any wastewater and stormwater by-pass pumping required to complete the works.

.5 Removal of existing fencing and lighting standards within the construction boundaries and relocation for storage in the Cheedookee Yard at 141 Studholmes Drive.

.6 Demolition and removal of existing pumping station.

.7 Confined space work.

.8 Construction of new pumping station, sanitary storage tank, and valve chambers.

.9 Waterproofing of all below ground structures.

.10 Installation of new mechanical, HVAC, electrical, and architectural components.

.11 Installation of process pumps including all station piping, valves, and appurtenances.

.12 Installation of odour control unit including all ducts, dampers, and appurtenances.

.13 Installation of indoor standby natural gas generator.

.14 Installation of all instrumentation and control equipment and SCADA equipment.

.15 Grading, construction of driveway, bollards, site works.

.16 Installation of water-tight sewers, manholes, forcemains, and valve chambers.

.17 Installation of new watermain and live tapping of existing watermains for tie-ins.

.18 Backfill and site grading.

.19 Testing, start-up, commissioning and training.

.20 Demobilization and restoration.

1.2 COORDINATING CONSTRUCTION WITH OPERATION OF EXISTING FACILITIES

.1 Coordinate construction activities on the site and within existing system, including pipe connections/disconnections, building connections, mechanical, electrical, and instrumentation connections, with the Engineer.

.2 The existing pumping station operates 24 hours a day, seven (7) days a week. In the event of conflict between the Work and routine facility operations, facility operations shall have priority. Take every precaution to avoid interfering with routine facility operation and maintenance. To avoid interference, reschedule applicable portions of the Work, if required, without change to the Contract Price and stipulated time to the Substantial Performance Date and Final Completion of the Work. Provide the Owner 30 days advance written notice of decommissioning the existing station.

.3 Unless a longer time is specified elsewhere in the Contract Documents, give the Owner a minimum 14 calendar days written advance notice of any portion of the Work whatsoever that requires assistance in any form from the Owner's staff including but not limited to isolation, by-passing, shutdown, tie-in, facility testing and start-up.

.4 Maintain existing fire/emergency vehicle and maintenance access/control at all times.

.5 The Owner will continue to maintain their system as required. It may also be necessary for maintenance contractors to perform emergency work in the construction area.

1.3 CONSTRUCTION SEQUENCING - GENERAL

.1 This Section does not describe the full extent of the work to be done under this Contract. It is intended to outline the general construction sequence only.

.2 Be responsible for scheduling of the works within the general sequence and permitted outages. Permitted outages stipulated within the contract documents must be continuous without interruption.

.3 The Engineer will review and approve the Contractor's construction sequence and schedule so as to minimize impact on operations, subject to approval of the Owner.

.4 Construct Work in stages to accommodate the Owner's use of premises and facility during construction. Within 14 calendar days of Notice to Proceed or Partial Notice to Proceed, the Contractor shall submit for approval by Engineer a surface access plan showing routes of access and road closures for Owner's personnel and Contractor's personnel during each phase of construction.

.5 Develop the construction schedule to accommodate the Owner's occupancy during construction.

.6 Obtain approval of the sequence of construction and schedule of all work within existing buildings and all existing station outages from the Owner and Engineer. All work related to isolation, shutdown, or tie-ins must have an approved plan before commencing. All valves in the existing system are to be operated only by the Owner.

.7 The following is a general sequence of construction for the work and is provided for bidding purposes only. The Contractor must develop a construction sequence and schedule upon receiving notice to proceed:

.1 Contractor is to mobilize on site and establish a delineated working area. All temporary fencing and privacy fencing is to be established prior to the commencement of any construction works.

.2 The site is to be prepared and cleared in accordance with the Specifications. A dewatering system is to be designed and installed.

.3 Excavation for the storage tank, pumping station foundation, and wet well is to occur in parallel with installation of an engineered shoring system.

.4 Concrete works are to be installed and finished as per the Specifications, following which, the they are to be tested for leaks and waterproofed.

.5 Backfill around underground structures and compact soil.

.6 Commence installation of masonry, mechanical, electrical, and metal works. Install yard piping including sewers and forcemains.

.7 Landscape site as per the grading plan.

.8 Install any remaining equipment, test, and commission as per the commissioning plan.

.9 Decommission, demolish and remove existing pumping station in its entirety. Confirm with Owner and Engineer equipment to be salvaged and delivered to Owner. Dispose of all concrete, equipment and materials off site. Saw-cut, cap, and plug all existing piping connected to the existing facility. Backfill to elevations indicated on the Site Grading Plan with material as specified.

.10 Demobilize and perform a site clean-up.

1.4 PERMITTED SERVICE SHUTDOWN

.1 All shutdowns (short or long) require 14 calendar days' notice with a Request for Shutdown application form submitted by the Contractor and signed by operations staff.

.2 All flushing and disinfection to pipes shall be paid for and completed by the Contractor.

.3 All service shutdowns shall be coordinated with and approved by the Owner and Engineer.

1.5 CONTRACT METHOD

.1 Construct the Works under a single lump sum contract.

2 PRODUCTS – NOT APPLICABLE

3 EXECUTION – NOT APPLICABLE

END OF SECTION

SECTION 01310
PROJECT MANAGEMENT AND COORDINATION

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SECTION 01310
PROJECT MANAGEMENT AND COORDINATION

1 GENERAL

1.1 PURPOSE

.1 The purpose of the schedule and reports mandated in this Section is to:

.1 Ensure adequate planning and execution of the Work by the Contractor.

.2 Establish the standard against which satisfactory completion of the Contract will be judged by the Engineer.

.3 Ensure that the Contractor provides, at regular intervals, sufficiently detailed and accurate information on the actual progress of the Work to enable the Engineer to analyze the validity of the Contractor's schedule updates.

.4 Assess the impact of changes to the Work.

.5 Substantiate, by way of a schedule demonstration, any request(s) by the Contractor for an extension of Contract Time.

.2 The Contractor has the obligation and responsibility, at all times, to plan and monitor all of its activities, anticipating and scheduling its staff, materials, station and Work methods in a manner to ensure completion of the Work in accordance with the terms and conditions of the Contract and at a rate that will allow the Work to be completed within the Contract Time.

1.2 SCHEDULE PREPARATION AND SUBMITTAL REQUIREMENTS

.1 The major types of schedule submittals and timing of submissions required under this Section are described in the following paragraphs.

.2 Baseline Schedules:

.1 Summary Level Preliminary Baseline Schedule:

.1 Shall be submitted to the Engineer and the Owner by the Contractor a minimum of two Working Days prior to the preconstruction meeting.

.2 Shall be submitted with accompanying narrative report. The narrative shall detail, at a minimum, all planned equipment, crew sizes and quantities.

.2 Detailed Preliminary Baseline Schedule:

.1 Shall be submitted to the Engineer and the Owner by the Contractor within ten Working Days after the date of the written Notice to Proceed or prior to the first progress payment, whichever occurs first.

.2 In order to ensure that the schedule is being developed according to the requirements of the Contract Documents, the Contractor shall be required to attend an initial schedule planning meeting and may be required to attend weekly meetings at which it will present to the Engineer the then-current version of the schedule. The Contractor will provide both hard and electronic copies of the schedule as it is developed, and as required by the Engineer. If so requested by the Engineer, the Contractor will require Subcontractors to attend these meetings.

.3 Resource-loaded, Critical Path Method (CPM) schedule using the latest commercially available version of MS Project.

.4 Shall be submitted with accompanying narrative report.

.5 Hard copies shall be submitted as a shop drawing in accordance with Section 01330 – Submittal Procedures.

.6 The Contractor shall provide the electronic copy of the schedule as both a MS Project file and PDF file.

.3 Detailed Final Baseline Schedule

.1 Shall be submitted to the Engineer and the Owner by the Contractor within 20 Working Days after the date of the written Notice to Proceed or prior to the first progress payment, whichever occurs first.

.2 Same requirements and format as specified above for Detailed Preliminary Baseline Schedule.

.3 Progress Schedules:

.1 Detailed Progress Schedules:

.1 Shall be submitted to the Engineer and the Owner by the Contractor once a month or more frequently as required.

.2 Shall be subject to the same requirements and format as specified above for the Detailed Final Baseline Schedule.

.3 Shall be submitted with accompanying construction photographs.

.2 Look-Ahead Schedule:

.1 Shall be submitted to the Engineer and the Owner by the Contractor once every two weeks using a simplified MS Excel spreadsheet format.

.2 Hard copies shall be submitted as a shop drawing in accordance with Section 01330 – Submittal Procedures.

.3 The Contractor shall provide the electronic copy of the schedule as both a MS Excel file and PDF file.

1.3 SCHEDULE PREPARATION

.1 With the exception of the Summary Level Preliminary Baseline schedule, the Contractor shall prepare schedules using the latest commercially available version of MS Project.

.2 The scheduling software shall be used to produce a resource-loaded Critical Path Method (CPM) schedule in the form of time-scaled diagrams with the critical path activities highlighted.

.3 Schedules shall be submitted to the Engineer in both hard copy and electronic formats. The Contractor shall provide the electronic copy of the schedule as both a MS Project file and PDF file. The hard copy of the schedule will be formatted as follows:

.1 Unless otherwise approved by the Engineer, white paper, 279mm x 432mm sheet size.

.2 Title Block: Show the name of project, project number, Contract number and owner, Data Date, date submitted, revision or update number, and name of scheduler.

.3 The As-Planned schedule will be numbered ‘0.0’. Revisions, if required, will be numbered ‘0.1’, ‘0.2’, etc. Numbering for the Progress Schedule updates shall reflect the number of months elapsed since the Contract commenced: that is, the first update will be numbered ‘1.0’; second month, ‘2.0’, etc.

.4 The Contractor shall identify horizontally, across the top of the schedule, the time frame by year, month, and day.

.5 The Contractor shall identify each activity with a unique number and activity code and a brief description of the Work associated with that activity.

.6 The Contractor shall reflect sequences of the Work, restraints, delivery windows, review times, Contract Times and Project Milestones set forth in Section 01110 – Summary of Work.

.7 The Contractor shall identify the duration of each activity and show early-start, early finish, late start, late finish and completion, and float for each activity and sub-activity.

.8 The Contractor shall identify the Work of separate stages and other logically grouped activities, and clearly identify critical path activities.

.9 Legend to describe standard and special symbols and bars.

.4 Scheduling Software:

.1 File Transfer and Back-Up: The Contractor, if requested, shall provide a copy of all baseline and update files on CD.

.2 Settings: The Contractor shall provide the Engineer with all the software settings it has used in the baseline schedules and updates. Examples of the information required are: Calendar Settings, User Preferences, Administrative Preferences, Schedule Settings, etc.

.3 Export to Excel: If requested, the Contractor will provide the Engineer with an Excel spreadsheet containing report data exported from the schedule.

.4 The Contractor will produce schedule layouts and reports according to the Engineer's requirements and instructions. Reports such as the following will be required in the indicated file formats:

.1 Detailed Schedule Layout [*.pdf* and *..mpp*]

.2 Critical Path Layout [*.pdf* and *.mpp*]

.3 Earned Value Tabular layout [*.xls*]

.4 Early and Late Resource curves [*.pdf*, *.xls*]

1.4 SUMMARY LEVEL PRELIMINARY BASELINE SCHEDULE

.1 The purpose of this schedule submission is to convey to the Owner at an early stage the Contractor's original plan to achieve overall and milestone(s) completion in accordance with the Contract Documents. Since this schedule is only expected to be developed to a summary level, it may be a bar chart, as opposed to a Critical Path Method schedule, and may be created using an MS Excel spreadsheet or other software application. The schedule should contain as much detail as is necessary to fully articulate the Contractor's plan up to and including completion certificate of the Work. The Contractor is also required to provide an accompanying narrative, describing in general terms how it intends to resource the project as well as assumed rates of production for major items of Work. The Contractor will provide any information requested by the Owner that the Owner consider necessary in order to understand the Contractor's original plan.

.2 The Contractor must submit the Summary Level Preliminary Baseline Schedule a minimum of two Working Days prior to the Pre-Construction meeting, and be prepared to discuss the schedule at the same meeting.

1.5 DETAILED PRELIMINARY BASELINE SCHEDULE

.1 The Detailed Preliminary Baseline Schedule, must be submitted within ten Working Days after the date of the written Notice to Proceed or prior to the first progress payment whichever occurs first. The Owner shall withhold the monthly progress payment until the Detailed Preliminary Baseline Schedule is acceptable in principle to the Owner and the Engineer.

.2 The Detailed Preliminary Baseline Schedule shall cover all phases of the Work, and shall represent the Contractor's practical original plan to complete the Work, considering restrictions of access and availability of Work areas, and availability and use of manpower, materials and equipment. It is to be a fully resource- loaded schedule, with labour, material and equipment resources provided at an activity level or as required by the Owner.

.3 The Detailed Preliminary Baseline Schedule shall show the sequence and interdependencies of construction and commissioning activities, as well as project-related activities reasonably required to complete the Work, and shall address the following, at a minimum:

.1 The Owner's issuance and the Contractor's receipt of the Notice to Proceed or Partial Notice to Proceed.

.2 Obtaining any applicable permits, design drawings, specifications and shop drawing submittals for early Product procurement, and

long lead time items. Refer to Section 01330 – Submittal Procedures.

.3 Mobilization and other preliminary activities.

.4 Site access.

.5 Any initial Site Work as applicable.

.6 Specified Work sequences, constraints, and Milestones, including Substantial Performance and Contract completion of the Work date(s).

.7 Type of Work to be performed by the Subcontractor(s) involved.

.8 Major equipment design, fabrication, factory testing, and delivery dates.

.9 Submittals such as shop drawings that are critical or near critical to schedule completion. Refer to Section 01330 – Submittal Procedures

.10 Major components of the Work and other relevant details, including at a minimum:

.1 Site Work

.2 Concrete Work

.3 Equipment Work

.4 Mechanical Work

.5 Electrical Work

.6 Leakage testing of tanks and structures

.7 Any applicable interfaces with Owner' furnished pre-purchased equipment

.8 Other important Work for each major facility

.9 Equipment and system startup and test activities

.10 Project closeout and cleanup

.11 Demobilization

.4 The activities defined in the Detailed Preliminary Baseline Schedule shall represent the planned durations in anticipation of normal manpower and equipment utilization in durations of whole Working Days. Except for non-construction activities, such as procurement, delivery or submittals, no activity duration shall exceed 20 Working Days unless approved by the Engineer. The durations shall be determined based upon resource planning under contractually-defined on-Site work conditions. The Engineer may require that the duration of major activities be calculated by the scheduling software on the basis of the planned rate of daily production. The Contractor will resource load the schedule using labour, and not crew, hours unless otherwise instructed by the Engineer. In calculating activity durations, normal inclement weather shall be considered. The Contractor shall schedule the Work to minimize the effect of adverse weather, and to allow for protection of the Site from such effects.

.5 Work Breakdown Structure (WBS)

.1 Within five Working Days of the date of the Notice to Proceed, the Contractor shall submit to the Engineer for approval its proposed WBS. The Contractor will incorporate any and all changes to the WBS Structure requested by the Engineer.

.2 Level one of the WBS shall include categories such as: Milestones, divided into separate (Level Two) subcategories for Contract, and Construction, Milestones; General Conditions; Submittals; Major Equipment; Construction; Commissioning; Project Close-Out.

.6 Activity Descriptions

.1 Activity names shall: describe action; identify building element; and specify location.

.7 Activity Numbering

.1 Activity numbers shall be alphanumeric and conform to the Engineer’s instructions.

.8 Activity Coding

.1 The Contractor shall make extensive use of the activity coding capabilities of the scheduling software in order to satisfy the grouping, sorting, filtering and report generating requirements of the Owner.

.9 Examples of the activity codes that will be required are: phase; area; location; responsibility; work type, etc.

.10 The estimated cost to perform each activity in the Detailed Preliminary Baseline Schedule will be entered into the MS Project schedule. The sum of all activity costs shall equal the Contract Price and each Division subtotal shall equal the subtotal provided in the Lump Sum Breakdown Schedule submitted with the Form of Tender by the Contractor. An unbalanced or front-end loaded schedule will not be accepted.

.11 The Detailed Final Baseline Schedule shall be accompanied by a narrative that provides a detailed description of the labour, materials, station, means and methods that the Contractor intends to use to carry out the Work and achieve the planned rate of production required to support the activity durations shown in the schedule. The narrative shall also provide explanations supporting the use of lead-lag relationships and constrained dates.

.12 The Contractor shall submit all revisions and/or additional information requested by the Engineer pursuant to its review should the Engineer consider that these additions are necessary for the Detailed Preliminary Baseline Schedule in order to comply with the requirements of this Section.

.13 Submission of the schedules (including Baseline and Progress Schedules) referred to in this Specification Section, and any subsequent updates to such schedules, shall constitute the Contractor's representation that:

.1 The Contractor and its Subcontractors intend to execute the Work in the sequence indicated in such schedule.

.2 The Contractor has distributed the proposed schedule to Subcontractors and Pre-purchased Equipment Vendors for their review and comment, and has obtained their concurrence.

.3 All elements of the Work required for the performance of the Contract are included. Failure to include any such element shall not excuse the Contractor from completing the Work within the milestone dates and Contract Time and other constraints specified in the Contract Documents.

.4 Seasonal weather conditions have been considered and included in the planning and scheduling of the Work influenced by high and low ambient temperatures and/or precipitation.

.5 The Contractor has thoroughly inspected the Site, considered the work of other Contractors and, where necessary to complete the Work under this Contract, coordinated its plan with Other Contractors retained by the Owner.

.6 The Contractor has incorporated any other special conditions in planning the Work such as specified or required Work restriction periods, etc.

.7 The express or implied acceptance by the Owner and/or the Engineer of the final as-planned schedule and any progress schedules shall not constitute an approval or acceptance of the Contractor's construction means, methods, or sequencing or its ability to complete the Work in a timely manner, and shall not place any obligation or responsibility on the Owner toward the Contractor nor shall it, in any way, limit or restrict the Contractor's obligations and responsibilities under the Contract. The Owner' and/or the Engineer's acceptance shall demonstrate agreement that:

.1 Contract Time, including dates of Substantial Performance of the Work, contract completion of the Work and all intermediate Milestones are within the specified times

.2 Specified Work constraints are shown as specified in the Contract Documents

.3 Access restrictions are accurately reflected

.4 Submittal review times are as specified in the Contract Documents

.5 Start-up, testing and facility commissioning times are as specified in the Contract Documents

.6 Submittal review times are as specified in the Contract Documents

.7 Training durations are as specified in the Contract Documents and timing is acceptable

1.6 DETAILED FINAL BASELINE SCHEDULE

.1 The required revisions must be made and the Detailed Preliminary Baseline Schedule finalized to the satisfaction of the Owner and the Engineer, whereupon it will become the Detailed Final Baseline Schedule, against which progress will be measured.

.2 The Detailed Final Baseline Schedule must be submitted within 20 Working Days after the date of the written Notice To Proceed and prior to the second progress payment whichever occurs first. The Owner shall withhold all or part of the monthly progress payment until the Detailed Final Baseline Schedule is acceptable in principle to the Owner and the Engineer.

.3 The Contractor acknowledges and understands that time is of the essence of this Contract and therefore that Baseline Early dates for activities, and not the late dates, reflect the target dates for project planning and execution. The Contractor will plan for, and enlist, resources with the goal of achieving the early dates.

1.7 DETAILED PROGRESS SCHEDULES

.1 The Contractor shall submit a Detailed Progress Schedule to the Engineer at the end of each month, with each application for payment starting with the second monthly progress payment. The schedule, together with the related data and reports specified in this Section, shall be submitted along with the monthly progress payment application. The progress payment application will not be reviewed until the schedule update is submitted. The Owner may withhold all or part of the monthly progress payment until the updated Detailed Progress Schedule is updated in a manner acceptable to the Engineer.

.2 Each Detailed Progress Schedule shall record and report data and report actual completion and/or start dates for each completed or in-progress activity, activity per cent complete for in-progress activities and forecast completion dates for all activities that are not yet complete. As-built logic will be adjusted as required to reflect the actual sequence of the Work. The Detailed Progress Schedule will show the projected completion date of the Work based on the progress information inserted into it, without changes to the schedule logic or the original duration of any activity. The Contractor shall use the retained logic option when executing schedule calculation. The Detailed Progress Schedule (or an approved revision thereto) will be shown as a target schedule to indicate whether the current progress schedule remains on target, has slipped or is ahead of schedule.

.3 The Contractor may then, in a second and subsequent update to the progress schedule, incorporate any logic and duration changes that represent its revised planning, provided all such changes are identified and documented in the schedule narrative, and are agreed to by the Engineer.

.4 If it appears that the progress schedule submitted by the Contractor no longer represents the actual sequencing and progress of the Work, the Engineer may instruct the Contractor to revise the progress schedule.

.5 The Engineer shall set the time allowed for the submission of a revised schedule required.

.6 Timely submission of updates is of significant and crucial importance to the management of this Contract. The lack of, or late receipt of, updates diminishes their value to the Owner. Therefore, if the Contractor fails to submit any progress schedule or required revision to a progress schedule

within the time period prescribed in the Contract Documents, the Owner, in its sole discretion, may hold back subsequent progress payments until the updated schedule is submitted or the revision is accepted.

.7 A complete schedule update submission (to be submitted along with each monthly progress payment application) must include the following schedule and progress reports:

.1 An updated progress schedule, comparing actual and target progress.

.2 A cash flow graph, generated by the MS Project scheduling software, comparing the targeted to actually achieved progress.

.3 A resource-loaded graph, comparing targeted to actual labour and material.

.4 A schedule narrative, including:

.1 Detailed descriptions of progress, including comparison of planned to actual rates of production, key deliveries to the Site, construction, erection, testing and commissioning.

.2 A discussion of the basis for any Work sequencing, logic, interdependencies or original activity duration revisions incorporated into an updated schedule.

.3 Comparisons of actual and planned progress, with a brief commentary on any actual or forecast delays or problems that might have an impact on the completion date of the Work, and a discussion of the measures being (or to be) adopted to overcome these.

.4 Records of Contractor's personnel and construction equipment on Site.

.5 Progress photographs.

.6 Safety statistics, including details of any hazardous incidents and activities relating to environmental aspects and public relations.

.7 Any other information specifically required by the Engineer.

.5 The Contractor shall provide the Engineer with a complete weekly list of personnel, station and construction equipment as well as production rates actually achieved on all major activities, and

labour hours for all major trades such as, for example, the formwork, mechanical, and electrical trades.

.6 If requested by the Engineer, the Contractor shall incorporate and logically connect approved Contract changes into the Critical Path Method (CPM) schedule. Each change will be identified by number and description, and activities/milestones will be added to record the following:

.1 Date the change was identified

.2 Date the change was priced (if applicable)

.3 Start and finish dates of the changed Work

.7 In the case of a potentially critical delay occurring between the regular schedule updates, and if requested by the Engineer, the Contractor shall update the schedule at the beginning of the delay event and at the resolution of the delay issue. Activities will be added to the schedule as required to analyze the delay using the Time Impact Analysis method.

.8 In order to further define (beyond the level of detail shown in the Detailed Final Baseline Schedule) critical portions of the Work such as facility shutdowns, the Contractor shall, if requested, develop detailed schedule fragments.

.9 The scheduling software's resource leveling features can only be used with the permission of the Engineer.

.10 The Contractor will maintain, in a MS Excel worksheet, a daily as-built bar chart schedule that will record Work actually performed against each schedule activity.

1.8 TESTING AND COMMISSIONING SCHEDULES

.1 The Contractor shall submit Commissioning Schedules in accordance with Section 01640 – Manufacturers' Services, Section 01650 – Equipment Startup and Performance Testing and Section 01660 – Commissioning.

1.9 LOOK-AHEAD SCHEDULES

.1 The Contractor shall provide short interval "look ahead" schedules once every two weeks, identifying Work that has been performed during the past two weeks and activities that are planned for the next four weeks. The short interval schedule shall be consistent with the progress schedule currently in force.

.2 The Look-Ahead Schedules shall generally reflect the Work associated with the Detailed Progress Schedule. The activities in the Look-Ahead Schedules shall be identified by the same number coding as the Detailed Progress Schedule and revised as necessary.

.3 The Contractor shall use a customized MS Excel spreadsheet template.

1.10 RISK MANAGEMENT PLAN

.1 The Risk Management Plan is an informative document that presents the Contractors proposed plan in order to mitigate critical construction risks.

.2 The Contractor is ultimately responsible for managing and mitigating all construction risks.

.3 The Contractor shall submit a Risk Management Plan showing the proposed action plan for critical construction risks include but not limited to the following risks:

.1 Delayed delivery of critical equipment.

.2 Excessive construction noise:

.1 Provision of level base line for noise.

.2 Inform local residents regarding the timing of excavation works.

.3 Poor construction air quality:

.1 Provision of full-time water truck to control dust

.4 Settlement of structures due to construction vibrations:

.1 Complete a pre-construction and post-construction elevation survey of existing nearby structures including buildings and valve chambers to measure any potential settlement.

.2 Survey the existing structures during excavation to monitor potential settlement.

1.11 COMPLETION, MILESTONES AND CONSTRAINTS

.1 The Owner has set out a Substantial Performance date for the Work based on the Time for Completion clauses in the Form of Tender. These dates shall be strictly adhered to; in this regard, the Contract provides for liquidated damages.

.2 Float is defined as the amount of time between the earliest start date and the latest start date of an activity or chain of activities on the CPM schedule. Float shall not be for the exclusive use of either the Contractor or the Owner.

.3 Use of float suppression techniques such as software constraints, preferential sequencing, special lead/lag logic restraints, extended activity times, or imposed dates, other than as required by the Contract, shall be cause for the rejection of any schedule submitted by the Contractor.

.4 In the event that the Contractor's progress schedule indicates completion prior to the stipulated overall completion (or other milestone) date, such float will not be for the exclusive use of either the Contractor or the Owner.

1.12 COMPLIANCE WITH SCHEDULE

.1 The Contractor shall comply with the latest schedule approved by the Owner and the Engineer.

.2 If, at any time, the Work is behind schedule with respect to the progress schedule currently in force, and if the Engineer believes there is a risk of the Work not being completed within the Contract Time as a result of such delay, the Contractor shall take all necessary measures to make up for such delay either by increasing staff, station or facilities, or by amending its Work methods, whichever is applicable, with no change to the Contract Price.

.3 In all cases of delay or potential delay, the Contractor shall keep the Engineer informed of its intentions with regard to mitigation of such delay and the Engineer may, if in its sole opinion it is deemed necessary, require the Contractor to revise all or part of its current progress schedule.

.1 If the Contractor fails to complete an activity by the latest approved scheduled completion date and this failure is anticipated to extend the Contract Time (or any Milestone(s)), the Contractor shall, within five Working Days of such failure, submit a written statement as to how the Contractor intends to recover the schedule shortfall and achieve targeted completion.

.2 The Owner may order the Contractor to increase its station, equipment, labour force, or working hours, at no additional cost, if the Contractor fails to:

.1 Complete a Milestone activity by the stipulated completion date; or

.2 Satisfactorily execute the Work as necessary to prevent delay to overall completion.

1.13 PROJECT PHOTOGRAPHS

.1 The Contractor must photographically document all phases of the Contract including preconstruction, construction progress (daily as a minimum), and post-construction.

.2 The Contractor must ensure that a digital camera is available at the Site for its own use and for the use of the Engineer. The Contractor shall enlist the services of a professional photographer to take photographs of the various parts of the construction on a regular basis and when problems or matters of particular interest or importance arise.

.3 Copies of such photographs shall be retained on Site until completion of the Work and should be identified with the following information:

.1 Date when photograph was taken and by whom

.2 Contract number

.3 Contractor's name

.4 Location (i.e., grid lines)

.5 Direction of view

.6 Description

.7 Contractor's photo file number (so that each photo may be readily identified)

.4 Deliver to the Owner and Engineer six electronic copies on CD-ROM or DVD-ROM. The Engineer may direct the Contractor to obtain additional photographic records of structures and features within the Site limit.

.5 The Engineer shall have the right to select the subject matter and vantage point from which photographs are taken. Matters of importance or interest which are to be photographed include:

.1 After the execution of the Contract and before the Work at the Site is started, and again upon issuance of Substantial Performance of the Work, take photographs of the construction Site as well as the property adjacent to the perimeter of the construction Site

.2 Structures, both inside and outside the Site. The pre-construction records will be compared to the post-construction records to assess damage or displacement of existing structures

.3 Faulty Work

.4 Type of excavation; width of trench, etc.

.5 Sheeting and shoring used

.6 Dewatering methods, condition of bottom of excavation

.7 Work on elements

.6 A complete set of photographs shall be prepared by the Contractor and submitted to the Engineer in six copies, plus six electronic copies to demonstrate how the Work is actually progressing and the planned and detailed sequencing of the Work at the time of the report. The cut-off date for the monthly progress report shall be as instructed by the Engineer.

1.14 WEEKLY NEWSLETTERS

.1 The Contractor shall prepare weekly newsletters and e-mail a PDF copy to the Engineer and the Owner every Monday morning.

.2 Newsletters shall summarize the Work completed the previous week and shall include pictures associated with this Work.

.3 Throughout the project, the Owner and Engineer can request the raw (non-PDF) electronic copies of any newsletters, including pictures.

.4 At Substantial Performance, six CDs containing all of the raw (non-PDF) and PDF copies shall be provided.

.5 Any Work completed between Substantial Performance and end of Warranty shall also be included in newsletters and six CDs updated at the end of the Warranty period to cover the entire project.

2 PRODUCTS (NOT USED)

3 EXECUTION (NOT USED)

END OF SECTION

Project Name:	**New Pier 8 WWPS, Forcemain, Sewer, and Storage Tank**
City Project Number:	
Last Date Updated:	

Class	Asset Code (By City)	Tag no.	Description (location)	Condition	Installation Date	Commission Date	Warranty Date	Serial No.	Manufacturer	Local Supplier (next page has contact info)	Model	Asset Value	Installation Cost Estimate above Asset Value	Life Expectancy (Years)	Nameplate Field	Nameplate Data

SECTION 01330
SUBMITTAL PROCEDURES

1 GENERAL 1

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SECTION 01330
SUBMITTAL PROCEDURES

1 GENERAL

1.1 SECTION INCLUDES

1.1.1 Shop drawings and product data for critical and non-critical delivery items.

1.1.2 Samples.

1.1.3 Certificates and transcripts

1.1.4 City of Hamilton Forms.

1.2 ADMINISTRATIVE

1.2.1 Submit all listed submittals to the Engineer for review. Submit with reasonable promptness and in orderly sequence to prevent delay in the Works. 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.

1.2.2 Work affected by submittals shall not proceed until the review and approval process is complete.

1.2.3 Present shop drawings product data, samples and mock-ups in SI Metric units.

1.2.4 Where items or information is not originally produced in SI Metric units, converted values are acceptable.

1.2.5 Review submittals prior to submission to the Engineer. This review confirms that each submittal has been checked and coordinated with requirements of the Works and Contract Documents. Submittals not stamped, signed, dated and identified as to specific project will be returned without being examined and shall be considered rejected.

1.2.6 Notify the Engineer in writing, at time of submission, identifying deviations from requirements of Contract Documents stating reasons for deviations.

1.2.7 Verify that field measurements and affected adjacent work have been coordinated.

1.2.8 The Contractor’s responsibility for errors and omissions in submittals is not relieved by the Engineer's review of submittals. Review by the

Engineer is for conformance with the design concept and compliance with the Contract Drawings and Documents.

1.2.9 The Contractor’s responsibility for deviations in submittals from requirements of Contract Documents is not relieved by the Engineer's review.

1.2.10 Keep one reviewed copy of each submission on site.

1.3 SHOP DRAWINGS AND PRODUCT DATA

1.3.1 Refer to the specified named acceptable products for critical and non-critical delivery items as appropriate.

1.3.2 The term "shop drawings" means drawings, diagrams, illustrations, schedules, performance charts, brochures and other data which are to be provided by the Contractor to illustrate details of a portion of the Works.

1.3.3 Indicate materials, methods of construction and attachment or anchorage, erection diagrams, connections, explanatory notes and other information necessary for completion of the Works. Where articles or equipment attach or connect to other articles or equipment, indicate that such items have been coordinated, regardless of where they are specified or on which drawings the work appears. Indicate cross-references to Contract Drawings and Specifications.

1.3.4 Identify all shop drawings as agreed with the Engineer.

1.3.5 Allow 14 working days for the Engineer’s review of each submission.

1.3.6 Adjustments made on shop drawings by the Engineer do not address the issue of Contract Price. If adjustments affect the value of the Works, state this in writing to the Engineer prior to proceeding with the work.

1.3.7 Make all changes to shop drawings as required by the Engineer and consistent with Contract Documents. When resubmitting, notify the Engineer in writing of any revisions other than those requested.

1.3.8 Accompany submissions with transmittal letter containing:

1.3.8.1 Date

1.3.8.2 Project title and number

1.3.8.3 Contractor's name and address

1.3.8.4 Identification and quantity of each shop drawing, product data and sample.

1.3.8.5 Other pertinent data

1.3.9 Submissions shall include:

1.3.9.1 Date and revision dates

1.3.9.2 Project title and number

1.3.9.3 Contract Drawing and/or Specification Reference (Including Clause Number).

1.3.9.4 Name and address of:

.1 Subcontractor

.2 Supplier

.3 Manufacturer

.4 Contractor's stamp, signed by Contractor's authorized representative certifying approval of submissions, verification of field measurements and compliance with Contract Documents

1.3.10 Details of appropriate portions of Work as applicable:

1.3.10.1 Fabrication

1.3.10.2 Layout, showing dimensions, including identified field dimensions and clearances

1.3.10.3 Setting or erection details

1.3.10.4 Capacities

1.3.10.5 Performance characteristics

1.3.10.6 Standards

1.3.10.7 Operating Weight

1.3.10.8 Wiring diagrams

1.3.10.9 Single line and schematic diagrams

1.3.10.10 Relationship to adjacent work

1.3.11 Submit one PDF electronic and hard copy of shop drawings for each requirement requested in the specifications and as the Engineer may reasonably request.

1.3.12 Submit one PDF electronic and hard copy of product data sheets or brochures for requirements requested in the specifications and as requested by the Engineer where shop drawings will not be prepared due to standardized manufacture of product.

1.3.13 Delete information not applicable to project from all submittals.

1.3.14 Supplement standard information to provide details applicable to project as required.

1.3.15 If upon review by the Engineer, no errors or omissions are discovered or if only minor corrections are made, one PDF electronic or hard copy will be returned to the Contractor and fabrication and installation of the Works may proceed. If shop drawings are rejected, the noted copy will be returned and resubmission of corrected shop drawings, through the same procedure indicated above, must be performed before fabrication and installation of the Works may proceed. The Contractor shall accept full responsibility for the completeness of each resubmittal. The Contractor shall verify that all corrected data and additional information previously requested by the Engineer are provided on the resubmittal.

1.3.16 When the corrected PDF electronic and hard copies are resubmitted, the Contractor shall direct specific attention to all revisions in writing and shall list separately any revisions made other than those called for by the Engineer on previous submittals. Requirements specified for initial submittals shall also apply to resubmittals. Resubmittals shall bear the number of the first submittal followed by a letter (i.e., A, B, etc.). Resubmittals shall include all items from the original submittal in addition to the corrections and not just corrections or missing information from the original submission.

1.3.17 If more than one resubmittal is required because of failure of the Contractor to provide all previously requested corrected data or additional information, the Contractor shall reimburse the Owner for the charges of the Engineer for review of the additional resubmittals. This does not include initial submittal data such as shop tests and field tests that are submitted after initial submittal.

1.3.18 When resubmittals are needed, resubmittals shall be made within the number of days of the date on the letter returning the material to be modified or corrected as required, unless within the number days, as required, the Contractor submits an acceptable request for an extension of time, listing the reasons why the resubmittal cannot be completed within the stipulated time.

1.3.19 The need for more than one resubmittal, or any other delay in obtaining the Engineer review of submittals, will not entitle the Contractor to

extension of the Contract Times unless delay of the Work is the direct result of a change in the Work authorized by a Change Order.

1.3.20 The review of shop drawings by the Engineer is solely for general conformity with the Contract. The Engineer does not warrant or represent that information in the submittal is accurate or complete. Review does not relieve Contractor of responsibility for errors or omissions in design, including the submittal, that are the Contractor's responsibility, and for conforming and/or correlating with all quantities and dimensions, performing the Work, selecting performance means and methods, co-ordinating with other parts of the Work between trades, and performing the Work safely. Notwithstanding the review, Contractor remains solely responsible for Contract compliance.

1.3.21 The maximum size of shop drawings shall be 900mm x 1200mm to permit red line photocopy reproduction.

1.3.22 Shop drawings which require the approval of a legally constituted authority having jurisdiction shall be submitted by Contractor to such authority for approval. Such shop drawings shall receive final approval of authority having jurisdiction before Engineer's final review.

1.3.23 Shop drawings will be returned with a stamp indicating one of the following:

1.3.23.1 No Exceptions

1.3.23.2 Reviewed with Exceptions

1.3.23.3 Reviewed with Exceptions – Resubmit

1.3.23.4 Rejected

1.3.23.5 For Information Only

1.3.24 Include in every shop drawing submission, a copy of the relevant specification section, with addendum updates included. Check-mark each paragraph to indicate compliance with the specification or mark otherwise to indicate requested deviations from specified requirements. Check marks (√) denote full compliance with a paragraph in its entirety. If deviations from the specifications are indicated, underline each point of deviation and denote by a number in the margin to the right of the identified paragraph. The remaining portions of the paragraph not underlined will signify compliance with the specified requirements. Provide in the submittal a detailed, written justification for each deviation.

1.3.25 Payment for equipment or materials will only be made if shop drawings have been stamped “No Exceptions” or “Reviewed with Exceptions”.

1.3.26 Drawings stamped “Reviewed with Exceptions” must be revised for inclusion in the Operation and Maintenance Manuals.

1.3.27 Upon final review of the shop drawing, the Contractor is to submit the Engineer one electronic PDF and hardcopy of the final shop drawing for record keeping purposes.

1.4 SAMPLES

1.4.1 Submit samples in duplicate for review as requested in respective specification Sections. Submit samples with identifying labels bearing material or component description, manufacturer’s name and brand name, Contractor’s name, project name, location in which material or component is to be used, and date.

1.4.2 Deliver samples prepaid to the Engineer's business address, or as otherwise directed by the Engineer.

1.4.3 Notify the Engineer in writing, at time of submission of deviations in samples from requirements of the Contract Documents.

1.4.4 Where colour, pattern or texture is a selection criterion, submit the full range of samples.

1.4.5 Adjustments made on samples by the Engineer do not address the issue of Contract Price. If adjustments affect the value of the Works, state such in writing to the Engineer prior to proceeding with the work.

1.4.6 Make all changes to samples as required by the Engineer and consistent with Contract Documents.

1.4.7 Reviewed and accepted samples will become the standard of workmanship and material against which installed work will be verified.

1.5 CERTIFIED SITE PLAN

1.5.1 Upon completion of foundation work, submit four hard copies and two electronic copies of a survey of the final disposition of the building/structures from a qualified Ontario Land Surveyor certifying that all parts of the building/structures are located in accordance with the requirements of the Contract Documents.

1.5.2 The surveyor shall verify and certify additional lines and levels of any part of the work if deemed necessary by the Engineer. Deviations from

Drawings shall be reported to the Engineer in writing within 24 hours of detection.

1.5.3 On completion of the work and before application for contract completion, submit to the Engineer six hard copies and two electronic copies of the same survey submitted after completion of foundation work but supplemented by the same surveyor to show outline of paved areas, final finished grades throughout site and location of buried services. Any deviations from Contract Documents shall be noted.

1.6 FORMS

1.6.1 Submit within 60 working days of Notice to Proceed one electronic MS Excel copy and one hard copy of a completed form entitled "Inventory of Spare Parts and Tools" as appended to the end of this Section. Update and submit this form every month.

1.6.2 Submit within 120 working days of Notice to Proceed one electronic MS Excel copy and one hard copy of a completed computerized maintenance management system (CMMS) form entitled "CMMS Database" as appended to the end of this Section. Update and submit this form every month.

2 PRODUCTS – NOT APPLICABLE

3 EXECUTION – NOT APPLICABLE

END OF SECTION

SECTION 01351
HEALTH AND SAFETY

1 GENERAL 1

1.1 GENERAL 1
1.2 CONSTRUCTION SAFETY MEASURES 2
1.3 OVERLOADING 3
1.4 SPECIAL PROTECTION AND PRECAUTIONS 3
1.5 SAFETY EQUIPMENT AND HAZARDOUS AREAS AND MATERIALS 4
1.6 SITE CONDITIONS 4

2 PRODUCTS – NOT APPLICABLE 5

3 EXECUTION – NOT APPLICABLE 5

SECTION 01351
HEALTH AND SAFETY

1 GENERAL

1.1 GENERAL

1.1.1 The Contractor, for purposes of the Ontario Occupational Health and Safety Act, shall be designated as the Constructor for this project and shall assume all of the responsibilities of the Constructor as set out in that Act and its regulations. The foregoing shall apply notwithstanding that the successful bidder has been referred to as the 'Contractor' in this and any other related document. The Contractor shall comply with the following:

1.1.1.1 The Contractor acknowledges that the Contractor has read and understood the Occupational Health and Safety Act (R.S.O. 1990, C-0.1, as amended).

1.1.1.2 The Contractor covenants and agrees to observe strictly and faithfully the provisions of the said Occupational Health and Safety Act and all regulations and rules promulgated thereunder.

1.1.1.3 The Contractor agrees to indemnify and save the Owner harmless for damages or fines arising from any breach or breaches of the said Occupational Health and Safety Act.

1.1.1.4 The Contractor agrees to assume full responsibility for the enforcement of the said Occupational Health and Safety Act to ensure compliance therewith.

1.1.1.5 The Contractor further acknowledges and agrees that any breach or breaches of the Occupational Health and Safety Act whether by the Contractor or any of the Contractor's sub-contractors may result in the immediate termination of this contract.

1.1.1.6 The Contractor shall allow access to the Work site on demand to representatives of the Owner to inspect Work sites to ensure compliance with the Occupational Health and Safety Act.

1.1.1.7 The Contractor agrees that any damages or fines that may be assessed against the Owner by reason of a breach or breaches of the Occupational Health and Safety Act by the Contractor or any of the Contractor's sub-contractors will entitle the Owner to set-off the damages so assessed against any monies that the Owner may from time to time owe the Contractor under this contract or under any other contract whatsoever.

1.1.2 The Contractor shall provide a list of all controlled hazardous materials or products containing hazardous materials, all physical agents or devices or equipment producing or omitting physical agent and any substance, compound, product or physical agent that is deemed to be or contains a designated substance in accordance with the Workplace Hazardous Materials Information System (WHMIS) as defined under the Ontario Occupational Health and Safety Act and shall provide appropriate Material Health and Safety Data Sheets for these substances used for the performance of the required Work, all prior to the performance of the Work.

1.1.3 Where hazardous materials, physical agents and/or designated substances are used in the performance of the required Work, the successful Contractor shall ensure that the requirements of the Ontario Occupational Health and Safety Act and associated regulations are complied with.

1.1.4 The Owner reserves the right to cancel any contract for non-compliance with the terms set out herein, health and safety regulations, the Environmental Protection Act, associated regulations, and other applicable legislation.

1.1.5 The Contractor shall perform the Work so as to cause the public the least inconvenience possible. In particular, the Contractor shall not obstruct any street, thoroughfare, or foot walk longer or to a greater extent than necessary.

1.1.6 The Contractor shall take all reasonable precaution necessary to ensure the safety of the Workers and the general public, particularly children who may play in the area of Work.

1.2 CONSTRUCTION SAFETY MEASURES

1.2.1 Contractor shall submit a site specific Health and Safety Plan within five working days after the date of Notice to Proceed or prior to mobilization on site, whichever occurs first. The site-specific Health and Safety Plan must address the requirements of all applicable Acts.

1.2.2 Meet the requirements of the most recent editions of:

1.2.2.1 Occupational Health and Safety Act, Regulations for construction projects, O. Reg. 213 (as amended by O. Reg. 631), Part II General Construction.

1.2.2.2 Occupational Health & Safety Act, Health Care and Residential Facilities Regulation, O. Reg. 67, Confined Spaces.

1.2.2.3 Occupational Health and Safety Act, Industrial Establishments Regulation, R.R.O. 1990, Reg. 851 (as amended by O. Reg. 516; 630; 230; and 450), Part I Safety Regulations.

1.2.2.4 Revised Statutes of Ontario 1980, Chapter 321, Revised Regulation of Ontario 1980, Regulation 691 as amended by O. Reg. 156 and O. Reg. 645, and Ontario Regulation 714.

1.2.2.5 Canada Labour Code, Canada Occupational Safety and Health Regulations, SOR/86-304 (as amended by SOR/87-623; 88-44; 88-68; 88-632; 89-479; 89-515; 90-180; 91-448; 92-544; 94-33; 94-263; 95-286; 95-533; 96-294; 96-400; and 96-525), Part XI – Confined Spaces

1.2.2.6 Workers Safety & Insurance Board (WSIB) and municipal statutes and authorities.

1.2.3 In event of conflict between any provisions of above authorities, the most stringent provision governs.

1.2.4 Where applicable, the Contractor shall be designated "Constructor" as defined by Ontario Act.

1.3 OVERLOADING

1.3.1 Ensure no part of work is subjected to a load which will endanger its safety or will cause permanent deformation.

1.4 SPECIAL PROTECTION AND PRECAUTIONS

1.4.1 Comply with the requirements of the Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage and disposal of hazardous materials and regarding labelling and the provision of material safety data sheets (MSDS) acceptable to Labour Canada.

1.4.2 Comply with the requirements of CAN/CGA B-105-M-93 when working in and around hazardous locations/confined spaces.

1.4.3 Conform to Ministry of Labour requirements for work in hazardous locations. Establish and implement written procedures to assure compliance.

1.4.4 Provide documentation of tests for gas and oxygen deficiency prior to starting work in hazardous locations.

1.4.5 Comply with the City of Hamilton Health and Safety Procedures. A City of Hamilton staff member will provide one hour of training to a specified representative of the Contractor. The Contractor is responsible for

providing the same training to all of his staff on-site. Maintain a record of training.

1.4.6 Smoking is not permitted in the building, in hazardous areas, or other areas as designated by the City. Post “No Smoking” signs as required.

1.5 SAFETY EQUIPMENT AND HAZARDOUS AREAS AND MATERIALS

1.5.1 Safety equipment such as gas detection equipment for explosive or toxic gases or oxygen deficiency, safety belts, ropes, etc., are to be made available to the resident inspection staff. When it is required for the resident inspection staff to enter manholes or other potentially hazardous areas, a Contractor's personnel has to enter the said areas with him and accompanying personnel with safety ropes, etc., shall be present as required.

1.5.2 All work areas suspected of containing explosive or toxic gases or that are oxygen deficient must be routinely tested for presence of same before any work is done. Make safe any work area that is found hazardous before any work may proceed, in accordance with safe practice and applicable statutes.

1.5.3 Post warning signs at hazardous areas or where hazardous materials are stored, and install protective barriers. Instruct personnel in proper safety procedures.

1.5.4 Identify all areas considered to be hazardous locations and comply with all requirements of the Ministry of Labour.

1.5.5 Ensure that all personnel engaged in confined space work or work in hazardous locations that require the use of respiratory equipment, comply with the requirements of the Ministry of Labour and must be clean shaven.

1.5.6 Only non-sparking tools may be used in potentially explosive areas.

1.5.7 Comply with the requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage and disposal of hazardous materials, and regarding labelling and provision of material safety data sheets acceptable to Labour Canada.

1.5.8 The Contractor shall inform the Owner of the location of these materials and shall ensure that these materials are not kept stored or used on site without the City's prior consent or approval.

1.6 SITE CONDITIONS

1.6.1 Work at site may involve contact with:

1.6.1.1 Diesel Fuel

1.6.2 Within the facility, the Contractor shall comply with the Owner's Health and Safety procedures. All workers must be trained in on-site safety procedures. Training will involve approximately one hour per person. The Owner will train one representative sent by the Contractor, who will then train all workers. Records of training to be submitted to the Engineer.

2 PRODUCTS – NOT APPLICABLE

3 EXECUTION – NOT APPLICABLE

END OF SECTION

SECTION 01353
SPECIAL PROCEDURES - TRAFFIC CONTROL

1 GENERAL 1

1.1 SECTION INCLUDES 1
1.2 REFERENCES 1
1.3 PROTECTION OF PUBLIC TRAFFIC 1
1.4 INFORMATIONAL AND WARNING DEVICES 2
1.5 CONTROL OF PUBLIC TRAFFIC 2
1.6 OPERATIONAL REQUIREMENTS 3

2 PRODUCTS – NOT APPLICABLE 3

3 EXECUTION – NOT APPLICABLE 3

SECTION 01353
SPECIAL PROCEDURES - TRAFFIC CONTROL

1 GENERAL

1.1 SECTION INCLUDES

.1 Information and Warning Devices.

.2 Protection and Control of Public Traffic.

.3 Operational Requirements.

1.2 REFERENCES

.1 Ontario Traffic Manual – Temporary Conditions (Book 7).

1.3 PROTECTION OF PUBLIC TRAFFIC

.1 Comply with requirements of Acts, Regulations and By-Laws in force for regulation of traffic or use of roadways upon or over which it is necessary to carry out the Work or haul materials or equipment.

.2 When working on a travelled way:

.1 Place equipment in position to present minimum of interference and hazard to travelling public.

.2 Keep equipment units as close together as working conditions permit and preferably on the same side of the travelled way.

.3 Do not leave equipment on a travelled way overnight.

.3 Do not close any lanes of road without the approval of the Engineer. Before re-routing traffic, erect suitable signs and devices in accordance with instructions contained in the Ontario Traffic Manual.

.4 Keep travelled way graded, free of pot holes and of sufficient width for required number of lanes of traffic.

.1 Provide a minimum 7m wide temporary roadway for traffic in two-way sections through the Work and on detours.

.2 Provide a minimum 5m wide temporary roadway for traffic in one-way sections through the Work and on detours.

.5 As directed by the Engineer, provide gravelled and/or paved detours or temporary roads to facilitate passage of traffic around restricted construction areas:

.1 Place and compact granular in accordance with Section 02500 – Roadway Construction and Restoration.

.2 Provide and maintain road access and egress to property fronting along the Work under the Contract and in other areas as indicated, unless other means of road access exist that meet the approval of the Engineer.

1.4 INFORMATIONAL AND WARNING DEVICES

.1 Provide and maintain signs, flashing warning lights and other devices required to indicate construction activities or other temporary and unusual conditions resulting from Project Work which requires road user response.

.2 Supply and erect signs, delineators, barricades and miscellaneous warning devices as specified under Temporary Conditions Signs and Devices in Ontario Traffic Manual.

.3 Place signs and other devices in locations recommended in Ontario Traffic Manual.

.4 Meet with the Engineer prior to the commencement of the Work to prepare a list of signs and other devices required for the project. If a situation on the site changes, revise the list to the approval of the Engineer.

.5 Continually maintain traffic control devices in use by:

.1 Checking all signs daily for legibility, damage, suitability and location. Clean, repair or replace to ensure clarity and reflectance.

.2 Removing or covering signs which do not apply to conditions existing from day to day.

1.5 CONTROL OF PUBLIC TRAFFIC

.1 Provide flag persons, trained in accordance with, and properly equipped as specified in Ontario Traffic Manual in the following situations:

.1 When public traffic is required to pass working vehicles or equipment which block all or part of a travelled roadway.

.2 When it is necessary to institute one-way traffic system through a construction area or other blockage where traffic volumes are heavy, approach speeds are high and traffic signal systems are not in use.

.3 When workers or equipment are employed on travelled ways over brows of hills, around sharp curves or at other locations where oncoming traffic would not otherwise have adequate warning.

.4 Where temporary protection is required while other traffic control devices are being erected or taken down.

.5 For emergency protection when other traffic control devices are not readily available.

.6 In situations where complete protection for workers, working equipment and public traffic is not provided by other traffic control devices.

.7 At each end of restricted sections where pilot cars are required.

.8 Delays to public traffic due to the Contractor's operation; maximum 15 minutes.

.2 Provide pilot cars as applicable. Equip pilot cars with orange flashing lights and signs clearly designating vehicles as pilot cars.

.3 Where roadway, carrying two-way traffic, is to be restricted to one lane, for 24 hours each day, provide portable traffic signal system. Adjust as necessary, and regularly maintain system during periods of restriction. Signal system to meet the requirements of Ontario Traffic Manual.

1.6 OPERATIONAL REQUIREMENTS

.1 Maintain existing conditions for traffic throughout the period of the contract except that, when required for construction under the contract and when measures have been taken as specified herein and approved by the Engineer to protect and control public traffic.

.2 Maintain existing conditions for traffic crossing right-of-way.

2 PRODUCTS – NOT APPLICABLE

3 EXECUTION – NOT APPLICABLE

END OF SECTION

SECTION 01420
REFERENCES

1 GENERAL 1

1.1 RELATED SECTIONS 1
1.2 REFERENCES 1

2 PRODUCTS – NOT APPLICABLE 6

3 EXECUTION – NOT APPLICABLE 6

SECTION 01420
REFERENCES

1 GENERAL

1.1 RELATED SECTIONS

.1 Other sections in this specification or the drawings may make reference to other documents and refer to these documents by an abbreviation.

.2 Some of the abbreviations and the full name of the organization are listed herein after.

1.2 REFERENCES

.1 AA - Aluminum Association, 900 19th Street N.W., Washington, D.C., U.S.A. 20006 http://www.aluminum.org

.2 AASHTO - American Association of State Highway and Transportation Officials, 444 N Capitol Street N.W., Suite 249, Washington, D.C., U.S.A. 20001 http://www.aashto.org

.3 ACI - American Concrete Institute, P.O. Box 9094, Farmington Hills, Michigan U.S.A. 48333 http://www.aci-int.org

.4 ACEC Association of Consulting Engineers of Canada, 130 Albert Street, Suite 616, Ottawa, ON. K1P 5G4 URL http://www.acec.ca

.5 AHA - American Hardboard Association, 1210W Northwest Hwy., Palatine, Illinois, U.S.A. 60067 URL: http://www.hardboard.org

.6 AITC - American Institute of Timber Construction, 7012 S. Revere Parkway, Suite 140, Englewood, Colorado, U.S.A. 80112

.7 AMCA - Air Movement and Control Association Inc., 30 West University Drive, Arlington Heights, Illinois, U.S.A. 60004-1893 http://www.amca.org

.8 APA – The Engineered Wood Association, P.O. Box 11700, Tacoma, Washington, U.S.A. 98411-0700 URL http://www.apawood.org

.9 ANSI - American National Standards Institute, 25 West 43rd Street, 4th Floor, New York, New York, U.S.A. 10036 http://www.ansi.org

.10 API - American Petroleum Institute,1220 L St. Northwest, Washington, D.C., U.S.A. 20005-4070 http://www.api.org

.11 ARI - Air Conditioning and Refrigeration Institute, 4100 North Fairfax Drive, Suite 200, Arlington, Virginia, U.S.A. 22203 URL http://www.ari.org

.12 ASHRAE - American Society of Heating, Refrigeration and Air-Conditioning Engineers, 1791 Tullie Circle NE, Atlanta, Georgia, U.S.A. 30329 http://www.ashrae.org

.13 ASME - American Society of Mechanical Engineers, United Engineering Centre, 3 Park Avenue, New York, New York, U.S.A. 10016-5990 URL http://www.asme.org

.14 ISAP – International Society for Asphalt Paving, 400 Selby Avenue, Suite 1, St. Paul, MN 55102 U.S.A. URL http://www.asphalt.org

.15 ASTM - American Society for Testing and Materials, 100 Barr Harbor Drive West, Conshohocken, Pennsylvania 19428-2959 http://www.astm.org

.16 AWCI - Association of the Wall and Ceiling Industries, 803 West Board Street, Suite 600, Falls Church, UA, U.S.A. 22046 http://www.awci.org

.17 AWMAC - Architectural Woodwork Manufacturers Association of Canada, 516 4 Street West, High River, Alberta T1V 1B6 http://www.awmac.com

.18 AWPA – American Wire Producer's Association, 801 North Fairfax Street, Suite 211, Alexandria, VA U.S.A. 22314-1757 URL http://www.awpa.org

.19 AWPA – American Wood Preservers' Association, P.O. Box 5690, Granbury, Texas, U.S.A. 76049-0690 URL http://awpa.com

.20 AWS - American Welding Society, 550 N.W. LeJeune Road, Miami, Florida U.S.A. 33126 http://www.amweld.org

.21 AWWA - American Water Works Association, 6666 W. Quincy Avenue, Denver, Colorado, U.S.A. 80235 http://www.awwa.org

.22 CCA Canadian Construction Association, 75 Albert Street, Suite 400, Ottawa, Ontario K1P 5E7 http://www.cca-acc.com

.23 CCDC Canadian Construction Documents Committee, Refer to ACEC, CCA, CSC or RAIC

.24 CFFM - Canadian Forces Fire Marshal, 101 Colonel By Drive, 8NT MGen George R. Pearkes Bldg., Ottawa, Ontario K1A 0K2 URL http://www.dnd.ca/admie/dgcps/CFFMe.htm

.25 CGA - Canadian Gas Association, 20 Eglinton Avenue West, Suite 1305, Toronto, Ontario M4R 1K8 URL http://www.cga.ca

.26 CGSB - Canadian General Standards Board, Place du Portage, Phase III, 6B1, 11 Laurier Street, Hull, Quebec K1A 1G6 http://w3.pwgsc.gc.ca/cgsb

.27 CISC - Canadian Institute of Steel Construction, 201 Consumers Road, Suite 300, Willowdale, Ontario M2J 4G8

.28 CITC - Canadian Institute of Timber Construction, 200 Cooper Street, Ottawa, Ontario K2P 0G1

.29 CMB - Construction Materials Board, 101 Colonel By Drive, 8NT MGEN George R. Pearkes Bldg., Ottawa, Ontario K1A 0K2

.30 COFI - Council of Forest Industries, 555 Burrard, Suite 1200, Vancouver, B.C., V7X 1S7 http://www.cofi.org

.31 CRCA - Canadian Roofing Contractors Association, 151 Slater Street, Suite 606, Ottawa, Ontario K1P 5H3 URL http://www.roofingcanada.com

.32 CSA - Canadian Standards Association, 178 Rexdale Blvd., Etobicoke, Ontario M9W 1R3 http://www.csa.international.ca

.33 CSC - Construction Specifications Canada, 100 Lombard Street, Suite 200, Toronto, Ontario M5C 1M3.

.34 CSDMA – Canadian Steel Door Manufacturing Association One Yonge Street, Suite 1400, Toronto, Ontario M5E 1J9

.35 CSPI – Corrugated Steel Pipe Institute, 652 Bishop Street N, Unit 2A, Cambridge, Ontario N3H 4V6 URL http://cspi.ca

.36 CSSBI – Canadian Sheet Steel Building Institute, 652 Bishop Street N, Unit 2A, Cambridge, Ontario N3H 4V6 URL http://cspi.ca

.37 CUFCA – Canadian Urethane Foam Contractor's Association, Box 3214, Winnipeg, Manitoba R3C 4E7 URL http://cufca.ca

.38 CWC – Canadian Wood Council, 1400 Blair Place, Suite 210, Ottawa, Ontario K1J 9B8 http://www.cwc.ca

.39 EC – Environment Canada, Conservation and Protection, Inquiry Centre, 351 St. Joseph Blvd., Hull, Quebec K1A 0H3 URL http://www.ec.gc.ca

.40 EEMAC - Electrical and Electronic Manufacturers' Association of Canada, 1 Yonge Street, Suite 1608, Toronto, Ontario M5E 1R1 http://www.electro.ca

.41 EFC – Electro Federation of Canada, 5800 Explorer Drive, Suite 200, Mississauga, Ontario L4W 5K9 URL http://www.electrofed.com

.42 EIMA EIFS Industry Manufacturer's Association, 3000 Corporate Center Drive, Suite 270, Morrow, Georgia U.S.A. 30260 URL http://www.eima.com

.43 FCC - Fire Commissioner of Canada, Place du Portage, Phase II, 165 rue Hotel de Ville, Hull Quebec K1A 0J2 http://info.load-otea.hrdc-drhc.gc.ca/fire-prevention/standards/commissioner.shtml

.44 ICPI - Interlocking Concrete Pavement Institute, P.O. Box 23053, Milton, Ontario L9T 2M0 http://www.icpi.org/icpi

.45 IEEE - Institute of Electrical and Electronics Engineers, IEE Corporate Office, 3 Park Avenue, 17th Floor, New York, New York, U.S.A. 10016-5997 URL http://www.ieee.org

.46 ISA – www.isa.org

.47 MTO - Ministry of Transportation Ontario.

.48 MOE – Ministry of the Environment.

.49 MSS - Manufacturers Standardization Society of the Valve and Fittings Industry, 127 Park Street, N.E., Vienna, Virginia U.S.A.221804602 URL http://www.mss-hq.com

.50 NAAMM - National Association of Architectural Metal Manufacturers, 8 South Michigan Avenue, Suite 1000, Chicago, Illinois U.S.A. 60603 URL http://www.naamm.org.

.51 NBC –National Building Code.

.52 NFC – National Fire Code.

.53 NABA – National Air Barrier Association, P.O. Box 2747, Winnipeg, Manitoba R3C 4E7 URL http://www.naba.ca

.54 NEMA - National Electrical Manufacturers Association, 1300 N. 17th Street, Suite 1847, Rosslyn, Virginia 22209 http://www.nema.org

.55 NETA – International Electrical Testing Association, www.netaworld.org

.56 NFPA - National Fire Protection Association, 1 Batterymarch Park, Quincy, Massachusetts, U.S.A. 02269-9101 http://www.nfpa.org

.57 NFSA - National Fire Sprinkler Association, P.O. Box 1000, Patterson, New York, U.S.A. 12563 http://www.nfsa.org

.58 NHLA - National Hardwood Lumber Association, 6830 Raleigh-La Grange Road, Memphis, TN U.S.A. 38184-0518 URL http://www.natlhardwood.org

.59 NLGA - National Lumber Grades Authority, 406-First Capital Place, 960 Quayside Drive, New Westminster, B.C. V3M 6G2

.60 NRC - National Research Council, Building M-58, 1200 Montreal Road, Ottawa, Ontario K1A 0R6 URL http://www.nrc.gc.ca

.61 NSF International

.62 NSPE National Society of Professional Engineers, 1420 King Street, Alexandria, VA U.S.A. 22314-2794 URL http://ww.nspe.org

.63 PCI - Prestressed Concrete Institute, 209 W. Jackson Boulevard, Suite 500, Chicago, Illinois U.S.A. 60606-6938 URL http://www.pci.org

.64 PEI – Porcelain Enamel Institute, P.O. Box 920220, Norcross, GA U.S.A. 30010 URL http://porecelainenamel.com

.65 QPL - Qualification Program List, c/o Canadian General Standards Board, Place du Portage, Phase III, 6B1, 11 Laurier Street, Hull, Quebec K1A 1G6 http://w3.pwgsc.gc.ca/cgsb

.66 RAIC – Royal Architectural Institute of Canada, 55 Murray Street, Suite 330, Ottawa, Ontario K1N 5M3 URL http://www.raic.org

.67 SAE - Society of Automotive Engineers, 400 Commonwealth Drive, Warrendale, Pennsylvania 15096-0001 http://www.sae.org

.68 SCC - Standards Council of Canada, 270 Albert Street, Suite 2000, Ottawa, Ontario K1P 6N7 http://www.scc.ca

.69 SMACNA - Sheet Metal and Air Conditioning Contractors' National Association, 4201 Lafayette Center Drive, Chantilly, Virginia 20151-1209 http://www.smacna.org

.70 SSPC – The Society for Protective Coatings, 40 24th Street, 6th Floor, Pittsburgh, Pennsylvania 15222-4656 URL http://www.sspc.org

.71 SSPC - Steel Structures Painting Council, 40 24th Street, Pittsburgh, Pennsylvania 15222-4656 http://www.sspc.org

.72 TPI – Truss Plate Institute, 583 D'Onofrio Drive, Suite 200, Madison, WI, U.S.A. 53719 URL http://www.tpinst.org

.73 TTMAC - Terrazzo, Tile and Marble Association of Canada, 30 Capston Gate, Unit 5 Concord, Ontario L4K 3E8 http://www.ttmac.com

.74 UL - Underwriters' Laboratories, 333 Pfingsten Road, Northbrook, Illinois, U.S.A. 60062 http://www.ul.com

.75 ULC - Underwriters' Laboratories of Canada, 7 Crouse Road, Scarborough, Ontario M1R 3A9 http://www.ulc.ca

.76 USACE - United States Army Corps Engineers, Huntsville, Alabama http://www.hnd.usace.army.mil

2 PRODUCTS – NOT APPLICABLE

3 EXECUTION – NOT APPLICABLE

END OF SECTION

SECTION 01450
QUALITY CONTROL

1 GENERAL 1

1.1 SECTION INCLUDES 1
1.2 INSPECTION 1
1.3 INDEPENDENT INSPECTION AGENCIES 1
1.4 PRE-CONSTRUCTION AND POST-CONSTRUCTION SURVEY 2
1.5 ACCESS TO WORK 2
1.6 PROCEDURES 2
1.7 REJECTED WORK 3
1.8 TESTS AND MIX DESIGNS 3
1.9 MOCK-UPS 3
1.10 MILL TESTS 4
1.11 EQUIPMENT AND SYSTEMS 4
1.12 WORKMANSHIP 4

2 PRODUCTS – NOT APPLICABLE 5

3 EXECUTION – NOT APPLICABLE 5

SECTION 01450
QUALITY CONTROL

1 GENERAL

1.1 SECTION INCLUDES

.1 Inspection and testing, administrative and enforcement requirements.

.2 Tests and mix designs.

.3 Mock-ups.

.4 Mill tests.

.5 Equipment and system adjustment and balancing.

1.2 INSPECTION

.1 Allow the Owner and the Engineer access to the Works at all times. If part of Work is prepared at locations other than the job site, allow access to such work whenever it is in progress.

.2 Give a minimum of 10 days' notice requesting inspection if work is designated for special tests, inspections or approvals by the Engineer instructions.

.3 If the 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 The Engineer may order any part of the Works 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, the Owner will pay the cost of examination and replacement.

1.3 INDEPENDENT INSPECTION AGENCIES

.1 An Independent Inspection/Testing Agency will be engaged by the Owner for the purpose of inspecting and/or testing portions of Work. The cost of such services will be borne by the Owner.

.2 Provide access and access-related equipment required for executing inspection and testing by appointed agencies.

.3 Employment of inspection/testing agencies does not relieve the Contractor from responsibility to perform work in accordance with the Contract Documents.

.4 If defects are revealed during inspection and/or testing, the appointed agency will request additional inspection and/or testing to ascertain full degree of defect. Correct defect and irregularities as advised by the Engineer at no cost to the Owner. The Contractor is to pay costs for retesting and re-inspection.

1.4 PRE-CONSTRUCTION AND POST-CONSTRUCTION SURVEY

.1 Undertake a pre-construction condition and crack survey of the existing buildings, structures, roads, gates, signs, gardens, trees, shrubs, grasses, ground cover, benches, sidewalks, pathways, equipment, fixtures, luminaires and fences in the vicinity of the proposed construction.

.2 Undertake a survey of existing surface finish conditions.

.3 Document findings with photographs and in writing. Video may also be acceptable.

.4 Be responsible for repairing damage due to construction.

.5 Turn over one CD containing all photographs taken to the Engineer at the commencement of construction.

.6 Survey existing buildings and structures within 15 metres of the new works.

.7 Prior to substantial performance, conduct a post-construction comparison survey of all of the above listed items in Item 1.4.1.

.8 This Work is to be undertaken by a speciality inspections firm and not by the Contractor’s own forces.

1.5 ACCESS TO WORK

.1 Allow inspection/testing agencies access to the Works, off-site manufacturing and fabrication plants.

.2 Cooperate to provide reasonable facilities for such access.

1.6 PROCEDURES

.1 Notify appropriate agency and the Engineer in advance (minimum of 48 hours) 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 a result of poor workmanship, use of defective products or damage and whether incorporated in work or not, which has been rejected by the Engineer as failing to conform to Contract Documents. Replace or re-execute in accordance with Contract Documents.

.2 Make good other contractor's work damaged by such removals or replacements promptly.

.3 If, in the opinion of the Engineer, it is not expedient to correct defective work or work not performed in accordance with the Contract Documents, the Owner may deduct from the Contract Price the difference in value between work performed and that called for by Contract Documents, which amount shall be determined by the Engineer.

1.8 TESTS AND MIX DESIGNS

.1 Furnish test results and mix designs as may be requested.

.2 The cost of tests and mix designs beyond those called for in Contract Documents shall be appraised by the Engineer and may be authorized as recoverable.

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 mock-ups only in locations acceptable to the Engineer.

.3 Construct mock-ups prior to start of affected work. Allow sufficient time for Engineer’s review. Work affected by mock-ups may not commence prior to acceptance of mock-up.

.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 If requested, the Engineer will assist in preparing a schedule fixing dates for preparation.

.6 Construct mock-ups to include and show for Engineer's review, specified materials and workmanship. Make revisions as directed by Engineer, consistent with the intent of the Contract Documents, until mock-ups are accepted.

.7 Mock-ups, reviewed and accepted by Engineer, shall become the standard of quality against which work will be measured.

.8 Mock-ups, by prior arrangement, may be incorporated into finished work if accepted by Engineer.

1.10 MILL TESTS

.1 Submit mill test certificates as required of Specifications Sections.

1.11 EQUIPMENT AND SYSTEMS

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

1.12 WORKMANSHIP

.1 The quality of the workmanship and materials shall be of first class quality and the Works shall present a neat and attractive appearance when finished.

.2 If ordered by the Engineer, the Contractor shall make enough openings in the Works and/or materials as are necessary to inspect the works.

.3 Should the Engineer find the work and/or materials so opened up to be faulty in any respect, the Contractor shall remove and make good all defective work and/or materials and shall bear the expense of all such opening, inspecting, and making good.

.4 Should the Engineer find the work and/or materials so opened up to be in acceptable condition, the expense of such opening and closing will be borne by the Owner.

.5 The Contractor is to provide a minimum 72 hours of notice to the Engineer prior to concealing work which may require inspection.

2 PRODUCTS – NOT APPLICABLE

3 EXECUTION – NOT APPLICABLE

END OF SECTION

SECTION 01510
TEMPORARY UTILITIES

1 GENERAL 1

1.1 SECTION INCLUDES 1
1.2 INSTALLATION AND REMOVAL 1
1.3 WATER SUPPLY 1
1.4 TEMPORARY HEATING AND VENTILATION 1
1.5 TEMPORARY POWER AND LIGHT 3
1.6 TEMPORARY COMMUNICATION FACILITIES 3

2 PRODUCTS – NOT APPLICABLE 3

3 EXECUTION – NOT APPLICABLE 3

SECTION 01510
TEMPORARY UTILITIES

1 GENERAL

1.1 SECTION INCLUDES

.1 Temporary utilities for the work including power, water, heating, ventilation, telephone and internet communication to be used during construction.

1.2 INSTALLATION AND REMOVAL

.1 Provide temporary utilities and controls in order to execute work properly, safely and expeditiously.

.2 Remove all temporary works from site after use, unless otherwise directed by the Engineer or specified in this specification. Work for the Engineer's site office will not be removed.

.3 Make all necessary applications, obtain permits and pay for all hook-ups, fees, charges for service and use.

1.3 WATER SUPPLY

.1 The Contractor shall provide a continuous supply of potable water for construction use. The Contractor shall connect to water supply, provide backflow prevention and meter this supply for record and billing purposes. The Contractor must employ all reasonable steps and precautions to conserve water supplied. The connection point and method of connection will be subject to the approval of the Engineer and the Owner.

.2 Enough water will be provided once only by the Owner for the purpose of disinfecting all watermains.

.3 Should the initial attempt at disinfecting not pass all testing requirements as stipulated by the Contract Documents additional water for disinfecting purposes will be provided by the Owner at the Contractor's sole expense.

.4 Enough water will be provided once only by the Owner for the purpose of leakage or pressure testing the all process piping and tanks.

.5 Should the initial attempt at leakage or pressure testing not pass all testing requirements as stipulated by the Contract Documents, additional water for disinfecting purposes and/or leakage testing purposes will be provided by the Owner at the Contractor's sole expense.

1.4 TEMPORARY HEATING AND VENTILATION

.1 Any construction heaters used inside building must be vented to the outside or be flameless type. Solid fuel salamanders are not permitted.

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

.1 Facilitate progress of the Works.

.2 Protect the Works and products against dampness and cold.

.3 Prevent moisture condensation on surfaces.

.4 Provide ambient temperatures and humidity levels for storage, installation and curing of materials.

.5 Provide adequate ventilation to meet health regulations for safe working environment.

.3 Maintain inside temperatures above a minimum of 10°C in areas and adjacent to areas where construction is in progress or ongoing.

.4 Ventilating:

.1 Prevent accumulations of dust, fumes, mists, vapours or gases in areas occupied during construction.

.2 Provide local exhaust ventilation to prevent harmful accumulation of hazardous substances into atmosphere of occupied areas.

.3 Dispose of exhaust materials in a manner that will not result in harmful exposure to persons.

.4 Ventilate storage spaces containing hazardous or volatile materials.

.5 Ventilate temporary sanitary facilities.

.6 Continue operation of ventilation and exhaust system for time after cessation of work process to assure removal of harmful contaminants.

.5 The permanent heating system of the building may be used when available. Be responsible for damage to heating system if use is permitted. If the permanent heating system is used, then all filters shall be replaced and all units and ducts and conduits shall be cleaned at the time of substantial performance.

.6 Date of Substantial Performance and Warranties for heating system will not commence until the entire system is in as near original condition as possible and is certified by the Engineer. This date shall not be prior to Substantial Performance of the entire Contract.

.7 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.

.8 Be responsible for damage to the Works due to failure in providing adequate heat and protection during construction.

1.5 TEMPORARY POWER AND LIGHT

.1 The Contractor will provide and pay for temporary power during construction and temporary lighting and operating of power tools.

.2 Whenever power or lighting in operating areas of the facility are interrupted by construction activity, provide temporary facilities.

1.6 TEMPORARY COMMUNICATION FACILITIES

.1 The Contractor will provide and pay for telephone hook up equipment necessary for the Contractor's own uses.

.2 Provide and maintain high speed internet access at the site on a separate dedicated line.

.3 Provide fax communication on site.

2 PRODUCTS – NOT APPLICABLE

3 EXECUTION – NOT APPLICABLE

END OF SECTION

SECTION 01520
CONSTRUCTION FACILITIES

1 GENERAL 1

1.1 SECTION INCLUDES 1
1.2 INSTALLATION AND REMOVAL 1
1.3 SCAFFOLDING AND SUPPORTS 1
1.4 HOISTING 1
1.5 SITE STORAGE/LOADING 1
1.6 FIRE PROTECTION 1
1.7 CONSTRUCTION PARKING AND ROADWAYS 2
1.8 EQUIPMENT, TOOLS AND MATERIALS STORAGE 2
1.9 SANITARY FACILITIES 3
1.10 SECURITY AND CONSTRUCTION FENCING 3
1.11 CONSTRUCTION SIGNAGE 3
1.12 SITE ACCESS 4
1.13 TRAILER FOR THE ENGINEER 4
1.14 CONSTRUCTION TRAILERS 8

2 PRODUCTS – NOT APPLICABLE 8

3 EXECUTION – NOT APPLICABLE 8

SECTION 01520
CONSTRUCTION FACILITIES

1 General

1.1 SECTION INCLUDES

.1 This section covers site access, security, fire protection, signage, fencing and construction facilities including storage and required equipment for construction.

1.2 INSTALLATION AND REMOVAL

.1 Provide construction facilities in order to execute work expeditiously.

.2 Remove all such work from site after use.

.3 Make all necessary applications, obtain permits and pay for all fees.

1.3 SCAFFOLDING AND SUPPORTS

.1 Provide and maintain scaffolding, ramps, ladders, swing staging, platforms and temporary stairs as required to complete the work.

1.4 HOISTING

.1 Provide, operate and maintain hoists and cranes required for moving of workers, materials and equipment.

.2 All hoist cranes shall be operated by qualified operators.

1.5 SITE STORAGE/LOADING

.1 Confine work and operations of employees as required by Contract Documents.

.2 Do not unreasonably encumber premises with products. Store materials and equipment in Contractor's storage area only.

.3 Do not place materials or equipment that will interfere with operations.

.4 Do not load or permit the loading of any part of the Works with a weight or force that will endanger the works.

.5 If stored equipment, tools or materials interfere with facility operations, remove promptly when directed by the Engineer.

1.6 FIRE PROTECTION

.1 Provide and maintain temporary fire protection equipment during performance of the Works required by governing codes, regulations and bylaws.

.2 Burning rubbish and construction waste materials is not permitted on site.

1.7 CONSTRUCTION PARKING AND ROADWAYS

.1 Parking will be permitted in areas as approved by the Engineer, provided it does not disrupt the public, station maintenance vehicles or the performance of operations staff.

.2 This site may not have sufficient parking or storage for the use of the Contractor. The Contractor shall make arrangements to acquire additional parking and storage space outside the site at his own cost.

.3 Provide and maintain adequate access to project site.

.4 No construction vehicle, storage or equipment will be allowed within the trail outside of the allotted construction area at anytime.

.5 Build and maintain temporary roads within the contract limits where indicated or directed by the Engineer and provide snow removal for the duration of the contract.

.6 The Contractor shall be responsible to repair the roads that are being used for the construction activities, as required, without any cost to the Owner.

.7 Do not store materials on, or otherwise modify, roads such that maintenance or snow removal is adversely affected. Any costs or damages incurred on existing roadways as a result of the Contractor's activities shall be the responsibility of the Contractor.

.8 All construction access roadways must be continuously maintained dirt, dust, water and mud free.

1.8 EQUIPMENT, TOOLS 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 and normal operation of the existing facility.

.3 No construction equipment, tools, materials shall be stored in the existing buildings.

1.9 SANITARY FACILITIES

.1 Provide sufficient sanitary facilities for all persons employed on the Contract subject to approval of type, size and location by the local health authorities and the Engineer.

.2 Maintain facilities with all required toilet room supplies in a clean and sanitary condition and disinfect frequently.

.3 Prohibit the committing of nuisance on the site and any employee found violating such a provision shall be promptly discharged.

.4 Remove any contaminated soil and replace with fresh clean material. Leave site in a clean sanitary condition.

.5 Contractor staff are not to use Engineer's or Owner's facilities.

1.10 SECURITY AND CONSTRUCTION FENCING

.1 Provide construction fencing and hoarding around the perimeter of the contract and working limits as shown on the drawings. The Contractor shall be responsible for maintenance of the fences, hoarding and surveillance of the work in order to provide security at all times against vandalism of the work and injury to persons not involved with construction. All hoarding will be painted with a colour to later selection by the Engineer.

.2 Security deemed necessary for protection against loss of or damage to any equipment, temporary materials, tools or permanent materials on site in relation to the project shall be the sole responsibility of the Contractor. Provide and maintain security gate at entrance to this contract as shown on the drawings.

.3 Construction boundary fences and hoarding shall remain in their place until all of the construction activities are completed by the Contractor and other adjacent contractors.

.4 The Owner shall provide security on the station side and the Contractor will be responsible for security on the construction side.

1.11 CONSTRUCTION SIGNAGE

.1 The Contractor will produce two project signboards approximately 1.22m x 2.44m, 20mm plywood construction to be installed at the site.

.2 The Contractor shall provide and install suitable wooden posts and bracing to support the signboards in locations to be designated by the Engineer.

.3 Install the signboards on the posts.

.4 On attainment of “Substantial Performance”, or at such earlier time as may be approved by the Engineer, the Contractor shall remove the construction project signboards and support structures, and make good the area.

.5 Throughout the construction period maintain the construction signs in good condition.

.6 Clean periodically as needed to the satisfaction of the Engineer.

.7 No other signs, other than warning signs and notices required by law, may be erected on site without the approval of the Engineer and the Owner.

1.12 SITE ACCESS

.1 Provide and use only the gates shown on the drawing for access to the site.

.2 All deliverables are to be delivered to the construction access gates. No deliveries are permitted to the Owner’s office or through the Owner’s access gates.

.3 Provide signs on site to direct construction traffic to work areas.

1.13 TRAILER FOR THE ENGINEER

.1 Provide for the sole use of the Engineer and the Owner, a field trailer as specified.

.1 Supply and maintain a trailer, satisfactory to the Engineer and Owner, for the exclusive use of the Engineer and Owner for the duration of the Contract until at least three months following Substantial Performance.

.2 Trailer to consist of a minimum of the following rooms

.1 Office for Engineer with own door with lock and key (a meeting room to be shared with the Contractor).

.3 The trailer to be set up in approved location within seven days of Notice to Proceed or actual work commencement whichever occurs first. Failure to comply will result in the City providing the required office and back-charging the Contractor.

.4 Locate the trailer within the work area as directed by the Engineer, physically separated from any other structure.

.5 Make all necessary applications, obtain permits and pay for all fees, charges for service and use.

.6 Provide and pay for all temporary telephone, potable water, power, heating, air conditioning, high speed internet equipment and services and lighting required during construction.

.7 Provide a windproof, weather tight structure at least 300mm above ground level and having a floor area of not less than $16m^2$ and 2.6m ceiling height.

.8 Equip the trailer with:

.1 one standard refrigerator, minimum $0.5m^3$ ($18\ ft^3$)

.2 one standard microwave

.3 One three tier wooden bookcase

.4 Shelves, plan racks, and a lockable steel wardrobe and storage cabinet, 1900mm high 900mm wide and 500mm deep for storing instruments and clothing

.5 one standard office desk having three lockable drawers

.6 one swivel type office chair with adequate ergonomic and lumbar support

.7 one legal-size, 4 drawer file cabinet with lock and key

.8 one standard four drawer, legal-size, lockable, steel filing cabinet with three sets of keys.

.9 one telephone with one phone line (separate to others) complete with voicemail, caller ID and call waiting. Phone to be supplied is capable of call display and speaker.

.10 high speed internet connection from independent telephone line, including Wi-Fi internet service

.11 one wastepaper basket

.12 a 1.25m x 1.25m meeting table

.13 2 standard office chairs

.14 fire extinguisher and first aid kit

.15 whiteboard with two sets of markers

.9 The trailer to be insulated, electrically heated, air-conditioned and electrically lighted as follows:

.1 wall-mounted electrical heaters sized to maintain an interior temperature of 21°C when the outside temperature is –30°C

.2 wall mounted air conditioning units

.3 temperature to be controlled at 21^0C year round

.4 adequate lighting with supplementary lighting in each area, including over the table and desks

.5 electrical outlets (4 minimum) as required

.10 Provide door to the trailer with suitable lock. Main door to the trailer shall come with at least four sets of keys.

.11 Provide at least two windows, each window having a size of at least $2.0m^2$. Provide window shades with screens.

.12 Provide washroom facilities with hot and cold sink, toilet and mirror to be shared between the Engineer and Owner. Maintain a supply of paper towels, toilet paper, and soap throughout the duration of the project. Provide weekly janitorial services and all washroom supplies.

.13 Provide one printer/copier/scanner/fax multi-function machine for the Engineer trailer to meet the following specifications:

.1 Required functions- colour copying, printing, scanning, colour digital sending, with multi-tasking capability

.2 Print speed- 40 pages per minute (colour or black and white

.3 Monthly duty cycle 5000-20,000 pages

.4 Processor speed 800 mHz

.5 Memory 1 GB RAM

.6 Hard disk 320 MB

.7 Print technology and quality -laser, up to 600 x 600 pdi

.8 Number of cartridges - 4 (1 each high yield cyan, magenta, yellow)

.9 Number of paper trays - 4 (letter, legal, 11x17, with 1 multi-purpose adjustable tray)

.10 Duplex printing – automatic

.11 Document finishing sheet fed, job separator, stacking, stapling

.12 Scanner type – flattened

.13 Scanner resolution - up to 600 dpi with scan resolution software

.14 Task speed- 5.6 seconds, 600 x 600 dpi

.15 Maximum scan size 11x17

.16 Automatic document feeder capacity- 50 sheets

.17 Copier- resolution of 600x600 dpi for colour, copy reduce/enlarge settings of 25 to 400 per cent, with number of copies up to 999 copies maximum

.18 Fax- resolution of 300 x 300 dpi for black, polling

.19 Connectivity- internal and external print servers, plus wireless print servers

.20 Software - print drivers and installation software

.14 Pay the lease or purchase costs for printer/copier/scanner/fax machine, and associated equipment, including maintenance, technical support, paper, cartridge and supply services.

.15 Provide Wi-Fi and high speed mobile Internet access suitable for a minimum of 40 GB monthly usage. Pay for the monthly charges by the Internet service provider. Internet access shall be designated for the Engineer's trailer and shall not be shared with the Contractor's trailer.

.16 Provide three connection services in the trailer for the printer. Provide technical services to assist the Engineer, Owner and its representatives to connect to the Wi-Fi and printing system.

.17 Provide and pay for the services of a security alarm system and take every reasonable precaution to protect the office and its contents against fire and theft, or other damage. Indemnify the Engineer and its agents against loss by fire, theft and injury to the building, to the office or its contents.

.18 Maintain the field office and the performance of the office equipment as specified until at least three months following Substantial Performance.

.19 Provide parking space with a satisfactory wearing surface to accommodate three vehicles minimum. Provide a walkway from the office doors to the parking area and keep both free of water, mud, ice and snow.

1.14 CONSTRUCTION TRAILERS

.1 The Contractor will be permitted to locate trailers only within the limits of the Contract.

.2 The Contractor shall be responsible for providing water, wastewater, power, telephone, internet connection to his trailer, as specified.

2 PRODUCTS – NOT APPLICABLE

3 EXECUTION – NOT APPLICABLE

END OF SECTION

SECTION 01525
NON-DESTRUCTIVE TESTING OF CONCRETE

1. GENERAL 1

1.1 SECTION INCLUDES 1
1.2 CODES, STANDARDS AND CERTIFICATION 1
1.3 PERSONNEL 2
1.4 PERMITS 2
1.5 HOURS OF WORK 2
1.6 RESPONSIBILITY OF THE CONTRACTOR 3
1.7 SUBMITTALS 3

2. PRODUCTS 3

2.1 EQUIPMENT 4

3. EXECUTION 4

3.1 EXPERIENCE 4

SECTION 01525
NON-DESTRUCTIVE TESTING OF CONCRETE

1. GENERAL

1.1 SECTION INCLUDES

1.1.1 This section covers the Non-Destructive Testing (NDT) of concrete walls and slabs. This section covers NDT for concrete slabs that are located at grade, including intermediate floors ceiling and roof slabs. The concrete walls can be both internal and external. Access to both sides of the concrete slabs and walls may not always be available.

1.1.2 The work specified in this section includes the determination of position location and size of metal, plastic and other construction materials embedded in the concrete slabs and walls. The items to be located include but are not limited to metal conduits, electrical cables, plastic pipes, concrete reinforcement, voids, etc.

1.1.3 The position in terms of location and depth, including size shall be accurate to less than 10mm. The concrete slabs and walls shall be cored and/or cut any necessary pipe, duct, cable tray and conduit or any other penetrations, based on the accuracy of the continuous NDT survey.

1.1.4 The NDT continuous survey, real-time inspection results obtained with minimal set up time shall be immediately available at the site for use by others. The items being located are to be viewable on a screen, and the data shall be down loaded by the equipment operator for permanent storage as the work proceeds.

1.1.5 The X, Y, and Z (depth) coordinates must be available as a direct readout from the equipment being used.

1.1.6 Perform NDT where specified on drawings and in specifications. In all cases, perform an x-ray of the area before the NDT.

1.2 CODES, STANDARDS AND CERTIFICATION

1.2.1 The equipment to be used and the equipment operator(s) shall comply with all provisions of the rules, regulations and orders of Federal, Provincial and Municipal government agencies applicable to the work under the Contract.

1.2.2 All equipment to be used for the work specified in this section shall comply with Federal, Provincial and local by-laws, rules and regulations.

1.2.3 Personnel using any equipment for work specified in this section shall be certified by the equipment manufacturer to safely operate the equipment and quickly interpret the results.

1.2.4 Supply hard copies of the survey showing interpreted data (i.e., type of material, size, depth, location, etc.) obtained during the survey, and as requested by the Engineer.

1.2.5 Hazardous materials shall not be allowed into the site to be engaged in the work specified in this section.

1.3 PERSONNEL

1.3.1 Conform to the more stringent of the current Occupational Health and Safety Act and Regulations, City Health and Safety Policies, and any or all other Acts and By-laws in force to ensure the safety of all workers and others engaged on the Site at all times.

1.3.2 For the purpose of the current Occupational Health and Safety Act and Regulations, the Contractor will be designated the Constructor.

1.3.3 The Contractor will be held in strict conformance with all regulations enacted by the Federal and Provincial Governments in conjunction with the Workplace Hazardous Materials Information System.

1.4 PERMITS

1.4.1 Apply for, obtain and pay for all other permits that are required for the work specified in this section. The Owner will provide a clean set of Contract Drawings and Specifications for each such application. Refer to Section 01330 – Submittal Procedures.

1.4.2 Coordinate any inspection required under the building permit with the Owner.

1.5 HOURS OF WORK

1.5.1 Normal working hours are considered to be 7:00 a.m. to 7:00 p.m. of any weekday that meet with the approval of the Engineer and providing that operations are conducted so as not to create a nuisance or disturb the peace unnecessarily.

1.5.2 Comply at all times with the Local Noise By-law. The Contractor shall be responsible for obtaining any noise by-law exemption that may be required for equipment that must be kept in continuous operation.

1.5.3 Obtain written approval of the Engineer if hours other than normal working hours are required or desired at least four days in advance of the contemplated change.

1.5.4 Wherever, in the judgement of the Engineer, it may be necessary or expedient to conduct work at night or on weekends, holidays or after or before normal working hours, the Contractor without any additional or extra cost to the Owner, shall perform the work. This clause will apply if the NDT creates a hazard to operating personnel, in which case after hours work will be necessary.

1.6 RESPONSIBILITY OF THE CONTRACTOR

1.6.1 The Contractor and the equipment operator is to keep itself informed of governmental rules, regulations and orders.

1.6.2 The Contractor is responsible for the implementation of regulatory requirements of any sub-contract he/she may enter into. Ensure that the requirements of this article are a part of any sub-contract he/she may enter into.

1.6.3 Furnish, in cooperation with the Owner, any information required by such governmental agencies.

1.7 SUBMITTALS

1.7.1 Submit to the Engineer before starting work specified in this section, copies of all permits and approvals required by any public agency with respect to this work.

1.7.2 Submit equipment manufacturers written confirmation that the equipment is safe for use for the work specified in this section.

1.7.3 Submit operator(s) certification from the equipment manufacturer by the later of the commencement of the project, or four weeks before commencement of work specified in this section.

1.7.4 Submit methodology to be employed to complete the NDT work specified in this section. Methodology should include information regarding the type and model of equipment and manufacturer of the equipment. Submit listing of similar work carried out in the last three years. Provide name of client, type of operation and a telephone contact number.

1.7.5 Submit safety procedures to be employed during the work. Include safety procedures required to be implemented by other personnel working near the NDT equipment, including clearance requirements from the equipment.

1.7.6 Submit electronic records (two CD’s) of the down loaded data, including four hard copies.

2. PRODUCTS

2.1 EQUIPMENT

2.1.1 Submit data with respect to the exact make, model and manufacturer of the equipment, including equipment limitations and any precautions and safety measures to be employed for the protection of other personnel working near the equipment.

2.1.2 The equipment to be employed for the NDT shall be that using Ground Penetrating Radar (Scanning) or by x-ray.

2.1.3 The work shall be carried out by Graff Company Limited, or Concrete Cutting and Coring, or engineer approved equal.

3. EXECUTION

3.1 EXPERIENCE

3.1.1 The work shall be carried out by an operator with a minimum of five years of experience in similar work.

END OF SECTION

SECTION 01561
ENVIRONMENTAL PROTECTION

1 GENERAL 1

1.1 SECTION INCLUDES 1
1.2 GENERAL 1
1.3 MEASURES 1
1.4 REFUELLING AREAS 3
1.5 CLEANING EQUIPMENT 3
1.6 SPILLS 3
1.7 USE OF PESTICIDES 4
1.8 SENSITIVE AREAS 4
1.9 MANAGEMENT AND DISPOSAL OF EXCESS MATERIALS 4
1.10 REMOVAL AND DISPOSAL OF HAZARDOUS MATERIALS 5
1.11 COMPLIANCE WITH THE OCCUPATIONAL HEALTH AND SAFETY ACT 6
1.12 FIRES 7

2 PRODUCTS – NOT APPLICABLE 7

3 EXECUTION – NOT APPLICABLE 7

SECTION 01561
ENVIRONMENTAL PROTECTION

1 General

1.1 SECTION INCLUDES

.1 This section specifies requirements for environmental controls including control of noise, dust, surface water and erosion, various pollution control methods and handling of Designated Substances as well as compliance with the Occupational Health and Safety Act and Site Safety.

1.2 GENERAL

.1 Establish and maintain site procedures such that noise levels from construction areas are minimized.

.2 Control noise level in accordance with local by-laws and Ministry of the Environment (MOE) Standards.

.3 Prevent dust nuisance resulting from construction operations at all locations on the site.

.4 Protect existing services, land, water courses.

.5 No extra compensation will be paid for any dust or other control equipment and water supplied and applied on Saturdays, Sundays or holidays.

1.3 MEASURES

.1 Noise Controls:

.1 Use vehicles and equipment with efficient muffling devices.

.2 Provide and use devices that will minimize noise levels in construction areas.

.2 Dust Controls:

.1 Dust shall be controlled through wetting down with water and power sweeping or by the construction of temporary access routes using Engineered materials (i.e., Granular “A” and Granular “B”).

.2 Transport dusty materials in covered haulage vehicles.

.3 Use of calcium chloride shall not be allowed for the control of dust.

.3 Mud Control:

.1 Keep access road and public roadways clean and free from mud.

.2 Provide mud mats and/or wash stations to prevent tracking of mud from any portion of the contract limits onto any paved roadway.

.3 Clean access road from the entrance to the station and construction site with street sweeper vehicle as required. The street sweeper should be capable of wet and dry cleaning. Ensure that dust is controlled during cleaning operations.

.4 Obtain and pay for services of street sweeper until Substantial Performance Date. This activity shall not be terminated at anytime during this period unless directed by the Engineer.

.4 Surface Water and Dewatering Control:

.1 Control all surface water and groundwater including rainfall, run-off, seepage from cofferdams and diversion channels, ice and snow. Ensure that erosion is controlled and that flooding of excavations or damage to structures does not occur.

.2 Intercept and divert surface drainage away from excavations and any groundwater monitoring devices where used. Intercept surface drainage as far back from excavations as practical by means of ditches, berms or other interception methods as may be required for effective control.

.3 Direct pumped water or run-off to settling ponds or sediment basins prior to discharge to adjacent storm sewers or watercourses.

.4 Provide settling ponds and sediment basins where needed.

.1 Control overflow rates from settling ponds or sediment basins to ensure minimum solids transportation.

.2 Provide straw bales, filter berms or sand bags as required and as approved by the Engineer to retard and filter run-off prior to discharge to storm sewers or watercourses.

.3 Clean out settling ponds from time to time so that sediment discharge is prevented.

.5 Intercept and divert concentrated run-off from unstable areas under sheet flow conditions, as directed by the Engineer.

.6 Do not direct any flow of water across or over pavements, except through approved pipes or properly constructed troughs.

.7 Keep gutters and drainage ditches open at all times to provide adequate surface drainage.

.8 Maintain all existing storm sewers clean and free of deleterious materials and blockages.

.9 Provide splash pads where water is discharged to the watercourse.

.10 Dispose of water so as not to be injurious to public health or safety, to property or to any part of work completed or under construction.

.11 Provide staked silt fence as required.

1.4 REFUELLING AREAS

.1 Review all proposed construction areas to plan access routes and fuelling areas and avoid brows of hills, sharp curves or other locations where oncoming traffic would not otherwise have adequate warning.

.2 Establish suitable fuelling and maintenance areas and obtain approval from the Engineer.

.3 Do not refuel or maintain equipment adjacent to or in watercourse or over water supply aquifers unless non-spill facilities are used.

.4 Do not fuel equipment within 30 metres of any watercourse unless otherwise non-spill facilities are used.

1.5 CLEANING EQUIPMENT

.1 Do not clean equipment in streams or lakes.

.2 Clean construction equipment prior to entering any paved roadway. At a minimum, all construction equipment should be cleaned weekly.

.3 Do not clean equipment in locations where debris can gain access to sewers, watercourses, lakes, or aquifers.

1.6 SPILLS

.1 Submit procedures for interception, rapid clean-up and disposal of any spillage that may occur, for the Engineer’s review, prior to commencing work.

.2 Be prepared at all times to intercept, clean-up and dispose of any spillage that may occur whether on land or water.

.3 Keep all materials required for clean up of spillages readily accessible on site.

.4 Report immediately any spills causing damage to the environment to the MOE Spills Centre.

1.7 USE OF PESTICIDES

.1 Coordinate the use of herbicides, pesticides and fungicides with landowners and occupants and Regional Pesticides Control Office of the MOE and obtain all necessary approvals prior to use.

.2 Obtain approval prior to using any herbicides, pesticides and fungicides within an aquifer protection area.

1.8 SENSITIVE AREAS

.1 Inform the Engineer in writing of the particular schedule for each river crossing, channelizing or other work in the designated sensitive areas.

.2 Avoid encroachment on unique natural areas and establish boundary protection and signage to avoid such encroachment.

.3 Do not disturb habitats of rare or endangered species. Agree and implement mitigative measures with the Engineer.

.4 Protect wetland sites used as feeding or breeding areas by migratory birds or as habitats for other animals and establish boundary protection and signage to avoid such encroachment.

.5 Schedule construction in sensitive areas so that there will be minimal interference with water uses including fish migration or spawning, or disruption of incubation period of eggs.

.6 Keep removal of vegetation to a minimum.

.7 Contain and deposit on land all aquatic plants uprooted or cut prior to or during construction.

1.9 MANAGEMENT AND DISPOSAL OF EXCESS MATERIALS

.1 The requirements of Ontario Provincial Standard Specification (OPSS) 180 shall apply except for the following revision/ amendments:

.1 Subsection 180.07.02, Conditions on Management by Reuse, shall be amended by the addition of the following:

.1 "Recycled hot mix asphalt or excess bituminous pavement shall not be used as trench backfill or bedding."

.2 Subsection 180.07.04, Conditions on Management by Open Burning, shall be deleted. No open burning will be permitted.

.3 The Owner must be given first right of refusal of any excess materials.

.2 Submit a Waste Quantity Report (Form OPSF 1805) for all Solid Non-Hazardous Waste as per the requirements of OPSS 180.

.3 Obtain waiver from landfill site releasing Owner from any liabilities, responsibilities with respect to the disposal of any type of material at the site. The Contractor shall exercise extreme caution during the excavation, collection, transport and disposal at landfill site of all excess and unsuitable materials.

1.10 REMOVAL AND DISPOSAL OF HAZARDOUS MATERIALS

.1 Hazardous materials shall be removed from the site and handled in accordance with current MOE Regulations at the time of construction.

.2 Asbestos-cement (transite) pipe shall be considered as a Designated Substance. Where the work required includes the removal and disposal of asbestos-cement pipe, the Contractor shall ensure that work on or about asbestos-cement pipe complies with all regulatory requirements. Note that the Ontario Ministry of Labour considers asbestos-cement pipe to be non-friable in nature and therefore when cut using hand tools, is classified as a “Type 1” operation.

.3 Comply with the governing Ministry of Labour Regulations respecting protection of works, remedial handling and disposition of the Designated Substances encountered.

.4 Prior to commencement of work on or about any Designated Substance, provide written notification to the MOE of the location(s) proposed for disposal of Designated Substances. Provide a copy of said notification to the Engineer a minimum of 10 working days in advance of starting work on or about any Designated Substance.

.5 In the event that the MOE has concerns with any proposed disposal location, further notification shall be provided until the MOE’s concerns have been addressed.

.6 Do not empty fuel, lubricants, herbicides, pesticides, fungicides, paint materials, solvents or other chemicals into sewers or watercourses.

1.11 COMPLIANCE WITH THE OCCUPATIONAL HEALTH AND SAFETY ACT

.1 It is specifically drawn to the attention of the Contractor that the Occupational Health and Safety Act provides, in addition to other items that:

.1 A Constructor shall ensure, on a project undertaken by the Contractor that:

.1 The measures and procedures prescribed by this Act and regulations are carried out on the project;

.2 Every employer and every worker performing work on the project complies with this Act and the regulations, and;

.3 The health and safety of workers on the project is protected;

.4 This Contract is deemed to be an individual project for the purposes of the Occupational Health and Safety Act and the regulations made thereunder and the Contractor to whom the Contract is awarded unequivocally acknowledges that he is the Constructor as defined in the said Act on this project and shall carry out all of the obligations and shall bear all of the responsibilities of the Constructor as set out in the said Act and Regulations;

.5 If the Owner is designated as the “Constructor” as a result of the Contractor’s actions, any increases in the Contractor’s or the Owner’s costs shall be borne by the Contractor;

.6 All Occupational Health and Safety Act Regulations for construction projects are to be strictly adhered to.

.7 The Contractor shall submit a work safety plan detailing safety precautions to be implemented during completion of this Contract. The items detailed shall include, as a minimum:

.1 Excavation, shoring, backfill, dewatering

.2 Pipes, valves, equipment installations

.3 Concrete formwork, re-steel, pouring

.4 Electrical installations, etc.

.2 Refer to Section 01351 – Health and Safety for more details.

1.12 FIRES

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

2 PRODUCTS – NOT APPLICABLE

3 EXECUTION – NOT APPLICABLE

END OF SECTION

SECTION 01610
GENERAL EQUIPMENT STIPULATIONS

1 GENERAL 1

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3 EXECUTION – NOT APPLICABLE 5

SECTION 01610
GENERAL EQUIPMENT STIPULATIONS

1 General

1.1 REFERENCE STANDARDS

.1 Conform to standards, in whole or in part as requested in each of the specifications.

.2 If there is a question as to whether any product or system is in conformance with applicable standards, the Engineer reserves the right to have such products or systems tested to prove or disprove conformance.

.3 The cost for such testing will be borne by the Owner in the event of conformance with Contract Documents or by the Contractor in the event of non-conformance.

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

1.2 QUALITY

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

.2 Defective products identified prior to completion of the Work will be rejected regardless of previous inspections. Inspection by the Engineer or any agent of the City at no time relieves the Contractor from responsibility for the supply of acceptable quality products.

.3 Remove and replace defective products at own expense and be responsible for delays and expenses caused by the rejection of defective products.

.4 Should any dispute arise as to the quality or fitness of any products, the decision to accept the product(s) rests strictly with the Engineer based upon the requirements of the Contract Documents.

.5 Unless otherwise indicated in the Specifications, maintain uniformity of manufacture for any particular or like item throughout the Works.

.6 Permanent labels, trademarks and nameplates on products are not acceptable in prominent locations, except where required for operating instructions, or when located in mechanical or electrical rooms.

1.3 STORAGE, HANDLING AND PROTECTION

.1 Handle and store products in a manner so as to prevent damage, adulteration, deterioration and soiling and in accordance with manufacturer's instructions.

.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 they are to be incorporated in the Works.

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

.4 Store cementitious products clear of earth or concrete floors, and away from walls.

.5 Keep sand, when used for grout or mortar materials, clean and dry. Store sand on wooden platforms and cover with waterproof tarpaulins during inclement weather.

.6 Store sheet materials, lumber and drywall on flat, solid supports and keep clear of ground. Cover and slope to shed moisture.

.7 Store and mix paints in heated and ventilated areas. 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 the satisfaction of the Engineer.

.9 Touch-up damaged factory finished surfaces to the Engineer's satisfaction. Use touch-up materials to match original. Do not paint over name plates.

.10 Review storage locations with Engineer. Locations must be co-ordinated with the on-going operations of the Facility.

1.4 TRANSPORTATION

.1 Pay the costs of transportation of products required in performance of the Works.

.2 Transportation cost of products supplied by the Owner will be paid for by the Owner, unless otherwise noted.

.3 Unload, handle and store Owner supplied products at the Works.

1.5 MANUFACTURER'S INSTRUCTIONS

.1 Unless otherwise indicated in specifications, install or erect products in accordance with manufacturer's instructions. Do not rely on labels or

enclosures provided with products. Obtain written instructions directly from manufacturers.

.2 Notify the Engineer in writing of conflicts between Specifications and manufacturer's instructions. The Engineer will clarify or establish the most appropriate solution to the conflict.

.3 Improper installation or erection of products, due to failure in complying with manufacturer's instructions, authorizes the Engineer to require removal and re-installation at no increase in the Contract Price or at no change to the Contract Time.

1.6 QUALITY OF WORK

.1 Ensure Quality of the Work is of the highest standard and is executed by workers experienced and skilled in their respective duties for which they are employed. Immediately notify the Engineer if the nature of the work is such as to make it impractical to produce required results.

.2 Do not employ anyone unskilled in their required duties. The Engineer reserves the right to require dismissal from the Works of any workers deemed incompetent or careless.

.3 Decisions as to standard or fitness or the Quality of Work, in cases of dispute, rest solely with the Engineer, whose decision is final.

1.7 COORDINATION

.1 Ensure the cooperation of all work in the layout of the Works. Maintain efficient and continuous supervision over the entire works.

.2 Be responsible for construction and placement of openings, sleeves, accessories and any materials or work necessary to fully coordinate all of the Works outlined in the Specifications.

.3 Before installation, inform the Engineer of all potential interferences and complete installation as directed by the Engineer.

1.8 CONCEALMENT

.1 In finished areas, conceal pipes, ducts and wiring in floors, walls and ceilings or as indicated on drawings and specifications.

1.9 REMEDIAL WORK

.1 Perform remedial work required to repair or replace parts or portions of the Works 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 the Works.

1.10 LOCATIONS OF FIXTURES

.1 Consider location of fixtures, outlets and mechanical and electrical items indicated on the drawings as approximate and fully coordinate their final placement and positioning.

.2 Where in doubt, or in the case of potential interferences, inform the Engineer and install as directed.

1.11 MATERIAL FASTENERS

.1 Provide material fastenings and accessories in same texture, colour and finish as adjacent materials, unless otherwise indicated.

.2 Prevent electrolytic action between dissimilar metals and materials.

.3 Use non-corrosive hot dip galvanized steel fasteners and anchors for securing exterior work, unless stainless steel or other materials are specifically requested in the affected Specifications.

.4 Space anchors within the individual load limit or shear capacity and ensure that they provide positive permanent anchorage. Wood or any other organic material plugs are not acceptable.

.5 Keep exposed fastenings to a minimum, space evenly and install neatly.

.6 Fastenings that cause spalling or cracking of material to which anchorage is made, are not acceptable.

1.12 EQUIPMENT ANCHORAGE

.1 Use anchors of standard commercial sizes and patterns with material and finish suitable for service.

.2 Use heavy hexagon head bolts, semi-finished unless otherwise specified. Use Number 304 stainless steel for exterior areas.

.3 Anchor bolts shall not project more than one diameter beyond nuts.

.4 Use plain type washers on equipment, sheet metal and soft gasket lock type washers where vibrations occur. Use resilient washers with stainless steel.

1.13 PROTECTION OF WORK IN PROGRESS

.1 Adequately protect the work completed or in progress. Work damaged or defaced, due to a failure to provide protection, is to be removed and replaced, or repaired, as directed by the Engineer, at no increase in the Contract Price or at no change to the Contract Time.

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

1.14 EXISTING UTILITIES

.1 When breaking into or connecting to existing services or utilities, execute the work at times dictated by the Owner and with a minimum of disturbance to the Works.

.2 Protect, relocate or maintain existing active services. Where necessary, cap off existing utilities in a manner approved by authority having jurisdiction. Stake and record the location of any capped services.

2 PRODUCTS – NOT APPLICABLE

3 EXECUTION – NOT APPLICABLE

END OF SECTION

SECTION 01640
MANUFACTURERS' SERVICES

1 GENERAL 1

1.1 DEFINITIONS 1
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1.3 QUALIFICATION OF MANUFACTURER'S REPRESENTATIVE 1

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1.8 SUPPLEMENTS 3

SECTION 01640
MANUFACTURERS' SERVICES

1 GENERAL

1.1 DEFINITIONS

.1 Person-Day: One person for eight hours within regular Contractor working hours.

1.2 SUBMITTALS

.1 Submit Training Schedule and Lesson Plans in accordance with Section 01330 – Submittal Procedures.

1.3 QUALIFICATION OF MANUFACTURER'S REPRESENTATIVE

.1 Authorized representative of the manufacturer, factory trained, and experienced in the technical applications, installation, operation, and maintenance of respective equipment, subsystem, or system. Additional qualifications may be specified elsewhere.

.2 Representative subject to acceptance by the City and the Engineer. No substitute representatives will be allowed unless prior written approval by such has been given.

2 PRODUCTS – NOT APPLICABLE

3 EXECUTION

1.4 FULFILLMENT OF SPECIFIED MINIMUM SERVICES

.1 Furnish manufacturers' services when required by an individual specification section, to meet the requirements of this Section.

.2 Where time is necessary in excess of that stated in the Specifications for manufacturers' services, or when a minimum time is not specified, the time required to perform the specified services shall be considered incidental.

.3 Schedule manufacturer's services to avoid conflict with other onsite testing or other manufacturers' onsite services.

.4 Determine, before scheduling services, that all conditions necessary to allow successful testing have been met.

.5 Only those days of service approved by the Engineer will be credited to fulfill the specified minimum services.

.6 When specified in individual specification sections, manufacturer's onsite services shall include:

.1 Assistance during product (system, subsystem, or component) installation to include observation, guidance, instruction of Contractor's assembly, erection, installation or application procedures.

.2 Inspection, checking, and adjustment as required for product (system, subsystem, or component) to function as warranted by manufacturer and necessary to furnish Manufacturer's Certificate of Proper Installation.

.3 Revisiting the site as required to correct problems and until installation and operation are acceptable to the Engineer.

.4 Resolution of assembly or installation problems attributable to, or associated with, respective manufacturer's products and systems.

.5 Assistance during functional and performance testing, and facility startup and evaluation.

.6 Training of the City's personnel in the operation and maintenance of respective product as required.

.7 Additional requirements may be specified elsewhere.

1.5 MANUFACTURER'S CERTIFICATE OF COMPLIANCE

.1 When specified in individual Specification section, submit prior to shipment of product or material.

.2 The Engineer may permit use of certain materials or assemblies prior to sampling and testing if accompanied by accepted certification of compliance.

.3 Signed by product manufacturer certifying that product or material specified conforms to or exceeds specified. Attach supporting reference data, affidavits, and certifications as appropriate.

.4 May reflect recent or previous test results on material or product, if acceptable to the Engineer.

1.6 MANUFACTURER'S CERTIFICATE OF PROPER INSTALLATION

.1 When so specified, a Manufacturer's Certificate of Proper Installation form, a copy of which is attached to this section, shall be completed and signed by the equipment manufacturer's representative.

.2 Such form shall certify that the signing party is a duly authorized representative of the manufacturer, is empowered by the manufacturer to inspect, approve, and operate their equipment and is authorized to make recommendations required to assure that the equipment is complete and operational.

1.7 VIDEO RECORDING

.1 The City may themselves record or retain the services of a commercial videotaping service to record each training session. After taping, the material may be edited and supplemented with professionally produced graphics to provide a permanent record. The Contractor shall advise all manufacturers providing training sessions that the material may be video recorded.

1.8 SUPPLEMENTS

.1 The supplements listed below, following "End of Section", are part of this Specification.

.2 Forms: Manufacturer's Certificate of Proper Installation.

END OF SECTION

MANUFACTURER'S CERTIFICATE OF PROPER INSTALLATION

THE CITY _____ EQPT SERIAL NO:_____

EQPT TAG NO:_____ EQPT/SYSTEM:_____

PROJECT NO:_____ SPEC. SECTION:_____

I hereby certify that the above-referenced equipment/system has been:

(Check Applicable)

- ☐ Installed in accordance with Manufacturer's recommendations.
- ☐ Inspected, checked, and adjusted.
- ☐ Serviced with proper initial lubricants.
- ☐ Electrical and mechanical connections meet quality and safety standards.
- ☐ All applicable safety equipment has been properly installed.
- ☐ System has been performance tested, and meets or exceeds specified performance requirements. (When complete system of one manufacturer)

Comments:_____

_____

_____

_____

_____

_____

_____

I, the undersigned Manufacturer's Representative, hereby certify that I am (i) a duly authorized representative of the manufacturer, (ii) empowered by the manufacturer to inspect, approve, and operate his equipment and (iii) authorized to make recommendations required to assure that the equipment furnished by the manufacturer is complete and operational, except as may be otherwise indicated herein. I further certify that all information contained herein is true and accurate.

Date:_____,
20

Manufacturer:_____

By Manufacturer's Authorized Representative: _____
(Authorized Signature)

SECTION 01650
EQUIPMENT STARTUP AND PERFORMANCE TESTING

1 GENERAL 1

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SECTION 01650
EQUIPMENT STARTUP AND PERFORMANCE TESTING

1 GENERAL

1.1 GENERAL

.1 This section contains requirements for the Contractor's performance in conducting and documenting all equipment inspection and testing required under this contract as applied to all mechanical, electrical, instrumentation, and HVAC equipment and systems, including structures for watertight construction, provided under this contract.

.2 This section supplements but does not supersede specific inspection and testing requirements found elsewhere in this Contract.

.3 The sequence of procedures to undertake this portion of the work will be:

.1 Contractor Equipment Startup

.2 City Witnessed Equipment Startup

.3 Performance Testing

.4 Commissioning (Refer to Section 01660)

.4 Each step of the above sequence will be completed to the satisfaction of the Engineer prior to proceeding to the next step in the sequence.

.5 The City reserves the right to be present for and observe all inspection, testing and commissioning activities. Contractor shall notify City Operations and provide a testing schedule 48 hours in advance of each step in the sequence.

.6 The Manufacturer's Technical Service Representative must be an experienced (five years minimum), factory-trained technical service representative, qualified to certify the correct installation and operation of a particular piece of equipment.

1.2 DEFINITIONS

.1 **Red Tag**: The intent of the Red Tag is to signify that the Contractor Equipment Startup and the City Witnessed Equipment Startup have been completed for the equipment, and that the Contractor is in control of the equipment.

.2 **Green Tag**: The intent of the Green Tag is to signify that the Equipment Startup and Performance Testing are complete for the equipment, and that

the City is in control of the equipment for the purposes of operations, and that the equipment is ready for Facility Commissioning.

.3 **Yellow Tag**: The intent of the Yellow Tag is to signify that the Substantial Performance has been issued and the equipment is under the Warranty and Guarantee Period. The Yellow Tag will indicate the start date and end date of the Warranty and Guarantee Period.

.4 A copy of the **Operations Asset Transfer Procedures** are included in the Appendices. All tags shall be supplied by the Contractor.

1.3 QUALITY ASSURANCE

.1 The Contractor will appoint an engineer or equally qualified operations specialist as Testing Manager to manage, coordinate, and supervise the Contractor's quality assurance program. The qualified professional will have at least five years' experience in managing the startup and commissioning of mechanical, electrical, instrumentation, HVAC, SCADA and piping systems. The Contractor will designate in writing the appointed Testing Manager including a resume to the Engineer at least one month prior to implementation of the testing program.

.2 The quality assurance program will include:

.1 A calibration program for all instruments, gauges, meters, and thermometers used for determining the performance of equipment and systems installed under this contract. All test equipment gauges, thermometers, meters, analysis instruments, and other equipment used for calibrating or verifying the performance of equipment installed under this contract will be calibrated to within plus or minus 2 percent of actual value at full scale.

.2 A calibration program for all instruments, meters, monitors, gauges, and thermometers installed under this contract.

.3 A testing plan detailing how all testing work required under this project manual will be implemented. The test plan will be divided into process systems or areas for ease of preparation and implementation. The test plan will include test procedures for the Contractor Equipment Startup, City Witnessed Equipment Startup and Performance Testing.

.4 A testing schedule detailing sequence, time and duration of Equipment Startup and Performance Testing. The schedule will follow the critical path method and will be updated as required to reflect changes.

.5 A testing program for all mechanical, electrical, instrumentation, and HVAC equipment and systems installed under this contract.

.6 A documentation program to record the results of all equipment and system inspection and tests.

.7 For the purposes of this section, a system will include all items of equipment, devices and appurtenances connected in such a fashion as their operation or function complements, protects or controls the operation or function of the others. The Contractor will coordinate the activities of all subcontractors and suppliers to implement the requirements of this section.

.8 Test equipment employed for individual test runs will be selected so that expected values as indicated by the detailed performance specifications will fall between 60 and 100 percent of full scale.

.9 Pressure gauges will be calibrated in accordance with ANSI/ASME B40.1. Thermometers will be calibrated in accordance with ASTM E77 and will be furnished with a certified calibration curve.

.10 Liquid flowmeters, including all open channel flowmeters and all meters installed in pipelines with diameters greater than 50 mm will be calibrated in situ using either the total count or dye dilution methods. Gas flowmeters installed in piping systems with diameters greater than 150mm will be calibrated in situ using the pilot tube velocity averaging method. Flowmeter calibration work will be performed by individuals skilled in the techniques to be employed. Calibration tests for flowmetering systems will be performed over a range of not less than 10 percent to at least 75 percent of system full scale. At least five confirmed valid data points will be obtained within this range. Confirmed data points will be validated by not less than three test runs with results which agree within plus or minus two percent.

.11 This section contains references to the following documents. They are a part of this section as specified and as modified from time to time. In case of a conflict between the requirements of this section and those of the listed documents, the Engineer will make the final determination.

.1 ANSI/AS ME B40.1 Gauges Pressure Indicating Dial Type-Elastic Element.

.2 ASTM E77 Method for Verification and Calibration of Liquid-in-Glass Thermometers.

.3 ASHRAE 41.8 Standard Methods of Measurement of Flow of Gas.

.4 Flow Measurement in Sewer Lines by the Dye Dilution Method, Journal of the Water Pollution Control Federation, Vol. 55, Number 5, May 1983, pg. 531.

.5 Flow Measurement in Open Channels and Closed Conduits, Vol. 1, U.S. Department of Commerce, National Bureau of Standards, pg. 361.

1.4 SUBMITTALS

.1 Provide electronic and six (6) hard copies of all submittals to the Engineer, except where noted otherwise.

.2 The following material shall be submitted for review a minimum of three months in advance of the commencement of the earliest of the activities to which the material applies:

.1 A detailed schedule, listing equipment and calendar dates when the Contractor plans to commence Equipment Startup and Performance Testing of the completed systems, along with a description of the temporary systems and installations planned to allow operational testing to take place. Similar types of equipment should be grouped together.

.2 Detailed testing plans, setting forth step-by-step descriptions of the procedures proposed by the Contractor for the systematic testing of all equipment and systems installed under this contract

.3 Sample forms for documenting the results of all Equipment Startup and Performance tests.

.4 A description of the Contractor's proposed plan for documenting the calibration of all test instruments.

.5 A description of the Contractor's proposed plan for calibration of all instrument systems, including flowmeters and all temperature, pressure, weight, and analysis systems.

.6 The credentials and certification of the testing laboratory proposed by the Contractor for calibration of all test equipment.

.7 Check-out Tags to be filled in by each applicable trade verifying that all appropriate checks have been made, including but not limited to, cleaning, inspection, insulation testing, leakage testing, lubrication, rotation, calibration, adjustment and wire loop checks.

.8 Equipment Startup Reports containing all Equipment Startup documentation, including but not limited to Check-out Lists, Calibration Forms, Inspection Reports, Verification Forms, etc., which are signed off by all parties, including the Contractor, Engineer, City, and Manufacturer's Representative, following successful City Witnessed Equipment Startup for each piece of equipment or system and prior to commencement of the Performance Test.

.9 Draft Contractor's Operations and Maintenance Manuals as per Section 01730 are to be submitted during the Equipment Startup stage, prior to the Performance Testing stage. Product data, to be furnished under this section, will be the original and six copies of all records produced during the entire testing program will be included in the appropriate section of the Maintenance Manual.

.10 Performance Test results must be submitted and reviewed by the Engineer prior to commencement of Facility Commissioning.

.3 Documentation

.1 The Contractor will develop and implement a records keeping system to document compliance with the requirements of this Section. Calibration documentation will include identification (by make, manufacturer, model, and serial number), Tag No. of all test equipment, date of original calibration, subsequent calibrations, calibration method, and test laboratory.

.2 Equipment and system documentation as a minimum will include date of test, equipment number Tag No., nature of test (Equipment Startup or Performance), test objectives, test results, test instruments employed for the test and signature spaces for the Engineer's witness and the Contractor's Testing Manager. A file will be established for each system and item of equipment. It is suggested that files be maintained separately for pipe pressure testing, mechanical equipment performance testing, instrumentation equipment performance testing (loops), and electrical equipment. These files will include the following information as a minimum:

.1 Metallurgical tests (if required)

.2 Factory performance tests (if required)

.3 Equipment Startup tests

.4 Performance tests

.3 The Contractor will develop test documentation forms specific for each system and associated equipment items installed under this contract: Forms that exist in the City of Hamilton latest SCADA Standard and those at the end of this section. Acceptable documentation forms for all other systems and items of equipment will be produced for review by the Engineer a minimum of four weeks prior to any Performance Testing. Once the Engineer has reviewed and taken no exception to the forms proposed by the Contractor, the Contractor will produce sufficient forms, at his expense, to provide documentation of all testing work to be conducted as a part of this contract. Contractor is required to use the following sign-off sheets as a minimum:

.1 Startup and Commissioning Status Reports

.2 Electrical Installation/Startup Checklist

.3 Mechanical Equipment Installation/Startup Checklist

.4 Alignment Data Record Form

.5 Pressure/Hydrostatic Tests

.6 Valve Installation Checklist

.7 Other forms in the latest City's Operations Asset Transfer Procedures.

.4 The Contractor will develop test plans detailing the coordinated, sequential testing of each item of equipment and system installed under this contract. Each test plan will be specific to the item of equipment or system to be tested. Test plans will identify by specific equipment or tag number each device or control station to be manipulated or observed during the test procedure and the specific results to be observed or obtained. Test plans will also be specific as to support systems required to complete the test work, temporary systems required during the test work, subcontractors' and manufacturers' representatives to be present and expected test duration. As a minimum, the test plans will include the following features:

.1 Step-by-step proving procedure (ring-out) for all control and control loops and electrical circuits by imposing low voltage currents and using appropriate indicators to affirm that the circuit is properly identified and connected to the proper device.

.2 Calibration of all analysis instruments and control sensors.

.3 Performance testing of each individual item of mechanical, electrical, and instrumentation equipment associated with a system.

.4 Performance system tests designed to duplicate, as closely as possible, operating conditions.

.5 Within 60 calendar days of the Notice to Proceed, the Contractor shall submit the test plan(s) required for the systematic functional tests for the equipment and or system installed under this contract. Submit six hard copies and electronic copies of test plan(s) for review. Once the test plan(s) have been reviewed and no exception taken, the Contractor will reproduce the plan(s) in sufficient number for the Contractor's purposes and an additional six hard copies and electronic copies for delivery to the Engineer. No test work for the equipment, system or facility will begin until the Contractor has delivered the specified number of approved final test plans to the Engineer.

.6 The Contractor will produce a testing schedule setting forth the sequence contemplated for performing the test work. The schedule will be in bar chart form, plotted against calendar time, and will detail the equipment and or systems to be tested. The schedule will show the contemplated start date, duration of the test and completion of each test. The test schedule will be submitted no later than four weeks in advance of the date testing is to begin. The Engineer will not witness any testing work for the purpose of acceptance until the Contractor has submitted a schedule to which the Engineer takes no exception. The test schedule will be updated weekly, showing actual dates of test work, indicating systems and equipment testing completed satisfactorily.

1.5 CONTRACTOR EQUIPMENT START-UP

.1 Contractor to conduct inspections and testing of all equipment components and sub-components and arrange for inspections of the installations by qualified equipment Manufacturer's Technical Service Representatives as required by the Contract Documents.

.2 The inspection and testing includes and is not limited to cleaning, leakage and pressure testing, alignment checks, disinfection, system flushing, lubrication, rotation checks, wiring loop checks, insulation testing, load testing, supply and demand testing, functional testing, etc.

.3 This stage is witnessed by the Engineer and Deficiency Reports are prepared by the Engineer.

.4 The Contractor is required to remedy outstanding incomplete or incorrect work in accordance with terms of Contract.

.5 The Contractor is to obtain completed Equipment Installation Certification Forms, calibration and signoff sheets for each piece of equipment and submit these to the Engineer for review. Successful Contractor Equipment Startup will not be achieved until the Engineer and Manufacturer's Technical Service Representatives are satisfied and have signed the sign off sheets.

.6 During this phase, the City reserves the right to observe the Contractor Equipment Startup proceedings.

.7 The City Witnessed Equipment Startup will not proceed until the Contractor Startup has been successfully completed to the satisfaction of a qualified Manufacturer's Technical Service Representative and the Engineer.

.8 Verification tests will consist of but may not be limited to the following:

.1 Pressure and/or leakage tests.

.2 Insulation tests for all electrical equipment and electrical systems.

.3 Functional checkout of all electrical systems.

.4 Component calibration, loop test, loop commissioning and tuning.

.5 Preoperational check-out for all mechanical equipment.

.6 Functional testing of all mechanical, electrical, and systems to demonstrate compliance with the performance requirements.

.9 In general, tests for any individual system will be performed in the order listed above. The order may be altered as authorized by the Engineer in writing after receipt of a written request, complete with justification of the need for the change in sequence.

.10 Pressure and Leakage Tests: Pressure and leakage tests will be conducted in accordance with applicable portions of these contract specifications. All tests will be witnessed by the Engineer. Evidence of successful completion of the pressure and leakage tests will be the Engineer's signature on the test forms prepared by the Contractor.

.11 Electrical Checkout: Prior to energization (in the case of electrical systems and equipment) all circuits will be insulation tested with a minimum acceptable limit of 1,000 megohms.

.12 Component Calibration and Loop Testing: Prior to energization (in the case of instrumentation system and equipment) all loops and associated instruments will be calibrated and tested in accordance with the procedures required in Division 16 - Electrical.

.13 Electrical Resistance: Electrical equipment and all cables will be subject to megger testing in accordance with the requirements of Division 16 - Electrical. The minimum acceptable test results will be 1,000 megohms.

.14 Preoperational check-out will include the following:

.1 Alignment of equipment using the reverse dial indicator method.

.2 Pre-operation lubrication.

.3 Manufacturers' recommendations for prestart preparation.

.15 Once all affected equipment has been subjected to the required check-out procedures and the Engineer has witnessed and has not found deficiencies in that portion of the work, individual items of equipment and systems may be started and operated under simulated operating conditions to determine as nearly as possible whether the equipment and systems meet the requirements of these specifications.

.16 If available, potable water may be employed for the testing of all liquid systems except gaseous, oil, or chemical systems. Test media for these systems will either be the intended fluid or a compatible substitute.

.17 The equipment will be operated a sufficient period of time to determine machine operating characteristics, including noise, temperatures and vibration; to observe and document performance characteristics; and to permit initial adjustment of operating controls.

.18 When testing requires the availability of auxiliary systems such as looped piping, electrical power, compressed air, control air, or instrumentation which have not yet been placed in service, the Contractor will provide acceptable substitute sources, capable of meeting the requirements of the machine, device, or system at no additional cost to the City.

.19 During the Contractor Equipment Startup test period, the Contractor will obtain baseline operating data on all equipment with motors greater than 0.75kW to include amperage, bearing temperatures, and vibration as required. This baseline data will be collected for the City to enter into a preventive maintenance system.

.20 Test results will be within the tolerances set forth in the detailed specification sections. If no tolerances have been specified, test results will conform to tolerances established by recognized industry practice. Where, in the case of an otherwise satisfactory installed test, any doubt, dispute, or difference should arise between the Engineer and the Contractor regarding the test results or the methods or equipment used in the performance of such test, the Engineer may order the test to be repeated.

.21 Retesting: If under test, any portion of the work should fail to fulfill the contract requirements and is adjusted, altered, renewed, or replaced, tests on that portion when so adjusted, altered, removed, or replaced, together with all other portions of the work as are affected thereby, will, unless otherwise directed by the Engineer, be repeated within reasonable time and in accordance with the specified conditions. The Contractor will pay all reasonable expenses incurred by the City as a result of repeating such tests.

.22 Post-Test Inspection: Once testing has been completed, all rotating machines will be rechecked for proper alignment. If equipment does not meet the specified alignment requirement, realign equipment and submit final alignment report. All equipment will be checked for loose connections, unusual movement, or other indications of improper operating characteristics. Any deficiencies will be corrected to the satisfaction of the Engineer. All machines or devices, which exhibit unusual or unacceptable operating characteristics, will be disassembled and inspected. Any defects found during the course of the inspection will be repaired or the specific part or entire equipment item will be replaced to the complete satisfaction of the Engineer at no cost to the City.

1.6 CITY WITNESSED EQUIPMENT STARTUP

.1 During this step, the Contractor, qualified Manufacturer's Technical Service Representative, Engineer and City will all be present to witness each Equipment Startup similar to the Contractor Startup.

.2 Contractor is to schedule all inspection and testing and ensure City is provided with a minimum of two weeks' notice prior to City Witnessed Equipment Startups.

.3 All Check-out Lists, Calibration Forms, Inspection Reports and Verification Forms are to be signed off by all parties upon successful validation of inspection and testing.

.4 Following acceptance by all parties that the equipment is ready for service, a Red Tag will be placed on the equipment designating that the Contractor Equipment Startup and the City Witnessed Equipment Startup are

complete for that equipment and that the Contractor is in control of the equipment.

.5 Engineer to update the Deficiency Reports according to any outstanding items.

1.7 PERFORMANCE TESTING

.1 Once each piece of equipment within a defined system carries a Red Tag has been completed, then that individual system or subsystem will be started and tested according to the individual specification for that equipment or system for a minimum of 15 consecutive calendar days, unless otherwise required by the individual specifications.

.2 Contractor to conduct Performance Testing of all equipment in conjunction with the qualified Manufacturers' Technical Service Representatives as required by the Contract Documents and under the witness of the Engineer.

.3 The City reserves the right to be present to witness any or all of the Performance Tests.

.4 Deficiency Reports will be updated by the Engineer. Deficiencies that are uncovered will be corrected and retesting will be conducted as required.

.5 Following acceptance by all parties that the equipment has passed the Performance Tests, a Green Tag will be placed on the equipment designating that the Performance Test is complete and the equipment is now in the City's control and operation.

.6 Documentation to support the validation of the Performance Test will be submitted by the Contractor.

.7 All Training of City staff must be completed prior to commencement of the Facility Commissioning stage.

.8 Following completion of Equipment Startup Requirements and certification by all parties that all equipment complies with the requirements of the specifications, the Contractor will fill all process units and process systems, except those employing potable water, oil, air, or chemicals, with plant service water. All potable water, oil, air, and chemical systems will be filled with the specified fluid. Water treatment chemicals will not be added during the Performance Testing.

.9 The Performance Testing period for each piece of equipment or system will be 15 consecutive days starting on a Monday, unless otherwise directed by the Engineer. Should the Performance Testing period be halted

for any reason related to the facilities constructed or the equipment furnished under this contract, or the Contractor's temporary testing systems, the Performance Testing program will be repeated until the specified continuous period has been accomplished without interruption.

.10 The Contractor will also conduct Performance Testing of complete systems for a period of not less than 48 hours, during which all parts of the system will be operated as a complete facility at various loading conditions, as directed by the Engineer.

.11 All process units will be brought to full operating conditions, including temperature, pressure, and flow and must meet the individual Performance requirements stipulated in the Contract.

.12 The City staff may be present to witness all or any part of the Performance Period. Failure by the Contractor to provide adequate notice prior to a particular Performance Test may result in the City having the Contractor repeat the test at no cost to the City.

2 PRODUCTS – NOT APPLICABLE

3 EXECUTION

1.8 GENERAL

.1 The Contractor's Testing Manager will organize teams made up of qualified representatives of equipment manufacturers, subcontractors, the Contractor's independent testing laboratory, and others, as appropriate, to efficiently and expeditiously calibrate and test the equipment and systems installed and constructed under this contract. The objective of the testing program will be to demonstrate, to the Engineer's complete satisfaction that the structures, systems, and equipment constructed and installed under this contract meet all performance requirements and the facility is ready for the Facility Commissioning stage to commence. In addition, the testing program will produce a record of baseline operating conditions for the City to use in the preventive maintenance program.

.2 The Contractor will provide, at no expense to the City, all power, fuel, compressed air supplies, potable water, all labour, temporary piping, heating, ventilating, air conditioning and all other items and work required to complete the installed tests. Temporary facilities will be maintained until permanent systems are in service.

1.9 CALIBRATION OF FIXED INSTRUMENTS

.1 Calibration of analysis instruments, sensors, gauges, and meters installed under this contract will proceed on a system-by-system basis. No

equipment or system performance testing will be performed until instruments, gauges, and meters to be installed in that particular system have been calibrated, the calibration work has been witnessed by the Engineer and the reports have been submitted to the Engineer.

.2 All analysis instruments, sensors, gauges, and meters used for performance testing will be subject to recalibration to confirm accuracy after completion, but prior to acceptance of each performance test. All analysis instruments, sensors, gauges, and meters installed under this contract will be subject to recalibration as a condition precedent to Facility Commissioning.

1.10 SUPPLEMENTS

.1 The Supplements listed below, follow the "End of Section," are part of this Specification.

.1 Electrical Installation/Startup Checklist

.2 Mechanical Equipment Installation/Startup Checklist

.3 Alignment Data Record Form

.4 Pressure/Hydrostatic Tests

.5 Valve Installation Checklist

END OF SECTION

Electrical Equipment Installation – Start Up Checklist

Project Name:	**Project Number:**	
Contractor:	**Date:**	

Equipment			
Identification Tag No.			
Manufacturer			
Model			
Serial Number			
Rating hp/kw		RPM	
Amps		Supply Voltage	
Phase		Wire	
Insulation Design		Insulation Class	
Temperature Raise		Enclosure Type	
Approvals CSA, NEMA, etc.		Date Received	
Others		Date Started	

	INSTALLATION	**A**	**B**	**C**	**D**
1	Foundation or Base				
2	Mounting Bolts				
3	Couplings, belts, chains				
4	Shaft Alignment				
5	Gaskets				
6	Motor Megger				
7	Motor Rotation				
8	Supply/Starter Fuse Size				
9	Supply/Starter O/L Size				
10	Interlock Checked				
11	Grounding Installation				
12	Cable or Conduit Installation				

	START UP OF EQUIPMENT	A	B	C	D
1	General Condition				
2	Bearing Temperature				
3	Seals, Packing				
4	Valves, Check valves				
5	Connecting Rods				
6	Couplings				
	Safety Hazards				
7	Lubrication				
8	Seal Lubrication				
9	Shafting, Universal				
10	Clutch				
11	Gear Drives				
12	Control – Local Run				
13	Control – Remote Run				
14	Painting				
	REMARKS				

Legend:
(**A**) Inspected and found acceptable
(**B**) Inspected, found defective but corrected
(**C**) Inspected, found defective and not corrected
(**D**) Not inspected

Inspection Result	Passed Installation and Start-up checkout. Equipment certified ready for service		Failed – Contractor to schedule equipment re-inspection	

Contractor

Date

Supplier

Date

Consultant

Date

City/Operator

Date

Project Name:	**Project Number:**	
Contractor:	**Date:**	

SERVICE:	**DATE INSTALLATION COMPLETE:**
TANK # / PIPE DESCRIPTION:	**MAKE AND MODEL NO:**

PRE-START-UP	**CHECKED BY (INITIAL)**	**DATE**	**REMARKS**
Waterproofing			
Valves or Plugs			
Test Pressure			
Duration of Test			
* Indicates (N/A) if not applicable			

Inspection Result	Passed Installation and Start-up checkout. Equipment certified ready for service		Failed – Contractor to schedule equipment re-inspection	

Contractor

Date

Supplier

Date

Consultant

Date

City/Operator

Date

Project Name:	**Project Number:**	
Contractor:	**Date:**	

EQUIPMENT:		**DATE INSTALLATION COMPLETE:**	
MAKE:	**MODEL #:**	**SERIAL #:**	
BODY	**CHECKED BY (INITIAL)**	**DATE**	**REMARKS**
Manufacturer/Model #			
VALVE Identification			
Type/Body Size			
Port Size/End Connection			
Trim Form			
Packing/Stem Seal Adjustment			
Lubrication			
Exterior Finish			
ACTUATOR – Manufacturer/ Model # and Size			
Type			
Open At/Close At			
Fail Position			
Handwheel/Manual Override Position Indicator			
Open/Closed Position Stop Adjustment			
POSITIONER - Manufacturer/ Model #			
All Assess. Installed and Functioning Correctly (Filter/Regulator, Gauge, Bypass, etc.)			
Input Signal/Output Signal			
Calibration			
OTHER – Positioning Indicating Switch Adjustment			
Feedback Potentiometer Calibration			
Devices Requiring MCCR Canadian Reg# (Identify with #)			
Operation & Maintenance Manuals Received			
PERFORMANCE –			

Manufacturer's Rep in Attendance			
Maximum Flow			
Value % Open @ Max Flow			
Inlet Pressure @ Max Flow			
Pressure Drop @ Max Flow			
Minimum Flow			
Valve % Open @ Min Flow			
Inlet Pressure @ Min Flow			
Pressure Drop @ Min Flow			
Relief Pressure (Safety Valves)			
Reseating Pressure (Safety Valves)			
Manufacturer's Letter of Confirmation of Equipment Proper Installation Received			
*Indicates (N/A) if not applicable			
COMMENTS:			

Inspection Result	Passed Installation and Start-up checkout. Equipment certified ready for service		Failed – Contractor to schedule equipment re-inspection	

Contractor

Date

Supplier

Date

Consultant

Date

City/Operator

Date

SECTION 01660
COMMISSIONING

1 GENERAL 1

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1.2 DEFINITIONS 1
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1.10 COMPLETION OF FACILITY COMMISSIONING 5

SECTION 01660
COMMISSIONING

1 GENERAL

1.1 GENERAL

.1 This section contains requirements for the Contractor's performance during the Commissioning of the structures, equipment and systems constructed and installed during the course of this contract. All commissioning work, as described in this section, will be performed by the Contractor.

1.2 DEFINITIONS

.1 Start-up and Commissioning consists of placing all the various systems into continuous operation in an orderly manner, operating the system for 14 consecutive calendar days, and conducting full range performance testing to fully verify and validate that the systems and the facility perform in the manner intended as per the design.

1.3 QUALITY ASSURANCE

.1 The Contractor will assemble a commissioning team under the direction of an individual duly authorized to commit the Contractor's personnel and resources to respond to requests for assistance on the part of the Engineer.

.2 The commissioning team will consist of a Commissioning Manager, representatives of the Contractor's mechanical, electrical, and instrumentation subcontractors, and others as appropriate. Qualifications for the Commissioning Manager to include a minimum five years' experience managing testing, start-up and commissioning of mechanical, electrical, instrumentation, building systems and piping systems. Provide a resume to Engineer for review prior to acceptance of proposed Commissioning Manager.

.3 The commissioning team will be available at the site of the work during normal working hours (eight hours a day, five days a week, Saturdays, Sundays, and legal holidays excepted) and will be available within two hours' notice at all other times upon notice by telephone.

.4 The commissioning team will at all times be equipped and ready to provide for emergency repairs, adjustments, and corrections to the equipment and systems installed and modified as a part of this contract.

1.4 SUBMITTALS

.1 The following information will be provided:

.1 Detailed plans for commissioning each process unit and each system constructed or modified as a part of the work performed under this contract.

.2 Working with representatives of the City, the Engineer and the System Integrator where applicable, the Contractor shall develop a plan for providing 24-hour response during the commissioning period. The plan will be complete with a daytime staffing plan and names, qualifications, and telephone numbers of those assigned to off-hour standby duty.

.3 Final Contractor's Operation and Maintenance Manuals before the end of the Facility Commissioning stage, prior to Substantial Performance Date.

.2 Working with representatives of the City and the Engineer, the Contractor will develop and produce a detailed, written plan for the Facility Commissioning and initial operation, under actual operating conditions, of the equipment and systems installed and constructed under this contract. The document, after review by the Engineer, will serve as the guidance manual for the commissioning process. The document will be prepared and submitted to the Engineer for review a minimum of six months prior to commencement of commissioning.

1.5 PRE-COMMISSIONING DISINFECTION

.1 This subsection identifies the minimum requirements for disinfection of water facilities, including facilities preparation, application of disinfection compounds to all surfaces in contact with treated water, sampling and testing, and applies to all elements of the facilities that will be in contact with treated and/or disinfected water under normal facility operating conditions.

.2 Prepare water facilities for Facility Commissioning by proper cleaning and disinfection in strict accordance with the latest edition of AWWA Standard C653. Facility Commissioning will not initiate until the facility is proven to be fully prepared for production and witnessed and accepted by the Engineer and City.

.3 Visually inspect all structures, tanks and pipes. Remove any accumulated debris, surface discolourations, corrosion and oily patches. Remove any tools, scaffolding, planks, rags and any other material not part of the treatment units.

.4 Thoroughly clean and flush all the process equipment, piping and conduits.

.5 Use high-pressure water jets, sweeping, scrubbing or other effective methods. Collect and properly discard all water, flakes, sediments, dirt and all foreign material accumulated during the cleaning operation.

.6 Initiate disinfection of the facility only after facilities are properly cleaned and the cleaning has been witnessed by the Engineer and accepted by the City. Use chlorine solutions identified in the AWWA Standard C653.

.7 Disinfect piping using one of three alternative methods described in latest edition of the AWWA Standard C651, including application methods, chlorine solution strengths, retention times, disposal of chlorinated water, and bacteriological sampling and testing.

.8 Disinfect all storage tanks, reservoirs, pumpwells, and similar water retaining structures using one of the methods described in latest edition of the AWWA Standard C652, including application methods, chlorine solution strengths, retention times, disposal of chlorinated water, and bacteriological sampling and testing.

.9 After disinfection is complete and prior to Commissioning, the City will collect, sample and pay for all bacteriological quality tests.

.10 In the event the samples do not meet the MOE requirements for bacteriological quality, the Contractor will re-disinfect the structures or pipes in accordance with procedures noted above. All costs associated with repeating the disinfection procedures to be borne by the Contractor including the costs for the City to resample for bacteriological compliance.

.11 The Facility Commissioning stage will not begin until the facility is proven to be in compliance with the latest MOE standards for bacteriological quality.

1.6 COMMISSIONING

.1 Facility Commissioning may not begin until Green Tags have been placed on all equipment, unless otherwise agreed in writing by the Engineer.

.2 The Contractor is responsible for the successful completion of the commissioning activities and for planning and scheduling commissioning activities, and will have equipment manufacturer representatives at the site as well as qualified mechanical, electrical, control and instrumentation personnel.

.3 Once the facility is pumping treated drinking water into the distribution system, the City is responsible for operating and controlling all Green Tagged equipment.

.4 Deficiency Reports will be updated by the Engineer. Deficiencies that are uncovered will be corrected by the Contractor and retesting will be conducted by the Contractor as required.

.5 Contractor to submit Facility Commissioning Report.

2 PRODUCTS – NOT APPLICABLE

3 EXECUTION

1.7 ROLE OF CONTRACTOR

.1 Facility Commissioning will not begin until completion of the Equipment Start-Ups and Performance Testing, including sign-off by the Contractor, Manufacturer's Technical Service Representative, Engineer, City and System Integrator where applicable, that the systems met all test requirements.

.2 The Contractor will remove all temporary piping, bulkheads, controls and other alterations to the permanent systems that may have been needed during the performance and operational testing and will perform the tasks necessary to make the improvements constructed under this contract fully operational.

.3 Facility Commissioning is considered to be complete when all systems have been operating continuously for a period of 14 calendar days without fault and in accordance with the full range of specified performance requirements.

.4 Failure of any part of Work during the period of continuous automatic operation will require restart of that portion or system of Work, following recertification of the fault or failure.

.5 Substantial Performance Date is subject to successful completion of Facility Commissioning to the satisfaction and acceptance of the Engineer and the City.

1.8 ROLE OF CITY

.1 Prior to handover to the City, the portion of the work to be commissioned will be designated with Green Tags and will be fully operational, performing all functions for which it was designed. For water facilities, the City's operation and maintenance personnel will be responsible for

operation of the facility during Facility Commissioning, once treated water is being pumped to the distribution system.

1.9 CONTRACTOR'S RESPONSIBILITY

.1 The Contractor will be available at all times during Commissioning period to provide immediate assistance in case of failure of any portion of the system being operated. The Contractor will be prepared to make modifications to the system or individual components in order to meet the requirements of the Contract.

.2 During the Facility Commissioning period, the City will be responsible for all normal operational costs and the Contractor will bear the costs of repairs or replacements, including labour and materials, required to keep the portion of the facility being commissioned, operational.

.3 If, as a result of the actions of the Contractor, it is necessary to suspend start-up commissioning or continuous operation during the Facility Commissioning period due to deficiencies or failure in any system, the full cost if interruption, call-back, testing and resumption of start-up, commissioning or continuous operation will be paid by the Contractor.

1.10 COMPLETION OF FACILITY COMMISSIONING

.1 At the end of the Facility Commissioning period and when all systems have been proven to function as per the design intention to the satisfaction of the Engineer and the City, application for substantial performance of the Contract may be made as outlined in General Conditions of Contract. Each of the items outlined in Supplemental General Conditions SGC 4.16 must be fully complied with before the Contract can be certified as substantially performed.

.2 Upon Completion of Contract and the start of the Warranty Period, a Yellow "Warranty Period" tag must be placed on all equipment, designating the start date and duration of the Warranty Period.

END OF SECTION

SECTION 01720
PREPARATION

1 GENERAL 1

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1.3 SURVEY REFERENCE POINTS 1
1.4 SURVEY REQUIREMENTS 2
1.5 EXISTING SERVICES 2
1.6 LOCATION OF EQUIPMENT AND FIXTURES 2
1.7 RECORDS 2
1.8 SUBSURFACE CONDITIONS 3

2 PRODUCTS – NOT APPLICABLE 3

3 EXECUTION – NOT APPLICABLE 3

SECTION 01720
PREPARATION

1 GENERAL

1.1 SECTION INCLUDES

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

.2 Survey services to establish and confirm elevations for the Works.

.3 Recording of subsurface conditions found.

1.2 REFERENCES

.1 Engineer will provide a listing of control points and temporary benchmarks for the Contractor's use.

1.3 SURVEY REFERENCE POINTS

.1 Existing base horizontal and vertical control points will be provided by the Engineer.

.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 the Engineer.

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

.5 The Owner will replace control points in accordance with the original survey control. The cost of resetting or replacing control points disturbed by the Contractor shall be at the Contractor's expense.

.6 All elevations indicated on the Contract Drawings or Specifications are referred to Hamilton datum. Refer to the datum references on the drawings.

.7 All general layout required by the Contractor for the purposes of construction shall be carried out by the Contractor. The Contractor shall provide such masts, scaffolds, batter boards, slope stakes, straight edges, templates and other devices as may be necessary to facilitate layout and inspection and construction of the Works within the contract price.

.8 The Engineer will check the Contractor's layout.

1.4 SURVEY REQUIREMENTS

.1 Record locations, with horizontal and vertical data in Project Record Documents.

.2 Establish lines and levels, locate and lay out the works using appropriate instrumentation.

.3 Stake for grading, fill and topsoil placement and landscaping features.

.4 Stake slopes and berms.

.5 Establish pipe invert elevations.

.6 Stake batter boards for foundations.

.7 Establish foundation column locations and floor elevations.

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

.9 Wherever new work must tie into existing facilities, establish lines and levels in appropriate for proper tie-ins.

1.5 EXISTING SERVICES

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

1.6 LOCATION OF EQUIPMENT AND FIXTURES

.1 The location of equipment, fixtures and outlets indicated on the drawings 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 manufacturers' recommendations for safety, access and maintenance.

.3 Inform the Engineer prior to installation and obtain approval for actual location.

.4 Submit field drawings to indicate relative position of various services and equipment as required by the Engineer.

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 SUBSURFACE CONDITIONS

.1 Promptly notify the Engineer in writing if subsurface conditions, or any reasonable assumption of probable conditions, differs materially from those indicated in the Contract Documents.

.2 The Engineer or other agents of the Owner will promptly investigate the conditions and the Engineer will advise the Contractor in writing of any necessary changes to the Works.

2 PRODUCTS – NOT APPLICABLE

3 EXECUTION – NOT APPLICABLE

END OF SECTION

SECTION 01730
OPERATIONS AND MAINTENANCE MANUAL

1 GENERAL 1

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1.3 CONTRACTOR'S OPERATIONS AND MAINTENANCE MANUALS 1
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1.6 SUPPLEMENTS 8

2 PRODUCTS – NOT APPLICABLE 8

3 EXECUTION – NOT APPLICABLE 8

SECTION 01730
OPERATIONS AND MAINTENANCE MANUAL

1 GENERAL

1.1 DEFINITIONS

.1 Maintenance Operation: As used in the Maintenance Summary Form is defined to mean any routine operation required to ensure satisfactory performance and longevity of equipment. Examples of typical maintenance operations are equipment disassembly/ reassembly, lubrication, belt tensioning, adjustment of pump packing glands, and routine adjustments.

1.2 QUALITY ASSURANCE

.1 Manuals for equipment and systems shall be prepared by equipment manufacturer or system Supplier.

1.3 CONTRACTOR'S OPERATIONS AND MAINTENANCE MANUALS

.1 Prepare three (3) copies (electronic (flash drive) and hard copy) of documentation including as-constructed shop drawings to instruct the City's operations and maintenance staff in the operation and associated maintenance of each piece of equipment and system as supplied and installed.

.2 Submit an outline of the Operation and Maintenance Manual, including table of contents, section tabs, and O&M material from equipment supplier for approval by the Engineer, 80 calendar days prior to Section 01640 – Manufactures' Services, Section 01650 – Equipment Startup and Performance Testing and Section 01660 – Commissioning.

.3 Submit three (3) copies (electronic (flash drive) and hard copy) of the Draft Contractor's Operations and Maintenance Manual 80 calendar days prior to the start of Section 01640 – Manufacturers' Services, Section 01650 – Equipment Startup and Performance Testing and Section 01660 – Commissioning.

.4 Submit three (3) final copies (electronic (flash drive) and hard copy) of the Contractor's Operations and Maintenance Manual prior to the end of Testing and Commissioning, prior to substantial performance.

.5 Provide black expanding three ring catalogue binders suitably labelled on both the spine and cover.

1.4 CONTENTS

.1 Arrange material in volumes as described below. Provide a separate binder for each volume unless directed otherwise by Engineer. Where more than one (1) binder is required to accommodate the documentation for a volume, increase or decrease the number of volumes and renumber as necessary:

.1 Volume 1 – Operation Manual (contents to be completed by the Engineer). Contractor shall allow for 18 binders (assuming one draft set of three copies for up to two Volumes, and one final set of six copies for up to two Volumes) to be manufactured in the same format as the other Volumes and provided to the Engineer. The Engineer will give the Contractor one hardcopy and one electronic copy of the contents of the binder to make up to 18 copies assuming 500 colour pages per binder. The Engineer's electronic copy will be a single PDF file with the Contractor to organize in accordance with Clause 1.5.3.

.2 Volume 2 – Architectural/Structural (by Contractor)

.3 Volume 3 – Mechanical Operations and Maintenance (by Contractor)

.4 Volume 4 – Electrical and Instrument Operation (by Contractor)

.2 The number of volumes will be increased and renumbered as necessary to accommodate the documentation. Each copy will be permanently numbered 1 to 6.

.3 The binder will be hot stamped in gold lettering on the spine to accommodate the full identification title of the project and the front face lettered with the following on the respective binders as a minimum:

.1 Full identification title of the project (e.g. New Pier 8 WWPS, Forcemain, Sewer, and Storage Tank 2017).

.2 Volume No. – Numbered as required to include all items accordingly.

.3 Volume Title (e.g. Mechanical Operations and Maintenance).

.4 City's Name (City of Hamilton) with City Logo in Colour.

.5 Number of Sets (i.e., 1 of 6).

.6 Contract No.

.4 The binders will be arranged according to the Construction Specifications Institute Masterformat – Master List of Sections, Titles and Numbers

utilizing laminated mylar plastic divider tabs and colour coded according to section. Colour will be as follows:

.1 Division – white.

.2 Systems – orange.

.3 Certification and Testing – green.

.4 Shop Drawings and Maintenance Bulletins – yellow.

.5 Safety and Maintenance – red.

.5 Make up each binder as follows:

.1 Tab: Table of Contents – details the titles of the various divisions of the manual in the binder.

.2 Tab: Introduction to manual – written explanation of the layout of the manual and intended use.

.3 Tab: Include the following information under a separate tab.

.1 Owner: Name, address, telephone, fax numbers.

.2 Owner's Project Manager: Name, address, telephone, fax numbers.

.3 Engineer: Name, address, telephone and fax numbers.

.4 Contractor: name, address, telephone and fax number, name of project manager.

.5 Major Sub-Contractors: Name, address, telephone and fax numbers of subcontractors included in that binder.

.6 Provide the following for each respective Division:

.1 Tab Division No. (e.g., Division 15).

.2 Division Name – (e.g., Mechanical).

.3 Index – List of all Sections under the applicable Division, in the order of appearance and included in the binder.

.4 List of all subcontractors and suppliers with contact information.

.5 Drawing List

.7 Organize the various applicable sections under separate divider tabs labelled division/number as required by the project.

.8 The following information will be provided for each system and major piece of equipment. Each piece of equipment will be referenced by its tag number. Where manufacturer's literature covers several models or options, the applicable information will be highlighted or redundant information crossed out.

.1 Index of information in that section in order of appearance.

.2 Description of system, components and technical data. Include interfaces, sequences, operational characteristic changes for seasonal operation. Include name plate information including equipment number, make, size, capacity, model number and serial number.

.3 Maintenance and operating instructions including:

.1 Installation instructions.

.2 Procedure for starting.

.3 Proper adjustment.

.4 Test procedures.

.5 Procedure for operating.

.6 Procedure for shutdown.

.7 Safety precautions.

.8 List of electrical relay settings and control and alarm contact settings.

.9 Repair or replacement procedures/details for all items of equipment that have operating components.

.10 Maintenance instructions for equipment.

.11 Maintenance instruction for finishes.

.4 Troubleshooting data.

.5 Preventative maintenance program complete with:

.1 Suggested check list sheets.

.2 List of points to be greased or oiled.

.3 Lubrication charts and lubrication instructions, which shall list points to be greased or oiled shall recommend type of grade and temperature range of lubricants and shall recommend frequency of lubrication.

.4 List of wear points to be inspected and/or adjusted regularly.

.5 Suggested schedule for lubrication and inspection.

.6 Schematic, single line and wiring diagrams.

.7 List of electrical relay settings and control and alarm contact settings.

.8 Electrical interconnection wiring diagram for equipment furnished, including all control systems.

.9 Valve tag list.

.10 Recommended spare parts list.

.11 Recommended list of special tools.

.12 Recommended list of maintenance materials.

.13 Certification, guarantee, warranty.

.14 Service representatives – name, address and telephone number.

.15 Suppliers for replacement parts – name, address, service depot and telephone number.

.16 Test results, witness testing commissioning, test results.

.17 Test data for piping systems (degreasing, flushing, pressure testing and disinfection).

.18 Hydrostatic or air tests performance.

.19 Equipment alignment certificates.

.20 Balancing data for air and water systems.

.21 Inspection approval certificates for all types of systems: plumbing and piping, hot air and ventilating, electrical and supervisory systems.

.22 Warranties, quantities certification

.9 Where applicable, provide the information in plastic map pockets in appropriate sections of the binder.

1.5 SUBMITTAL PROCEDURE

.1 Preliminary Manuals:

.1 Submit three (3) copies (electronic and hard copy) for Engineer's review.

.2 Disposition: In accordance with Section 01330 – Submittal Procedures.

.3 If no exceptions are taken:

.1 One copy will be returned to Contractor.

.2 One copy will be forwarded to Resident Contract Administrator.

.3 One copy will be retained in Engineer's file.

.4 Submit the balance of six (6) copies (electronic and hard copy) of Final Manual.

.4 If exceptions are noted requiring resubmittal:

.1 Two copies will be returned to Contractor with Engineer's comments for revision.

.2 One copy will be retained in Engineer's file.

.3 Resubmit three (3) new copies of the revised Preliminary Manuals (electronic and hard copy) for Engineer's review.

.4 If exceptions are noted requiring resubmittal, repeat the items in Clause 1.5.1.4.

.2 Final Manuals:

.1 Submit a total of six (6) copies (electronic and hard copy) of the final manuals.

.3 Electronic Copies of Final Manuals:

.1 Furnish eight electronic versions of the final, complete O&M manual in electronic format on a CD-ROM. Use Microsoft Word, Excel, and PDF formats.

.1 Text, photos, and drawings shall all be placed on clearly marked CD-ROMs in a current version of Adobe Acrobat PDF file System. A single PDF file may be used if the total number of pages in the manual does not exceed 50. For manuals with more than 50 pages (text and graphics), each subsection should be a separate PDF file.

.2 The electronic form of the manual shall be provided a linked Table of Contents, which will serve as the primary navigational aid for the user, from inside an Internet browser.

.3 Each PDF file shall have a least five keywords assigned to it, based on its individual subject material. If an entire manual (less than 50 pages) is contained in one PDF file, then sufficient keywords should be used to ensure that "searching" for a particular subsection will be successful. (Example: if "calibration" is a subsection, then the word calibrate and/or calibration should be added to the keyword list.) If each subsection is a separate PDF file, then keywords should be designed to lead the user to all commonly used terms of the text.

.2 Catalogue, or indexing should not be done. All manuals will be indexed when aggregated on the Owner's system.

.3 Each PDF file should be configured in the same way so that users are presented with a standard interface for all manuals, regardless of Vendor. To accomplish this, follow this procedure for each PDF file provided:

.1 From the main menu, select File, then open the subject PDF file.

.2 With the file open, select File, Document Properties, Summary (current version of Adobe Acrobat). Enter the Title, Subject, Author, and Keywords for this file. Make these consistent and descriptive of subject document. Binding should be Left Edge.

.3 Select File, Document Properties, Open Options:

Initial View:	Page Only
Page Number:	1
Magnification:	Fit Width

Page Layout:	Single page
Window Options:	Resize Window to Initial Page Center Window on Screen
User Interface Options:	None

1.6 SUPPLEMENTS

.1 The supplements listed below, following "END OF SECTION", are part of this Specification. It shows the format of the Manuals to follow. Samples of various sections are shown. The Contractor is to list all sections in this Contract.

2 PRODUCTS – NOT APPLICABLE

3 EXECUTION – NOT APPLICABLE

END OF SECTION



CONTRACT NO. XXXX
NEW PIER 8 WASTEWATER PUMPING STATION (HC062) FORCEMAIN, SEWER, AND SANITARY STORAGE TANK

VOLUME 2:
ARCHITECTURAL/ STRUCTURAL
PROCESS EQUIPMENT OPERATIONS AND MAINTENANCE

VOLUME 3:
MECHANICAL OPERATIONS AND MAINTENANCE
VOLUME 4:
ELECTRICAL AND INSTRUMENTATION OPERATION
Set 1 of 2
CONTRACTOR

[MONTH YEAR]

[PROJ.NO.]

City Of Hamilton
Pier 8 Wastewater Pumping Station (HC062)

Contract No. XXXX
Operations
&
Maintenance Manual

Prepared by Contractor

Specification
XXXX Thru XXXX
Volume 2 of (TBD)

Consulting Engineer:

PARSONS

General Contractor
TBD

Set 2 of XX

April 2017

OPERATION AND MAINTENANCE

CONTROL COPY
SET 1 OF 6

[MONTH YEAR]

[PROJ.NO.]

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02100 - Clearing and Grubbing – Not Applicable

02220 - Excavating, Trenching, and Backfilling
- Certification and Testing
- Shop Drawings and Maintenance Bulletins
- Safety and Maintenance

3-Concrete
3 - Index
3 - Subcontractors and Suppliers
3 - Drawing List

03100 - Concrete Formwork
- Certification and Testing
- Shop Drawings and Maintenance Bulletins
- Safety and Maintenance

4-Masonry – Not Applicable

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SECTION 01740
CLEANING

1 GENERAL 1

1.1 SECTION INCLUDES 1
1.2 PROJECT CLEANLINESS 1
1.3 FINAL CLEANING 2

2 PRODUCTS – NOT APPLICABLE 3

3 EXECUTION – NOT APPLICABLE 3

SECTION 01740
CLEANING

1 GENERAL

1.1 SECTION INCLUDES

.1 Progressive cleaning.

.2 Final cleaning.

1.2 PROJECT CLEANLINESS

.1 Maintain the Works in tidy condition, free from accumulation of waste products and debris, other than that caused by the Owner or other contractors.

.2 Maintain the roadways and access road to and from the site and construction compound in tidy condition, devoid of debris and free of mud/dirt tracking.

.3 Maintain the construction site in tidy conditions and free of debris and potential hazards.

.4 Remove waste materials from site at regularly scheduled times or dispose of as directed by the Engineer. Do not burn waste materials on site.

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

.6 Provide on-site drum containers for collection of waste materials and debris.

.7 Provide and use clearly marked separate bins for recycling.

.8 Remove waste material and debris from site and deposit in waste container at end of each working day.

.9 Dispose of waste materials and debris off site.

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

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

.12 Provide adequate ventilation while using volatile or noxious substances. The use of building ventilation systems is not permitted for this purpose.

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

.14 Schedule cleaning operations so that resulting dust, debris and other contaminants will not fall on wet, newly painted surfaces and will not contaminate building systems or electrical or control panels.

.15 Protect all hatches from debris and dust such that at substantial performance, the hatches are in original condition.

1.3 FINAL CLEANING

.1 Prior to substantial performance, remove surplus products, tools, construction machinery and equipment not required for performance of remaining work.

.2 Remove waste products and debris other than that caused by others, and leave the Works clean and suitable for occupancy.

.3 Remove waste products and debris other than that caused by the City or other contractors.

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

.5 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.

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

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

.8 Vacuum clean and dust building interiors, behind grilles, louvres, screens and electrical control panels.

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

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

.11 Remove dirt and other disfiguration from exterior surfaces.

.12 Clean and sweep roofs, gutters, areaways.

.13 Sweep and wash clean paved areas.

.14 Clean equipment and fixtures to a sanitary condition and clean or replace filters of mechanical equipment.

.15 Clean all drainage systems.

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

.17 Provide a cleanliness sign-off sheet to be signed by the Contractor, Owner and Engineer prior to substantial performance.

2 PRODUCTS – NOT APPLICABLE

3 EXECUTION – NOT APPLICABLE

END OF SECTION

SECTION 01760
WARRANTY WORK

1 GENERAL 1

1.1 SECTION INCLUDES 1
1.2 GENERAL 1
1.3 SUBMITTALS 1
1.4 INSPECTION AND DECLARATION OF FINAL CERTIFICATE 1
1.5 WORK DURING WARRANTY PERIOD 2
1.6 REPAIR BY OWNER 2

2 PRODUCTS – NOT APPLICABLE 2

3 EXECUTION – NOT APPLICABLE 2

SECTION 01760
WARRANTY WORK

1 General

1.1 SECTION INCLUDES

.1 The section includes requirements for work during the Warranty Period.

1.2 GENERAL

.1 Provide all warranties outlined in the Contract Documents from the time of Substantial Performance of the Works or components of the works.

.2 Perform warranty work required during progress of the work and during the Warranty Period.

.3 Extend warranties on any non pre-purchased or post-purchased component of the work that is required to be placed in operation prior to Substantial Performance for the purpose of complying with the sequence of construction.

1.3 SUBMITTALS

.1 Inform the Engineer in writing of the arrangements made for carrying out warranty work during the Warranty Period.

.2 Provide a telephone number and address for receipt of notices relating to matters requiring action by the Contractor during the Warranty Period.

1.4 INSPECTION AND DECLARATION OF FINAL CERTIFICATE

.1 Request inspection for Final Certificate no later than 20 working days before the expiry of the Warranty Period.

.2 Participate in a joint inspection of the Works for the purpose of establishing Completion. Arrange for, coordinate and pay for any special access required to inspect the Works, such as the confined space entry or isolation.

.3 Review the status of all Warranty items carried out during the Warranty Period with the Engineer.

.4 Complete all outstanding deficiencies, repair noted defects, complete all outstanding warranty items and obtain the Engineer's written agreement that all works are complete in accordance with the Contract Documents.

.5 Apply for Substantial Performance.

1.5 WORK DURING WARRANTY PERIOD

.1 Perform all warranty work required upon receipt of verbal or written notices from the Engineer.

.2 Repair or make good settlements and defects on surfaces of backfilled trench or excavations.

.3 Repair all damages to structures caused by settlement of ground adjacent to or over excavation.

.4 Maintain all trees and shrubs either planted or relocated for the duration of the Warranty Period.

1.6 REPAIR BY OWNER

.1 The Owner will, without giving notice to the Contractor, repair shrinkages or defects that are dangerous in nature, that constitute an extreme emergency or that affect the operation of the Works. The Contractor will be notified of less serious conditions prior to work being performed.

.2 The Engineer will notify the Contractor of emergency work performed by the Owner.

.3 The cost of labour, equipment and material to perform emergency work will be charged to the Contractor.

2 PRODUCTS – NOT APPLICABLE

3 EXECUTION – NOT APPLICABLE

END OF SECTION

SECTION 01780
CLOSEOUT SUBMITTALS

1 GENERAL 1

1.1 SECTION INCLUDES 1
1.2 SUBMISSION 1
1.3 OPERATION AND MAINTENANCE DATA 2
1.4 RECORD DRAWINGS AND SAMPLES 2
1.5 RECORDING ACTUAL SITE CONDITIONS 2
1.6 FINAL SURVEY 3
1.7 SPARE PARTS 3
1.8 MAINTENANCE MATERIALS 4
1.9 SPECIAL TOOLS 4
1.10 STORAGE HANDLING AND PROTECTION 4
1.11 WARRANTIES AND BONDS 4

2 PRODUCTS – NOT APPLICABLE 5

3 EXECUTION – NOT APPLICABLE 5

SECTION 01780
CLOSEOUT SUBMITTALS

1 General

1.1 SECTION INCLUDES

.1 As-built drawings, 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 SUBMISSION

.1 Prepare instructions and data by personnel experienced in the maintenance and operation of described products and submit copies for the Engineer's review in accordance with the specifications.

.2 At least one copy will be returned with comments and the remaining copies will be retained to assist the Engineer and will be returned after delivery of the final copies.

.3 Revise the content of documents as required prior to final submittal.

.4 Ensure spare parts, maintenance materials and special tools provided are new, undamaged and not defective, and of the same quality and manufacture as products provided in the Works.

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

.6 Defective products will be rejected, regardless of any previous inspections by the Engineer or other agents of the Owner. Defective products to be replaced at the Contractor's expense.

.7 Pay the costs of transportation related to replacement of defective products.

1.3 OPERATION AND MAINTENANCE DATA

.1 Refer to Section 01730 – Operations and Maintenance Manuals.

1.4 RECORD DRAWINGS AND SAMPLES

.1 Record drawings:

.1 Prior to start of Testing, Adjusting and Balancing (TAB), finalize production of record drawings.

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

.3 Provide record drawings for all equipments and services that are permanently installed onsite.

.4 Submit to the Engineer for approval and make corrections as directed.

.5 TAB to be performed using record drawings.

.6 Submit completed reproducible record drawings with Operating and Maintenance Manuals. Provide with a memo referencing the documents and with signatures and dates of the Contractor (supplier) and the Engineer (recipient) provided on the memo with copies of this memo kept by both the Contractor and the Engineer.

.7 Contractor to provide six colour electronic copies (six CDs) and two colour photocopies of the record drawings in addition to the original non-colour record drawings.

.2 Submit copies of record drawings for inclusion in final TAB report to the Engineer from all disciplines.

1.5 RECORDING ACTUAL SITE CONDITIONS

.1 Record information on set of drawing prints provided by the Engineer.

.2 Provide felt tip marking pens, maintaining separate colours for each major system, for recording information.

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

.4 Contract Drawings and shop drawings: legibly mark each item to record actual construction, including (refer to Section 01330 – Submittal Procedures):

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

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

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

.4 Field changes of dimensions and details.

.5 Changes made by Contract Change Directives.

.6 Details not on original Contract Drawings.

.7 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 Contract Change Directives.

.6 Other Documents: maintain manufacturers' certifications, inspection certifications, field test records, required by individual specifications sections.

1.6 FINAL SURVEY

.1 The Owner will carry out the final survey.

1.7 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 the location and place in storage as directed by the Owner.

.4 Obtain receipt for all delivered products from the Owner or Engineer and submit these receipts prior to substantial performance.

1.8 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 the location and place in storage as directed by the Owner.

.4 Obtain receipt for all delivered products from the Owner or Engineer and submit these receipts prior to substantial performance.

1.9 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 the location and place in storage as directed by the Owner.

.4 Obtain receipt for all delivered products from the Owner or Engineer and submit these receipts prior to substantial performance.

1.10 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 manufacturers' 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 the Contractor’s own expense and to the satisfaction of the Engineer.

.6 Exercise all equipment in strict conformance with the equipment manufacturers written instructions during storage and following installation. Provide all equipment exercise logs to the Engineer for review.

1.11 WARRANTIES AND BONDS

.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.

.4 No warranty will commence until issuance of substantial performance on respective work components. The warranty on items used during construction, with the Owner's permission, for the safe and orderly completion of the works will not commence until substantial performance.

.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.

2 PRODUCTS – NOT APPLICABLE

3 EXECUTION – NOT APPLICABLE

END OF SECTION

SECTION 01820
DEMONSTRATION AND TRAINING

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1.15 MAINTENANCE HANDS-ON TRAINING 10

SECTION 01820
DEMONSTRATION AND TRAINING

1 GENERAL

1.1 DESCRIPTION

1.1.1 This section contains requirements for demonstration and training the City's personnel, by persons retained by the Contractor specifically for the purpose, in the proper operation and maintenance of the equipment and systems installed under this contract.

1.1.2 Training will start during the Equipment Start-Up Phase and must be complete prior to the start of Performance Testing.

1.1.3 Furnish trained, articulate personnel to coordinate and expedite training, to be present during training coordination meetings with Owner, and familiar with operation and maintenance manual information specified in Section 01730 -Operation and Maintenance Manuals.

1.1.4 Manufacturer's representative shall be familiar with facility operation and maintenance requirements as well as with specified equipment.

1.1.5 Furnish complete training materials, to include operation and maintenance data, to be retained by each trainee.

1.2 TRAINING

1.2.1 Training Manuals

.1 The Contractor is to prepare operations and or maintenance manuals on the devices prior to the hand over and training on the systems, equipment and devices which are comprehensive and relate specifically to the devices to be demonstrated. A minimum of 50 training manuals (electronic and hard copy), i.e., 10 training manuals/sessions at five (5) sessions shall be provided. The manuals shall include as a minimum:

.1 Descriptions of the equipment and devices, and how they should perform in the installed application

.2 A breakdown of the components of the devices

.3 Assembly and Disassembly procedures

.4 Lubrication requirements

.5 Calibration requirements including ISA data sheets

.6 Spare parts lists

.7 Inspection and diagnostic procedures

.8 Preventative and breakdown service requirements and procedures

.9 Maintenance and service schedules

.10 Names, addresses, phone numbers of suppliers of parts and materials

.11 Copies of required legislated certificates, warranties or other pertinent documentation

.12 All materials provided for training shall conform to the following:

.1 Size: 8.5 x 11 inches

.2 Paper: 20 lb minimum, white, for typed pages

.3 Text: Manufacturer's printed data, or neatly word processed and designed specifically for learning. Ample space for note-taking shall be provided

.4 Double-sided

.5 Drawings and sketches:

.1 Provide reinforced punches binder tab, bind in with text.

.2 Reduce larger drawings to not larger than 11 x 17 inches and fold to size of text pages.

.3 Use colour prints to highlight key elements

.13 Cover to include:

.1 Contract number

.2 Title of project

.3 Identify of separate structure or system as applicable

.4 Identify of general subject matter covered in the manual

.5 Locations or facility names

.6 Publication date

.7 Revision number

.14 Binders shall be:

.1 Commercial quality D-ring binders with durable and cleanable plastic covers

.2 Maximum post width: two inches

.3 When multiple binders are used, the Contractor shall correlate the information into related consistent groupings and clearly number all volumes

1.2.2 Training Schedule

.1 List specified equipment and systems that require training services and show:

.1 Respective manufacturer.

.2 Estimated dates for installation completion.

.3 Estimated training dates.

.2 Conduct five (5) training sessions of each classroom and hands-on training program as follows:

.1 Three (3) sessions for Operations Staff.

.2 One (1) session for Mechanical Maintenance Staff.

.3 One (1) session for Electrical and Instrumentation Maintenance Staff

.3 Operations staff work on continuous shifts. Training schedule must account for this and cover all staff.

.4 Adjust schedule to ensure training of appropriate personnel as deemed necessary by Owner, and to allow full participation by manufacturers' representatives. Adjust schedule for interruptions in operability of equipment and operability of existing facilities.

.5 Coordinate with Section 01330 – Submittal Procedures and Section 01650 – Equipment Startup and Performance Testing.

1.2.3 Lesson Plan: prepare for each required course, containing the following minimum information:

.1 Title and objectives.

.2 Recommended types of attendees (e.g., managers, Engineers, operators, maintenance).

.3 Course description and outline of course content.

.4 Format (e.g., lecture, self-study, demonstration, hands-on).

.5 Instruction materials and equipment requirements.

.6 Resumes of instructors providing the training.

1.2.4 Lesson Content:

.1 Classroom training shall include the following as a minimum:

.1 Purpose of the equipment or system.

.2 Principles of the equipment or system.

.3 Operation and need for each piece of equipment in the system.

.4 Equipment monitoring and controls.

.5 Startup and shutdown of the equipment.

.6 Emergency operation procedures.

.7 Equipment maintenance and preventative maintenance.

.8 Operational troubleshooting.

.2 The on-site Operational training sessions are to include, as a minimum, the following topics:

.1 Normal operating procedures

.2 Safety requirements

.3 Operational and Maintenance trouble shooting requirements, with the ability to detect abnormalities of operation and describe serious faults to Electrical / Instrumentation / Mechanical Maintenance staff

.4 Minor preventative maintenance requirements using basic hand tools for applying skills to perform the following:

.1 Cleaning, without major disassembly

.2 Lubricating

.3 Adjust, minor calibrations

.4 Inspections, testing, diagnostics without disassembly

.5 Repair, test for functionality, loose connections etc.

.3 The on-site Mechanical / Electrical / Instrumentation Maintenance training sessions are to include the following as a minimum:

.1 Safety requirements;

.2 Lubrication, cleaning, servicing and providing preventative maintenance;

.3 Adjustment and calibration to optimize performance and life of the equipment;

.4 Removal, disassembly and inspection of all moving parts and wear surfaces;

.5 Measurement, recalibration or alignment of all moving parts and wear surfaces;

.6 Removal, disassembly and inspection of all ancillary equipment;

.7 Complete reassembly and testing procedures.

1.2.5 Prestartup Training:

.1 Coordinate training sessions with Owner's operating personnel and manufacturers' representatives, and with submission of operation and maintenance manuals in accordance with Section 01730 - Operation and Maintenance Manuals.

.2 Complete at least 14 days prior to beginning of facility startup.

1.2.6 Post-Startup Training: If required in Specifications, furnish and coordinate training of Owner's operating personnel by respective manufacturer's representatives.

1.3 QUALITY ASSURANCE

1.3.1 The Contractor will provide training of the City's personnel for all equipment as specified herein. The training sessions will be conducted by qualified, experienced (five (5) years minimum), factory-trained representatives of the various equipment manufacturers. Training will include instruction of operating personnel in equipment operation and preventive maintenance, and of plant maintenance personnel in equipment maintenance.

1.4 SUBMITTALS

1.4.1 The following information will be submitted to the Engineer:

.1 An overall Training schedule for all equipment, including; date, time, subject and duration (estimated number of hours understanding the minimum hours included in this specification) of each training session will be provided to the Engineer for the City's review, no later than four (4) weeks prior to the start of Training. Include identity and qualifications of individuals to be conducting the Training.

.2 Lesson plans for each training session to be conducted by the manufacturer's representatives. In addition, training manuals, handouts, visual aids, and other reference materials will be included. The material must be reviewed and accepted by the Engineer no later than four (4) weeks prior to the start of the Training.

.3 Concurrent classes will not be allowed.

.4 The Contractor will provide ten (10) copies of the training manuals, handouts, visual aids and reference materials in binders, at least two (2) weeks prior to <u>each</u> training session (i.e. 50 manuals total).

.5 The Contractor will submit four (4) electronic copies of the information, including, where feasible, training manuals, handouts, visual aids, reference materials, etc., at least two (2) weeks prior to <u>each</u> training session (i.e. 20 copies total).

.6 The Contractor will identify "MOE Director Approved" training that is eligible for CEUs (Certified Education Units).

1.5 REQUIRED DEMONSTRATION AND TRAINING SESSIONS

1.5.1 Provide the demonstration, walkthrough, and training sessions for all new structures, and equipment.

1.5.2 Allot time during training for the Engineer to provide training on new operating methods and processes.

1.5.3 Provide lunch for training sessions.

2 PRODUCTS

1.6 GENERAL

1.6.1 The Contractor will conduct training sessions for the City's operation and maintenance personnel to instruct the staff on the proper operation, care, and maintenance of the equipment and systems installed under this contract. Training will take place at the site of the work and under the conditions specified in the following paragraphs. Vendor operation and maintenance manuals will be available to City personnel at least 30 days prior to the date scheduled for the individual training session.

1.6.2 Unless otherwise specified in the equipment specifications or pre-purchase documents, a minimum of five (5) training sessions for City staff will be provided for each piece of equipment.

1.6.3 Duration of individual training sessions to be of a sufficient length to conform with the requirements specified herein.

1.7 LOCATION

1.7.1 Field training sessions will take place at the site of the equipment.

1.7.2 The City will make available a classroom facility with a capacity of at least ten (10) persons for the classroom training session located at 700 Woodward Avenue if required by the Contractor.

1.8 LESSON PLANS

1.8.1 Formal written lesson plans will be prepared for each training session. Lesson plans will contain an outline of the material to be presented along with a description of visual aids to be utilized during the session. Each plan will contain a time allocation for each subject. One (1) complete set of originals (electronic and hard copy) of the lesson plans, training manuals, handouts, visual aids, and reference material will be the property of the City and will be suitably bound for proper organization and easy reproduction.

1.9 FORMAT AND CONTENT

1.9.1 Each training session will be comprised of time spent both in the classroom and at the specific location of the subject equipment or system. As a minimum, a training session will cover the following topics for each item of equipment or system:

.1 Familiarization

.2 Safety

.3 Operation

.4 Troubleshooting

.5 Preventive maintenance

.6 Corrective maintenance

.7 Parts

.8 Local representatives

.9 Operation and maintenance manuals

1.10 DVD RECORDING

1.10.1 The Contractor shall video record one of each type of training session and then submit six (6) Professional DVD copies, each DVD copy containing all of the training sessions.

1.10.2 Each DVD shall contain titles with the date of each training session shown.

1.10.3 Each DVD shall be edited such that each training session is a different chapter.

1.10.4 The Contractor will advise all manufacturers providing training sessions that the material will be video recorded.

3 EXECUTION

1.11 GENERAL REQUIREMENTS

1.11.1 All Training will be conducted immediately prior to the start of Equipment Performance Testing, and classes will be scheduled such that classroom sessions are interspersed with field instruction in logical sequence. The Contractor will arrange to have the training conducted on non-consecutive

days, with no more than six (6) hours of training scheduled per session between the hours of 8:00 a.m. and 3:00 p.m.

1.12 OPERATOR CLASSROOM TRAINING

1.12.1 As a minimum, classroom equipment training for Operations personnel will include:

.1 Using slides and drawings, discuss the equipment's specific location in the plant and an operational overview.

.2 Purpose and plant function of the equipment.

.3 A working knowledge of the operating theory of the equipment.

.4 Start-up, shutdown, normal operation, and emergency operating procedures, including a discussion on system integration and electrical interlocks, if any.

.5 Identify and discuss safety items and procedures.

.6 Routine preventative maintenance, including specific details on lubrication and maintenance of corrosion protection of the equipment and ancillary components.

.7 Operator detection, without test instruments, of specific equipment trouble symptoms.

.8 Required equipment exercise procedures and intervals.

.9 Routine disassembly and assembly of equipment if applicable (as judged by the City on a case-by-case basis) for purposes such as operator inspection of equipment.

1.13 OPERATOR HANDS-ON TRAINING

1.13.1 As a minimum, hands-on equipment training for Operations personnel will include:

.1 Identify location of equipment and review the purpose.

.2 Identifying piping and flow options.

.3 Identifying valves and their purpose.

.4 Identifying instrumentation:

.1 Location of primary element.

.2 Location of instrument readout.

.3 Discuss purpose, basic operation and information interpretation.

.5 Discuss, demonstrate, and perform standard operating procedures and round checks.

.6 Discuss and perform the preventative maintenance activities.

.7 Discuss and perform start-up and shutdown procedures.

.8 Perform the required equipment exercise procedures.

.9 Perform routine disassembly and assembly of equipment if applicable.

.10 Identify and review safety items and perform safety procedures, if feasible.

1.14 MAINTENANCE CLASSROOM TRAINING

1.14.1 Classroom equipment training for the Maintenance personnel will include:

.1 Theory of operation.

.2 Description and function of equipment.

.3 Start-up and shutdown procedures.

.4 Normal and major repair procedures.

.5 Equipment inspection and troubleshooting procedures including the use of applicable test instruments and the “pass” and “no pass” test instrument readings.

.6 Routine and long-term calibration procedures.

.7 Safety procedures.

.8 Preventive maintenance such as lubrication; normal maintenance such as belt, seal, and bearing replacement; and up to major repairs such as replacement of major equipment part(s) with the use of special tools, welding jigs, etc.

1.15 MAINTENANCE HANDS-ON TRAINING

1.15.1 Hands-on equipment training for Maintenance personnel will include:

.1 Locate and identify equipment components.

.2 Review the equipment function and theory of operation.

.3 Review normal repair procedures.

.4 Perform start-up and shutdown procedures.

.5 Review and perform the safety procedures.

.6 Perform City-approved practice maintenance and repair job(s), including mechanical and electrical adjustments and calibration and troubleshooting equipment problems.

1.15.2 Review and use equipment Manufacturer's manuals in the hands-on training.

END OF SECTION

DIVISION 2
SITE CONSTRUCTION

02050	Site Demolition
02100	Site Preparation
02140	Dewatering
02200	Earthwork – Architectural
02220	Excavation, Trenching and Backfilling
02223	Excavation, Backfilling, and Compacting for Pavement – Architectural
02314	Deep Excavations and Backfilling
02315	Temporary Protection Systems
02327	Vibration Monitoring
02370	Erosion Control
02451	Pile Foundations – General
02452	Pile Tests
02459	Steel H Piles
02460	Helical Pile Foundation
02505	Granular Base Coarse
02511	Asphaltic Concrete Paving
02525	Curbs and Sidewalks
02530	Sanitary Sewers
02610	High Density Polyethylene Pipe and Fittings
02631	Maintenance Holes and Catchbasins
02652	Hydrostatic Testing Water Retaining Structures
02825	Ornamental Metal Fence

SECTION 02050
SITE DEMOLITION

PART 1 GENERAL

1.01 GENERAL REQUIREMENTS

A. General Conditions, Supplementary Conditions and Division 01 apply to this Section.

1.02 SECTION INCLUDES

A. Demolition of designated site structures and removal of materials from site.

B. Demolition and removal of pavements, curbs and gutters, drainage structures, utilities, signage or landscaping.

C. Disconnecting and capping or removal of identified utilities.

D. Filling or removal of underground tanks and piping.

E. Filling voids in subgrade created as a result of removals or demolition.

1.03 RELATED SECTIONS

A. Section 02100 - Site Preparation: Clearing outside periphery of structures.

B. Section 02200 - Earthworks.

C. Section 02227 - Aggregate Materials: Backfill materials.

D. Section 02270 - Slope Protection and Erosion Control

1.04 PROJECT RECORD DOCUMENTS

A. Accurately record actual locations of capped utilities, and subsurface obstructions.

1.05 REGULATORY REQUIREMENTS

A. Conform to local governing authority codes for demolition of structures, safety of adjacent structures, dust control and runoff control.

B. Obtain required permits and licenses from authorities. Pay associated fees including disposal charges. Dispose of waste materials at approved disposal sites only.

C. Notify affected utility companies before starting Work and comply with their requirements.

D. Do not close or obstruct roadways, sidewalks or hydrants without permits.

E. Conform to applicable regulatory procedures when discovering hazardous or contaminated materials. Notify Sitework Engineer of Record upon discovery of hazardous or contaminated materials.

F. Test soils around buried tanks for contamination.

1.06 PROTECTION OF REMAINING AND ADJACENT SERVICES AND STRUCTURES

A. Do not interfere with, encumber, endanger or create nuisance, from any cause due to demolition Work, to public property or any adjacent attached and/or detached structures in possession of Owner or others, which are to remain, whether occupied or unoccupied during this Work.

B. Make good damage to such structures resulting from Work under this Section at no cost to Owner. Make good adjacent building surfaces damaged by Work of this Section.

C. Take necessary precautions to guard against movement, settlement or collapse of existing adjacent utility services, public property and/or structures, whether to remain or not. If these or other unforeseen conditions develop, take immediate emergency measures, report to the Sitework Engineer of Record, confirm in writing, and await instructions before proceeding with any further related demolition Work.

D. Prior to start of demolition disconnect all electrical and telephone service lines in the areas to be demolished. Post warning signs on all electrical lines and equipment which must remain energized to serve other areas during period of demolition. Disconnect electrical and telephone service lines in demolition areas to the requirements of local authority having jurisdiction.

E. Prior to start of demolition disconnect and cap all mechanical services in accordance with requirements of local authority having jurisdiction. Natural gas supply lines shall be removed by the gas company or by a qualified tradesman in accordance with gas company instructions.

F. In each case, notify the affected utility company in advance and obtain approval where required before commencing with the Work on main services.

G. All existing underground services including but not limited to sanitary sewers and appurtenance, storm sewers and appurtenances, watermains and appurtenances, lighting, and utility cables, irrigation systems, within the site must NOT be removed unless required to facilitate new construction. All excavation for existing service removal must be backfilled with clean fill meeting all requirements of the Contract Documents.

1.07 PROJECT CONDITIONS

A. Structures to be demolished will be discontinued in use and vacated prior to start of Work.

B. Owner assumes no responsibility for condition of structures to be demolished.

C. Conditions existing at time of inspection for bidding purposes will be maintained by Owner in so far as practicable. Variations within structures may occur by Owner removal and salvage operations prior to start of demolition Work.

D. Unless otherwise indicated in the Contract Documents or specified by the Owner in writing, all items of salvageable value to Contractor shall be removed from the site and structure. Storage or sale of removed items on site will not be permitted and shall not interfere with any other Work specified in the Contract Documents.

E. Explosives shall not be brought to site or used without written consent of authorities having jurisdiction. Such written consent will not relieve Contractor of total responsibility for injury to persons or for damage to property due to blasting operations. The performance of any required blasting shall comply with governing authority regulations.

PART 2 PRODUCTS

2.01 FILL MATERIALS

A. Aggregate materials per Specifications.

PART 3 EXECUTION

3.01 PREPARATION

A. Provide, erect, and maintain erosion control devices, temporary barriers and security devices at locations indicated and per governing authority regulations.

B. Protect existing landscaping materials, appurtenances and structures which are not to be demolished. Repair damage caused by demolition operations at not cost to Owner.

C. Prevent movement or settlement of adjacent structures. Provide bracing and shoring.

D. Mark location of utilities. Protect and maintain in safe and operable condition the utilities to remain.

3.02 DEMOLITION REQUIREMENTS

A. Conduct demolition to minimize interference with adjacent structures or pavements.

B. Cease operations immediately if adjacent structures appear to be in danger. Notify authority having jurisdiction. Do not resume operations until directed.

C. Conduct operations with minimum interference to public or private access. Maintain access and egress at all times.

D. Obtain written permission from adjacent property owners when demolition equipment will traverse, infringe upon or limit access to their property.

E. Sprinkle Work with water to minimize dust. Provide hoses and water connections for this purpose.

F. Comply with governing regulations pertaining to environmental protection.

G. Clean adjacent structures and improvements of dust, dirt, and debris caused by demolition operations. Return adjacent areas to condition existing prior to start of Work.

3.03 DEMOLITION/REMOVAL

A. All existing underground services including but not limited to sanitary sewers and appurtenance, storm sewers and appurtenances, watermains and appurtenances, lighting, and utility cables, irrigation systems, within the site which are in conflict with new services shall be removed by the Contractor to facilitate new construction. All excavation for existing service removal must be backfilled with clean fill meeting all requirements of the Contract Documents.

B. Existing gas lines, telephone, television cables, and primary cables to be relocated by others and shall be coordinated with the utility provider by the Contractor.

3.04 DISPOSAL OF DEMOLISHED MATERIALS

A. Remove from site debris, rubbish, and other materials resulting from demolition operations.

B. No burning of any material, debris, or trash on-site or off-site will be allowed, except when allowed by the appropriate governing authority and the Owner. If allowed as stated above, burning shall be performed in manner prescribed by governing authority. Attend burning materials until fires have burned out or have been extinguished.

C. Transport materials removed from demolished structures with appropriate vehicles and dispose off-site to areas which are approved for disposal by governing authorities and appropriate property owners.

END OF SECTION

SECTION 02100
SITE PREPARATION

PART 1 GENERAL

1.01 GENERAL REQUIREMENTS

A. General Conditions, Supplementary Conditions and Division 01 apply to this Section.

1.02 SECTION INCLUDES:

A. Identification of the construction limits.

B. Cleaning site of debris, grass, trees and other plant life in preparation for site or building excavation Work.

C. Protection of existing structures, trees or vegetation indicated on the Contract Documents to remain.

D. Stripping topsoil from areas that are to be incorporated into the limits of the Project and where so indicated on the Drawings.

1.03 RELATED SECTIONS

A. Section 02050 - Demolition

B. Section 02200 - Earthwork

C. Section 02270 - Slope Protection and Erosion Control

1.04 ENVIRONMENTAL REQUIREMENTS

A. Construct temporary erosion control systems as shown on the plans or as directed by the Sitework Engineer of Record to protect adjacent properties and water resources from erosion and sedimentation.

B. Hickenbottom risers are to be constructed as detailed on the Drawings including installation, maintenance and removal, storm sewers, clear stone jacket, maintenance hole structures, and restoration of disturbed areas including rip rap as detailed, grading, topsoil and sod, and all other labour and/or materials required to complete the Work.

C. The Contractor shall not allow silt-laden water to enter any adjacent sewer system, adjoining properties or existing watercourse. To this end, the Contractor will be required to construct any channel Work and/or storm sewer pond outfalls in the dry. The method of dewatering and siltation control will be as specified in the Drawings.

D. It shall be the responsibility of the Contractor to contain and control storm water runoff prior to the main outfalls being operational.

E. In the event that the site Work on this Project will be under the jurisdiction of a Municipal Topsoil Preservation by-law, Conservation Authority or Ministry of Natural Resources Work permits, the Contractor is responsible for ensuring compliance with the applicable regulations throughout the entire construction period. The permits require erosion and sedimentation control measures to be in place during construction and include monitoring of storm water flows during construction.

F. The Contractor shall be responsible for conducting the stormwater management and site stabilization practices in accordance with the governmental authorities requirements and for any enforcement action taken or imposed by the governmental authorities, including the cost of fines, construction delays and remedial actions resulting from the Contractors failure to comply with all provisions of the requirements.

1.05 PROJECT CONDITIONS

A. Conditions existing at time of inspection for bidding purposes will be maintained by Owner in so far as practical.

B. Variations to conditions or discrepancy in actual conditions as they apply to site preparation operations are to be brought to the attention of the Sitework Engineer of Record prior to the commencement of any site Work.

PART 2 PRODUCTS

A. Off-site materials shall be transported to Project using well maintained and operating vehicles. Once on site, transporting vehicles shall stay on designated haul roads and shall at no time endanger improvements by rutting, overloading, or pumping.

PART 3 EXECUTION

3.01 PREPARATION

A. Verify that existing plant life and clearing limits are clearly tagged, identified and marked in such a manner as to insure their safety throughout construction operations.

3.02 PROTECTION

A. Locate and identify existing utilities that are to remain and protect them from damage.

B. Any information shown for existing utilities has been provided by others. The Contractor is responsible for locating and verifying any possible conflicts and/or discrepancies with regard to existing / proposed utilities and report such conflicts and/or discrepancies to the Sitework Engineer of Record within 48 hours prior to commencement of the Work. Lost time due to failure of the Contractor to confirm utility locations and notify the Sitework Engineer of Record of possible conflicts 48 hours prior to construction will be at the Contractor's expense.

C. The Contractor shall inform the Sitework Engineer of Record, the Local Municipality, and the utility Owner or authority of the proposed method of excavation around, and temporary support of utilities and services prior to the start of construction. The proposed method will be subject to the approval of the authority having jurisdiction.

D. The Contractor shall Provide for confinement of operations within specified working area limits, (for all excavation, bracing, shoring, sheeting, granular bedding and cover material, compaction, backfill, ground surface grade restoration, vertical trenching as and where required to confine trenches) for the supporting and protection of all existing services and structures whether shown on the plans or not, for the securing of all permits and fulfilling of all requirements of the Local Municipalities and the Regional Municipalities (where applicable), on the authority having jurisdiction over the utility, Natural Gas or other utility transportation pipeline utility, Railway Authority, Hydro Electric and telephone and telecommunication company(s) requirements and any other utility provider with respect to support, protection, safety, inspection, and traffic control.

E. Protect trees, plant growth, irrigation, and features designated to remain as final landscape.

F. Conduct operations with minimum interference to public or private accesses and facilities. Maintain access and egress at all times and clean or sweep any roadways daily or as required by the governing authority. At such times as deemed necessary by the Owner, dust control shall be Provided with sprinkling systems or equipment Provided by the Contractor.

G. Protect bench marks, property corners and all other survey monuments from damage or displacement. If a marker needs to be removed it shall be referenced by a licensed land surveyor and replaced, as necessary, by the same licensed surveyor.

H. Provide traffic control as required, in accordance with local municipal requirements.

I. The limit of construction area is shown on the Drawing. Construction to be completed without trespass onto adjoining privately owned lands, unless otherwise indicated.

3.03 CLEARING

A. Clear all areas within the site boundary as well as any offsite servicing areas required for complete site construction and execution of Work.

B. Unless otherwise indicated on the Drawings, remove trees, stumps, shrubs, grass, other vegetation, improvements, boulders, asphalt, concrete rubble, tires, wood, fence and any other redundant materials, or obstructions interfering with installation of new construction. Removal includes digging out stumps and roots. Depressions caused by clearing and grubbing operations are to be filled to subgrade elevation to avoid water ponding. Satisfactory fill material shall be placed in horizontal layers not exceeding 200 mm loose depth, and thoroughly compacted per fill requirements of the Specifications.

C. Remove grass, trees, plant life, stumps and all other construction debris from the site to a dump site that is suitable for handling such material according to applicable local, provincial and federal laws and regulations.

3.04 TOPSOIL EXCAVATION

A. Strip topsoil from areas that are to be filled, excavated, landscaped or re-graded to such a depth that it prevents intermingling with underlying subsoil or questionable material.

B. Cut heavy growths of grass from areas before stripping and remove with the rest of the cleared vegetative material.

C. Topsoil shall consist of organic surficial soil found in depth of not less than 150 mm. Satisfactory topsoil is reasonably free of subsoil, clay lumps, stones and other objects over 50 mm in diameter, weeds, roots, and other objectionable material.

D. Stockpile topsoil in storage piles in areas shown or where directed. Construct storage piles to freely drain surface water. Cover storage piles as required to prevent windblown dust. Dispose of unsuitable topsoil as specified for waste material. Excess topsoil shall be removed from the site by the Contractor unless specifically noted otherwise on the Drawings.

3.05 DUST CONTROL

A. The Contractor will be responsible for all dust control in accordance with local municipal standards, bylaws and requirements including supply and placement of water, calcium, or other means as directed by the Sitework Engineer of Record.

END OF SECTION

SECTION 02140
DEWATERING

1 PART 1 – GENERAL 1

1.1 DESCRIPTION 1
1.2 RELATED WORK SPECIFIED ELSEWHERE 1
1.3 REFERENCES 1
1.4 SUBMITTALS 1
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1.6 SYSTEM REQUIREMENTS 2

2 PART 2 – PRODUCTS 2

3 PART 3 – EXECUTION 2

3.1 FIELD PUMP TEST 2
3.2 INSTALLATION AND MAINTENANCE 2
3.3 DISPOSAL OF WATER 3
3.4 REMOVAL OF PRIMARY DEWATERING SYSTEM 3

SECTION 02140
DEWATERING

1 PART 1 – GENERAL

1.1 DESCRIPTION

.1 This Section specifies the requirements for dewatering procedures where necessary to stabilize ground and/or keep excavations dry during the construction of the Works.

1.2 RELATED WORK SPECIFIED ELSEWHERE

.1 Temporary Facilities: Section 01535

.2 Temporary Controls: Section 01560

.3 Rough Grading: Section 02210

.4 Excavating, Trenching and Backfilling: Section 02220

1.3 REFERENCES

.1 Comply with all provisions recommendations and stipulations outlined in:

.1 "GEOTECHNICAL INVESTIGATION, WEST HARBOUR PUMPING STATION AND ASSOCIATED WORKS, HAMILTON, ONTARIO", File No. 7-16-0090-01, November 11, 2016, Terraprobe Inc.

.2 HYDROGEOLOGIC INVESTIGATION, WEST HARBOUR PUMPING STATION AND ASSOCIATED WORKS, HAMILTON, ONTARIO" File No. 7-16-0090-46, January 7, 2019, Terraprobe Inc.

.3 Applicable Permit to Take Water, Ministry of the Environment, Conservation and Parks.

1.4 SUBMITTALS

.1 Submit detailed shop drawings for the proposed primary dewatering system, including the locations and depths of the primary dewatering units, the location and depth of piezometers (observation wells), details of pumping, discharge points, etc.

.2 Do not change the proposed dewatering system without the approval of the Engineer.

.3 All design and shop drawings shall bear the signature and stamp of a Licensed Professional Engineer registered in the Province of Ontario with a demonstrated competence in this type of work.

1.5 PROTECTION AND DAMAGES

.1 Prevent damage to pipes, manholes, other structures, ground cover and grades within and in the immediate vicinity of the area of work. Make good any damage.

.2 Rectify any and all damage caused to excavated bases and/or pipe bedding and other adjacent structures and slopes due to improper and/or inadequate dewatering to the satisfaction of the Engineer and at no cost to the Owner.

1.6 SYSTEM REQUIREMENTS

.1 In the event of encountering groundwater levels within excavations, install a primary dewatering system to maintain the groundwater level at least 1 m below the invert of the excavation or trench. This will ensure that the excavation, pipe laying, construction of foundations, placement and compaction of bedding and backfill etc. can be carried out in the dry. Care must be given to not disturb or soften the foundation, native soils or fills already placed and prevent uplift of any structure or piping 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 pipes and structures have 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.

.4 Maintain a duplicate system of equal or greater capacity as the emergency equipment, in case of breakdown of the dewatering systems in place.

2 PART 2 – PRODUCTS

Not Applicable

3 PART 3 – EXECUTION

3.1 FIELD PUMP TEST

.1 Perform a field-pumping test 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 Maintain the dewatering systems in operation until the Engineer has given a written authorization that the dewatering systems could be shut off.

.3 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.

.4 Do not remove any observation well except with the written permission of the Engineer. Within 24 hours, replace observation wells that were damaged or destroyed.

3.3 DISPOSAL OF WATER

.1 Dispose of water removed from the excavations in such a way 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.

.2 Note that Section 34 of the Ontario Water Resources Act requires that a permit be obtained for taking water in excess of 50,000 litres/day from any ground or surface source of water supply. Obtain the permit, if required, by applying to the Ontario Ministry of Environment and Climate Change. Discharge water from a dewatering system directly to a watercourse provided the discharge is of good quality, and contains no significant silt or other debris, and is at a rate, and in a manner not to cause scouring to the streambeds or banks. Discharge the water in the direction of the stream flow and unto a splash pad.

.3 Refer to Sections 01561 regarding sediment basins and erosion control.

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 Engineer to do so.

.2 Remove the primary dewatering system in stages to allow the groundwater level to rise at a controlled rate.

END OF SECTION

SECTION 02200
EARTHWORK- ARCHITECTURAL

PART 1 GENERAL

1.01 GENERAL REQUIREMENTS

.A General Conditions, Supplementary Conditions and Division 01 apply to this Section.

1.02 SUMMARY

.A Section Includes:

.1 Protection, modification and/or installation of utilities, as sitework progresses paying particular attention to grade changes and any necessary staging of work.

.2 Cutting, filling and grading to required lines, dimensions, contours and proposed elevations for proposed improvements.

.3 Scarifying, compaction, drying and removal of unsuitable material to ensure proper preparation of areas for fills or proposed improvements.

.B Related Sections:

.1 Section 02223 – Excavation, Backfill and Compaction for Pavement

.2 Section 02227 – Aggregate Materials

1.03 REFERENCES

.A American Society for Testing and Materials (ASTM):

.1 ASTM D698 – Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort

.2 ASTM D1557 – Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort

.3 ASTM D2922 – Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods

.4 ASTM D4318 – Standard Test Methods for Liquid Limit, Plastic Limit and Plasticity Index of Soils

.B American Association of State Highway and Transportation Officials (AASHTO):

.1 AASHTO T-88 – Standard Method of Test for Particle Size Analysis of Soils

.C Occupational Health and Safety Act and Regulation for Construction Projects.

1.04 SUBMITTALS

.A Section 01300 – Submittals: Procedure for Submittals

.B Submit a sample of each type of off-site fill materials that is to be used at the site, in an air tight 5 kg container for the testing laboratory.

.C Submit the name of each material supplier and specific type and source of each material. Any change in source throughout the job requires approval of the Owner and Engineer.

.D For use of fabrics or geogrids, a design shall be submitted for approval by the Owner.

1.05 QUALITY ASSURANCE

.A Independent Testing Laboratory selected and paid by the Contractor shall be retained to perform construction testing on site based on the following:

.1 Building Sub-grade Areas, including 3.0m Outside Exterior Building Lines: In cut areas, not less than one compaction test for every 235 square metres. In fill areas, same rate of testing for each 200mm lift (measured loose).

.2 Areas of Construction exclusive of building sub-grade: In cut areas, not less than one compaction test for every 950 square metres. In fill areas, same rate of testing for each 200mm lift (measured loose).

.B If compaction requirements are not complied with at any time during construction process, remove and re-compact deficient areas until proper compaction is obtained at no additional expense to the Owner.

.C In all areas to receive pavement, a CBR (or LBR) test shall be performed for each type of material imported from off-site.

.D The following tests shall be performed on each type of on-site or imported soil material used as compacted fill as part of construction testing requirements.

.1 Moisture and Density Relationship: ASTM D698 or ASTM D1557.

.2 Mechanical Analysis: AASHTO T-88.

.3 Plasticity Index: ASTM D4318

.E Field density tests fir in-place material shall be performed according to one of the following standards as part of construction testing requirements:

.1 Nuclear Method: ASTM D2922 (Method B-Direct Transmission)

.F Independent Testing Laboratory shall prepare test reports that indicate test location, elevation data, and test results. Owner, Consultant/Engineer, and Contractor shall be provided with copies of reports within 96 hours of time test was performed. In event that any test performed fails to meet these specifications, Owner, Consultant/Engineer and Contractor shall be notified immediately by independent testing laboratory.

.G All costs related to retesting due to failure shall be paid for by the Contractor at no additional expense to Owner. Owner reserves the right to employ an Independent Testing

Laboratory and to direct any testing that is deemed necessary. Contractor shall provide Independent Testing Laboratory free access to site for testing activities.

PART 2 PRODUCTS

2.01 MATERIALS

.A Excavated and re-used material for subsoil fill as specified herein.

.B Aggregate fills as specified in Section 02227.

.C Imported subsoil material approved by the Owner and specified herein.

.D Topsoil fills as specified in Section 02100. (refers to Civil Division 2)

.E Acceptable stabilization fabrics and Geogrids or equivalents as approved by the Engineer, and as specified in Contract Documents.

.F Filter/Drainage Fabrics as specified in contract documents, or equivalent as approved by Engineer.

.G Provide geotextile for exterior gravel strip, refer to drawings for location. Product and manufacturer: Terrafix geotextile 270R by Terrafix Geosynthetics Inc. www.terrafixgeo.com Phone: 416-674-0363.

2.02 EQUIPMENT

.A Off-site materials shall be transported to project using well maintained and operational vehicles. Once on site, transporting vehicles shall stay on designated haul roads and shall at no time endanger improvements by rutting, overloading, or pumping.

PART 3 EXECUTION

3.01 PREPARATION

.A Identify required lines, levels, contours and datum. Survey stakes with exact elevations must be positioned to identify the engineered fill areas and the proposed finished fill grade.

.B Locate and identify existing utilities that are to remain and protect them from damage.

.C Notify utility companies to remove and/or relocate any utilities that are in conflict with the proposed improvements.

.D Protect plant life, lawns, fences, existing structures, sidewalks, paving and curbs from excavating equipment and vehicular traffic.

.E Protect benchmarks, property corners and all other survey monuments from damage or displacement. If a marker needs to be removed it shall be referenced by a licensed land surveyor and replaced, as necessary, by the same.

.F Remove from site material encountered in grading operations that, in opinion of Owner or Owner's representative, is unsuitable or undesirable for backfilling, sub-grade or foundation purposes, for which cannot be re-used for any other site grading operation and all surplus fill materials. Dispose of in a manner satisfactory to Owner. Backfill areas with layers of suitable material and compact as specified.

.G Prior to placing fill in low areas, such as previously existing creeks, ponds, or lakes, perform following procedures. All work must be performed per applicable legislation/regulation and as approved by Engineer.

.1 Drain water out by gravity with ditch having flow line lower than lowest elevation in low area. If drainage cannot be performed by gravity ditch, use adequate pump to obtain same results.

.2 After drainage of low area is complete, remove mulch, mud, debris and other unsuitable material by using acceptable equipment and methods that will keep natural soils underlying low areas dry and undisturbed.

.3 If proposed for fill, all muck, mud, and other materials removed from above low areas shall be dried on-site by spreading in thin layers for observation by Owner or Owner's representative. Material shall be inspected and, if found to be suitable for use as fill material, shall be incorporated into lowest elevation of site filling operation, but not under the building area or within 3.0m of perimeter of building pad or paving subgrade. If, after observation by Owner or Owner's representative, material is found to be unsuitable, all unsuitable material shall be removed from site.

.4 In the event of a site material deficit, co-ordinate, and import fill from off site and include all costs as specified herein.

.H The fill is not to be brought to the site until such time that a sample has been reviewed and tested by qualified engineers, with respect to suitability of material for filling purposes intended, and it is certified that the material is free of chemical or toxic contaminants.

3.02 EXCAVATION FOR FILLING AND GRADING

.A Classification of Excavation: Contractor by submitting bid acknowledges that he has investigated the site to determine type, quantity, quality, and character of excavation work to be performed. All excavation to comply with requirements of the OHSA for construction projects and per requirements of M.O.L.

.B Perform excavation using capable, well maintained equipment and methods acceptable to Owner and governing agencies.

.C When performing grading operations during periods of wet weather, provide adequate drainage and ground water management to control moisture of soils.

.D Shore, brace, and drain excavations as necessary to maintain safe, secure, and free of water at all times.

.E Excavated material containing rock or stone greater than 150mm in largest dimension is unacceptable as fill within the proposed building and paving area.

.F Rock or stone less than 150mm in largest dimension is acceptable as fill up to 600mm below the surface of proposed subgrade when mixed with suitable material.

.G Rock or stone less than 50mm in largest dimension and mixed with suitable material is acceptable as fill within the upper 600mm of proposed subgrade.

3.03 FILLING AND SUBGRADE PREPARATION

.A Fill areas to contours and elevation shown with unfrozen materials.

.B Place fill in continuous lifts specified herein.

.C Refer to Section 02223 for filling requirements for pavements.

.D Areas exposed by excavation or stripping and on which subgrade preparations are to be performed shall be scarified to minimum depth of 200mm and compacted to minimum of 98% of SPMDD unless otherwise specified in the contract documents or drawings at a moisture content of not less than 1% below and not more than 3% above, or as directed by the Geotechnical Engineer, the optimum moisture content. These areas shall then be proof-rolled to detect any areas of insufficient compaction. Proof-rolling shall be accomplished by making a minimum of two (2) complete passes with a fully-loaded tandem-axle dump truck, or approved equivalent, in each of the two perpendicular directions under the supervision and direction of a field geotechnical engineer. Areas of failure shall be excavated and re-compacted as stated above.

.E Fill materials used in preparation of subgrade shall be placed in lifts or layers not to exceed 200mm loose measure and compacted to a minimum density of 98% of SPMDD unless otherwise specified in the contract documents or drawings at a moisture content of not less than 1% below and not more than 3% above the optimum moisture content, or as directed by the Geotechnical Engineer.

.F Within building envelopes including concrete aprons, all fill materials will be compacted to 100% SPMDD.

.G Material imported from off-site shall have a CBR (California Bearing Ratio) or LBR (Limerock Bearing Ratio) value equal to or above the pavement design subgrade CBR or LBR value indicated on the Drawings, and subject to acceptance by the Engineer.

3.04 MAINTENANCE OF SUBGRADE

.A Finished subgrades shall be verified to ensure proper elevation and conditions for construction above subgrade.

.B Protect subgrade from excessive wheel loading during construction, including concrete trucks and dump trucks.

.C Remove areas of finished subgrade found to have insufficient compaction density to depth necessary and replace in a manner that will comply with compaction requirements by use of material equal to or better than best subgrade material on site. Surface of subgrade after compaction shall be hard, uniform, smooth, stable, and true to grade and cross-section.

3.05 FILTER FABRIC

.A The filter material shall be as described in the appropriate Appendices and/or Drawings or an equal alternative and the Contractor is required to have a sample of the material delivered to the site for approval prior to commencing the installation.

.B Place filter material in the manner outlined by the manufacturer or as specified. Adjacent sections of filter cloth shall be overlapped a minimum of 600mm, unless otherwise noted.

3.06 GEOTEXTILE FOR EXTERIOR GRAVEL STRIP

.A Install as per manufacturer suggested guidelines at locations as shown on drawings.

3.07 FINISHING GRADING

.A Refer to Section 02245 for soil stabilization using lime, cement, fly ash and geotextile fabric methods for sub-base materials.(refers to Civil Division 2)

END OF SECTION

SECTION 02220
EXCAVATION, TRENCHING AND BACKFILLING

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SECTION 02220
EXCAVATION, TRENCHING AND BACKFILLING

1 PART 1 – GENERAL

1.1 DESCRIPTION

.1 This Section specifies the requirements for excavating and backfilling for the installation of structures, pipelines and appurtenances.

1.2 RELATED WORK SPECIFIED ELSEWHERE

.1 Site Preparation: Section 2100

.2 Storm Sewers: Section 2530

.3 Maintenance Holes and Catch Basins: Section 2631

.4 Sanitary Laterals and Sewers: Section 2531

.5 Watermains: Section 2511

.6 Dewatering: Section 02140

.7 Excavation Shoring Systems: Section 2151

.8 Cast-In-Place Concrete: Section 3330

1.3 REFERENCES

.1 ASTM C117-90, Test Method for Material Finer Than: 0.075 mm Sieve in Mineral Aggregates by Washing.

.2 ASTM C136-84a, Method for Sieve Analysis of Fine and Coarse Aggregates

.3 ASTM D698-1990, Test Methods for Moisture Density Relations of Soils and Soil Aggregate Mixtures Using 2.49 kg Rammer and 304.8 mm Drop.

.4 ASTM D1557-1990, Test Methods for Moisture Density Relations of Soils and Soil-Aggregate Mixtures Using 4.54 kg Rammer and 457 mm Drop.

.5 OPSS 507, Construction Specification for Site Restoration for Underground Utilities

.6 OPSS 516, Construction Specification for Excavating, Backfilling and Compacting for Maintenance holes, Catch Basins, Ditch Inlets and Valve Chambers.

.7 OPSS 517, Construction Specification for Dewatering of Pipeline, Utility, and Associated Structure Excavation

.8 OPSS 538, Construction Specification for Support Systems

.9 OPSS 1010, Material Specification for Aggregates – Base, Subbase, Select Subgrade, and Backfill Material.

.10 OPSS 1006, Material Specification for Aggregates – Surface Treatment

.11 OPSS 180, General Specification for the Management of Excess Materials

.12 OPSS 186, Material Specification for Geotextiles.

.13 OPSS 1205, Material Specification for Clay Seal.

1.4 DEFINITIONS

.1 Trench: As defined in the current Occupational Health and Safety Act and Regulations.

.2 Common Excavation: Excavation of all materials other than solid masses of rock which includes wet or frozen material, snow, ice, trees, stumps, roots, vegetation matter, concrete pipes, concrete as well as individual boulders, rock fragments and detached rock blocks.

.3 Rock Excavation:

.1 Rock blasting is not allowed.

.2 Excavation of solid mass rock which must be by hoe ramming or jack hammering to break the bedrock into sizes that can be excavated, or some other recognized hard rock quarry procedure.

.3 Removal of boulders and rock fragments larger than one cubic metre in volume.

.4 Additional Excavation:

.1 All excavation ordered in writing by the Engineer beyond that specified herein, except as defined as Excess Excavation.

.2 Additional excavation includes but is not limited to excavation below the underside of the working mat, below the bottom of trenches, and excavation beyond the length of the working trench.

.5 Excess Excavation: All excavation carried out by the Contractor that was not authorized or required by the Engineer.

.6 Backfill:

.1 Fill material used against exterior walls of structures, below subgrade or placed above the bedding material and below the restoration materials.

.2 Pipe bedding, cover, and embedment for trenches for all pipes under seeded and sodded area to be Granular A.

.3 Backfill materials may consist of native Site material, granular material or imported fill material as approved by the Engineer.

.4 Backfilling of the reservoir and pumping station may only commence once the Contractor has demonstrated that the concrete reservoir structure is watertight by way of the leakage test.

.7 Topsoil: Material capable of supporting good vegetative growth and suitable for use in top dressing, landscaping and seeding.

.8 Waste Material: Excavated material unsuitable for use in work or surplus to requirements.

.9 Native Site Material: Any acceptable material obtained from excavating or grading under the current Contract.

.10 Controlled Density Fill: A blend of Portland Cement, fly ash, aggregate and water.

.11 Standard Proctor Density: As defined in ASTM D698.

1.5 SUBMITTALS

.1 Submit details of the proposed methods and procedures to be employed for trench and structures excavation.

.2 Indicate the proposed source of granular material and backfill material.

.3 Submit the details of the excavation and bedding materials prior to the pre-construction meeting.

1.6 COLD WEATHER WORK

.1 Obtain written permission from the Engineer before starting excavation in frozen ground. Written authorization from the Engineer must be obtained for methods to be used to carry out such work.

.2 Protect all excavations to prevent frost from penetrating the ground below the foundations. Remove any footing or structure laid on frost which, in the opinion

of the Engineer, has been damaged through neglect of this clause of the Specifications.

.3 Do not backfill with frozen material and do not place fill where the material in place is already frozen.

.4 Replace any excavated frozen material with suitable backfill material at no additional cost to the Contract. Frozen material may be stockpiled for use after being left to thaw.

1.7 SITE CONDITIONS

.1 The Contractor shall examine the site to ascertain any special condition and become familiar with any object which may affect the work of this section. No extra payment will be made for work resulting from a failure to know existing conditions. Examine all Contract Drawings for work that might affect excavation and backfill.

1.8 DISPOSAL SITES

.1 Arrange with the Owner for disposal of surplus excavated materials.

.2 Obtain from the property owner a written agreement setting out terms, conditions and ultimate responsibility for materials as placed.

.3 Arrange with the Engineer to have a City Environmental Officer of the Ontario Ministry of Environment and Climate Change do an inspection of the disposal sites prior to and after dumping operations are completed.

.4 Keep disposal sites stable and dump materials in a manner not to cause nuisance, injury, or inconvenience until the property owner assumes responsibility under the terms of agreement.

1.9 STABILITY OF EXCAVATION

.1 The Engineer may direct the Contractor to stop work should the construction methods being employed not ensure that the excavations are kept stable and dry.

.2 Employ construction methods and plant procedures and precautions to ensure that excavations are stable, free from disturbance and unless designated as sub-aqueous work, dry.

.3 Employ construction methods, plant procedures and good materials placement to ensure that no migration of fine soil material into the pipe bedding or structure working mat from the adjacent ground occurs.

.4 Employ construction methods and plant procedures and precautions to ensure the stability of all excavated slopes, bases of the trench, all new and existing structures as part of this Contract.

1.10 QUALITY ASSURANCE

.1 All material supplied by the Contractor is subject to inspection and testing at the discretion of the Engineer.

.2 At least four (4) weeks prior to commencing work furnish the Engineer with a list of sources of materials and provide without charge sufficient samples, tests and reports as may be required for the Engineer's review.

.3 Upon request by the Engineer, provide moisture density curves for each type of imported material if required to be compacted to a specified density. Moisture density curves shall be in accordance with ASTM D698-64.

.4 Preliminary approval of imported fill material on site, or supplied by the Contractor, does not constitute general acceptance. Acceptance depends upon satisfactory field test results and performance in place.

2 PART 2 – PRODUCTS

2.1 BACKFILL MATERIALS

.1 Native Site material:

.1 Excavated material approved by the Engineer.

.2 Material free from frozen lumps, cinders, ashes, refuse, vegetable or organic matter, rocks and boulders over 150 mm in any dimension. The backfill shall not contain more than ten (10) percent by weight of soft or friable material, clay, dust, vegetable loam, or other deleterious materials which, in the opinion of the Engineer, is unsuitable.

.2 Imported material:

.1 All sources from which the topsoil/fill material is obtained and all truckloads of material to be deposited conform to the definition of "inert fill" per Ontario Regulation 347 and Table 9-Residential/ Parkland/ Institutional of the Soil, Ground Water and Sediment Standards for Use per Part XV.1 of the Environmental Protection Act, March 9, 2004. Material from a source approved by the Engineer.

.2 Material free from frozen lumps, cinders, ashes, refuse, vegetable or organic matter, rocks and boulders over 150 mm in any dimension, or other deleterious materials.

.3 The backfill materials shall be approved material obtained from excavations under this Contract, or other sources approved by the Engineer. No frozen material shall be classified as suitable material for backfilling except under special direction from the Engineer.

.4 The material used for bedding and backfilling all excavations shall be, unless otherwise specified, as shown on the Contract Drawings or specified herein and meet the gradation requirements set forth in OPSS Form 1010.

.5 Granular Materials:

.1 Granular "A": to OPSS.MUNI 1010

.2 Granular "B": to OPSS.MUNI 1010

.3 Granular "M": to OPSS.MUNI 1010

.4 19 mm clear stone: to OPSS.MUNI 1004

.5 Mortar sand: to OPSS.MUNI 1004

.6 Unshrinkable fill: to OPSS 1359

.6 Do not use any material without approval from the Engineer. Where, in the opinion of the Engineer, the excavated material is not suitable for backfill, import suitable backfill material at the Contractor's expense.

.7 Do not use shale or thinly bedded limestone that may break up on exposure or freezing. The material shall be composed of sound particles that will not be affected by watering or by the elements.

.8 Submit suitable representative samples of the proposed imported bedding and backfill materials to the Engineer at least one week in advance of the proposed start of placing. The material to be used must be approved by the Engineer before this work commences.

.9 Fill concrete, mud slab and mass concrete should be as per Division 3.

.10 Existing Fill: Existing loose fill above undisturbed soil is not suitable for foundation purpose.

3 PART 3 – EXECUTION

3.1 SHORING AND BRACING

.1 Perform sheeting, shoring and bracing as per Section 02151.

3.2 DEWATERING

.1 Dewater the excavation as per Section 02140.

3.3 REMOVAL OF FROZEN GROUND

.1 Do not use a backhoe bucket or drop weights to break the frozen ground.

.2 Adopt a method of removal of frozen ground that will not cause excessive noise, ground vibration, or damage to adjacent structures and utilities.

.3 Use methods of removal approved by the Engineer.

3.4 EXCAVATION

.1 Excavate to the lines, grades, elevations and dimensions shown on the Contract Drawings and/or specified or as directed by the Engineer.

.2 Do not start the trench excavation until the ground water level has been lowered in the area of the trench as per Section 02140.

.3 Notify the Engineer/Inspector if the bottom of the excavation appears to be unsuitable for a foundation. Excavate unsuitable material as directed or agreed to by the Engineer until a satisfactory foundation is attained, then backfill with approved granular materials as directed.

.4 Excavate trenches so that the width at the bottom does not exceed the width at the top.

.5 Do not excavate more than 15 metres of the trench in advance of completed pipelines or utilities.

.6 Excavate the trench completely and sufficiently far in advance of pipe laying to allow for the proper installation of the pipe.

.7 Do not use a trenching box if the soil conditions or methods of use are such that disturbance of the soil bedding of the pipe occurs.

.8 Stockpile excavated materials suitable for backfill.

.9 Separate materials that are not suitable for backfill.

.10 Perform corrective measures ordered by the Engineer to rectify deficiencies caused by Excess Excavation.

.11 If the excavation base is “soft”, weakened or disturbed, due to inadequate control of groundwater, do not commence removal of the base until the groundwater level has been lowered sufficiently to stabilize the base.

.12 Remove and replace weakened or disturbed soil with Class B concrete or approved granular material compacted to 95% maximum dry density in accordance with Standard Proctor Density, where the excavated surface below or beside the proposed structure is disturbed or weakened by unsuitable construction methods or procedures.

3.5 WORKING MAT

.1 Where shown on the Contract Drawings, place a layer of granular material as a working mat layer immediately after the excavation has been completed.

.2 Provide a 75 mm thick mud slab of low strength concrete under structures and footings.

3.6 BACKFILLING

.1 Do not backfill cast-in-place concrete structures until approval has been obtained from the Engineer.

.2 Place backfill material in layers not more than 300 mm thick, loose depth, and wetted if required.

.3 Place backfill materials uniformly and simultaneously on all sides of structures.

.4 Compact each layer of backfill to 95% of maximum dry density in accordance with Standard Proctor Density.

.5 In areas designed for vehicle traffic, backfill to 100% of maximum dry density in accordance with Standard Proctor Density.

.6 Place the backfill material to a minimum depth of one metre above the crown of the pipe before using power operated tractors or rolling equipment to compact the backfill.

.7 As soon as possible after the pipe has been jointed and properly bedded, carefully place selected backfill material in the excavation and spread it in uniform layers not exceeding 300 mm in loose depth for the full width of the trench.

.8 Take care to carry the fill up evenly around the structures to keep asymmetrical loading to a minimum.

.9 Backfill carefully so that no damage is done to the waterproofed exterior wall faces, or the filter fabric.

.10 Refer to the Contract Drawings for a typical detail of backfilling around structures.

3.7 BACKFILLING SHORED EXCAVATIONS

.1 Withdraw the sheathing gradually as the backfilling progresses.

.2 Do not remove bracing until the backfill reaches the level of bracing.

.3 Place and compact backfill in a manner that fills voids left by pulled sheathing.

.4 Place and compact backfill around and over sheathing left in place.

.5 The backfill material within the limits of sheeted excavations shall be placed after such portion of the sheeting has been withdrawn as will permit maximum contact with the soil on each side of the excavation without endangering the support of the adjacent pavement, structures and utilities.

.6 Rectification of all settlement that occurs in the backfill during the maintenance period and all damages resulting there from, are Contractor's responsibility at no extra cost to the Owner.

3.8 STOCKPILING AND DISPOSAL OF MATERIALS

.1 Stockpile all excavated material on the site in the location(s) identified on the Contract Drawings, during construction.

.2 No extras will be considered for the stockpiling or double handling of excavated material that may be necessary.

.3 Dispose of all excess excavated material not required for backfill or embankments off the site to the satisfaction of the Engineer.

.4 Transport materials in a manner so that spillage is avoided.

.5 No burning of spoil materials will be permitted on the Site.

3.9 SUPPORT AT STRUCTURES

.1 Support the pipe up to first joint outside of the structure with one of the following methods:

.1 Reinforced concrete beam.

.2 Steel I-Beam or angle section.

.3 Class B concrete cast-in-place to the bottom of the excavation.

.2 Support and connections to the structure are to be capable of adequately supporting the pipe and overburden over the pipe.

3.10 RESTORATION

.1 Upon completion of work, remove surplus materials and debris, trim slopes and correct defects noted by Engineer.

.2 Replace topsoil as indicated or directed by Engineer.

.3 Clean and reinstate areas affected by work as directed by Engineer.

END OF SECTION

SECTION 02223
EXCAVATION, BACKFILLING AND COMPACTING FOR PAVEMENT- ARCHITECTURAL

PART 1 GENERAL

1.01 GENERAL REQUIREMENTS

.A General Conditions, Supplementary Conditions and Division 01 apply to this Section.

1.02 SUMMARY

.A Section Includes:

.1 Excavate to line, grade and configuration as shown in the plans and specifications for proposed and future pavement areas.

.2 Fill to line, grade and configuration as shown in the plans and specifications for proposed and future pavement areas.

.3 Compacting fill materials in an acceptable manner as stated herein.

1.03 REFERENCES

.A American Society for Testing and Materials (ASTM):

.1 Latest edition.

.B American Association of State Highway and Transportation Officials (AASHTO):

.1 Latest edition.

.C Local Municipal Standards and Specifications.

.D Occupational health and Safety Act and Regulation for Construction Projects.

.E Refer to Section 02200 for additional reference standards.

1.04 SUBMITTALS

.A Section 01300 – Submittals: Procedure for Submittals

.B Shop Drawings or details pertaining to excavating and filling for pavement are not required unless shown on drawings or specifications or if contrary procedures to the project documents are proposed.

.C Submit a sample of each type of off-site fill material that is to be used in backfilling in an air-tight, 5kg container for the testing laboratory or submit a gradation and certification of the aggregate material that is to be used to the testing laboratory for review.

1.05 QUALITY ASSURANCE

.A Independent Testing Laboratory selected and paid by Contractor, shall be retained to perform construction testing on filling operations and sub-grade analysis as specified in Section 02200 and as stated herein.

PART 2 PRODUCTS

2.01 MATERIALS

.A Fill material from on-site as specified in Section

.B 02200 and approved by the Owner or Owner's representative.

.C Fill material from off-site as specified in Section 02200 and approved by the Owner or Owner's representative.

.D Aggregate material as specified in Section 02227.

.E Acceptable stabilization fabrics and geogrids as specified in contract document or equivalent approved by Consultant.

2.02 EQUIPMENT

.A Off-site materials shall be transported to project using well maintained and operating vehicles. Once on site, transporting vehicles shall stay on designated haul roads and shall at not time endanger improvements by rutting, overloading, or pumping.

PART 3 EXECUTION

3.01 PREPARATION

.A Identify all lines, elevations and grades necessary to construct pavements, curb and gutter, bases, walkways and roadways as shown in the plans and specifications.

.B Carefully protect benchmarks, property corners, monuments or other reference points. Should any markers, etc. need to be removed, it shall be referenced by a licensed land surveyor and replaced as necessary by same.

.C Locate and identify all site utilities that have previously been installed and may be in danger of damage by grading operations.

.D Locate and identify all existing utilities that are to remain and protect them from damage.

.E Over excavate and properly prepare areas of sub-grade that are not capable of supporting the proposed systems. These areas shall be stabilized by using acceptable filter fabrics and/or aggregate material placed and compacted as specified.

3.02 EXCAVATION

.A Excavate roadway and pavement areas to line and grade as shown in the plans and specifications.

.B Engage all suitable material into the project fill areas as specified in Section 02200.

.C All excess excavated soil shall be removed off-site and disposed of as instructed by Construction Manager.

.D Unsuitable excavated material is to be re-used in areas approved by the Owner and/or disposed of in a manner and location that is acceptable to the Owner and local governing agencies.

.E Perform excavation using capable, well maintained equipment and methods acceptable to the Owner and the project document requirements.

3.03 FILLING AND SUB-GRADE PREPARATION

.A Within building envelopes/concrete aprons, all fill materials will be compacted to 100% SPMDD.

.B Areas exposed by excavation or stripping and on which sub-grade preparations for paving are to be performed, including future pavement areas, shall be scarified to minimum depth of 200mm and compacted to minimum of 98% SPMDD, unless otherwise specified in the contract documents or drawings at a moisture content of not less than 1% below and not more than 3% above the optimum moisture content or as directed by the Geotechnical Engineer. These areas shall then be proof-rolled to detect any areas of insufficient compaction. Proof-rolling shall be accomplished by making a minimum of two (2) complete passes with a fully-loaded tandem-axle dump truck, or approved equivalent, in each of the two perpendicular directions under the supervision and direction of a field Geotechnical Engineer. Areas of failure shall be excavated and re-compacted as stated above.

.C Fill materials used in preparation of sub-grade shall be placed in lifts or layers not to exceed 200mm loose measure and compacted to a minimum density of 98% SPMDD unless otherwise specified in the contract documents or drawings at a moisture content of not less than 1% below and not more than 3% above the optimum moisture content.

.D Frost tapers of sub-grade transitions and back of curbs must be provided at 5:1 or as directed by the Geotechnical Engineer.

.E The following table stipulates maximum allowable values for plasticity index (PI) and liquid limit (LL) of suitable fill materials to be used in the specified areas, unless specifically stated otherwise on the Drawings:

.F

LOCATION	PI	LL
*Paving Area, below upper 600mm	20	50
*Paving Area, upper 600mm	15	40

(*References to Depth are to Proposed Sub-grade Elevations)

.G Material imported from off-site shall have a CBR (California Bearing Ratio) of LBR (Limerock Bearing Ratio) value equal to or above the pavement design sub-grade CBR or LBR value indicated on the Contract documents.

3.04 COMPACTION

.A Maintain optimum moisture content of fill materials to attain required compaction density.

.B All materials shall be tested in accordance with Section 02200.

.C An independent testing laboratory selected and paid by the Contractor, shall be retained to perform testing on-site, in accordance with Section 02200.

.D If compaction requirements are not complied with at any time during construction process, remove and re-compact deficient areas until proper compaction is obtained at no additional expense to Owner.

3.05 MAINTENANCE OF SUB-GRADE

.A Finished sub-grades shall be verified to ensure proper elevation and conditions for construction above sub-grade.

.B Protect sub-grade from excessive wheel loading during construction including concrete trucks and dump trucks.

.C Remove areas of finished sub-grade found to have insufficient compaction density to depth necessary and replace in a manner that will comply with compaction requirements by use of material equal to or better than best sub-grade material on-site. Surface of sub-

grade after compaction shall be hard, uniform, smooth, stable, and true to grade and cross-section.

3.06 FINISHING GRADING

.A Finishing grading shall be in accordance with Section 02200 and as more specifically stated herein.

.B Grading of paving areas shall be checked by string line from grade stakes se at no more than 15m centers. Tolerances of 30mm, more or less, will be permitted. Contractor is to provide engineering and field staking necessary for verification of lines, grades, and elevations.

END OF SECTION

SECTION 02314
DEEP EXCAVATIONS AND BACKFILLING

1. GENERAL 1

1.1 SCOPE 1
1.2 RELATED SECTIONS 1
1.3 PROTECTION OF EXISTING PROPERTIES AND UTILITIES 1
1.4 REFERENCES 2
1.5 SUBMITTALS 2

2. PRODUCTS 3

2.1 MATERIALS 3

3. EXECUTION 3

3.1 LIMITS OF EXCAVATION 3
3.2 DEPTH AND SEQUENCING OF EXCAVATION AND CONDITION OF BASE 3
3.3 PUMPING/DEWATERING 4
3.4 EXCAVATED MATERIAL 4
3.5 BACKFILLING 4
3.6 QUALITY CONTROL 5

SECTION 02314
DEEP EXCAVATIONS AND BACKFILLING

1. GENERAL

1.1 SCOPE

1. This Section covers the Work for excavation and disposal of fill and soils to permit construction of all structures as shown on the Contract Drawings.
2. Control and removal of water in the excavations as required, including all structure excavations for both temporary and permanent structures.
3. Provide quality control of all Work under this Section in accordance with the Contractor's Quality Control Plan prepared and submitted in accordance with Section, 01400, Quality Control.

1.2 RELATED SECTIONS

1. Section 01450 – Quality Control
2. Section 02140 – Dewatering
3. Section 02327 – Vibration Monitoring
4. Section 02370 – Erosion and Sediment Control
5. Section 03300 – Cast In Place Concrete

1.3 PROTECTION OF EXISTING PROPERTIES AND UTILITIES

1. Existing buried utilities and structures:
   - .1 Size, depth and location of existing utilities and structures as indicated are for guidance only. Completeness and accuracy are not guaranteed.
   - .2 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.
   - .3 Confirm locations of buried utilities by careful test excavations.
   - .4 Maintain and protect from damage, water, sewer, gas, electric, telephone and other utilities and structures encountered.
   - .5 Where utility lines or structures exist in area of excavation, obtain direction of Contract Administrator before removing or re-routing.
   - .6 Record location of maintained, re-routed and abandoned underground lines.

2. Existing buildings and surface features:

   .1 Perform pre-construction inspection and building elevation monitoring in accordance with Section 02320 - Pre-Construction Inspection and Building Elevation Monitoring.
   .2 Protect existing buildings and surface features which may be affected by work from damage while work is in progress. In event of damage, immediately make repair to approval of Contract Administrator.
   .3 Where excavation necessitates root or branch cutting, do cutting as approved by Contract Administrator.

3. Sequence Work in accordance with Section 01114 – Construction Sequence and Temporary Works.

1.4 REFERENCES

1. Section 02140 – Dewatering.
2. Section 02315 – Temporary Protection System
3. Section 02370 – Erosion Control.
4. Geotechnical Report prepared by Geotechnical Report prepared by Terraprobe, Ref No. 7-16-0090-01, “Geotechnical Investigation West Harbour Pumping Station and Associated Works, Hamilton, Ontario, November 2016”
5. All reference standards and related specifications shall be current issue or latest revision at the first date of tender advertisement.
6. Ontario Provincial Standard Specifications (OPSS)

   .1 OPSS 180, General Specification for the Management of Excess Materials.
   .2 OPSS 510, Construction Specification for Removal.
   .3 OPSS 518, Construction Specification for Control of Water from Dewatering Operations.
   .4 OPSS 902, Construction Specification for Excavation and Backfilling – Structures.

1.5 SUBMITTALS

1. Submit the following to the Contract Administrator, in accordance with this specification:

.1 Quality Control Plan in accordance with Section 01400 – Quality Control to include Contractor's methods and processes of ensuring compliance with all requirements herein.

.2 A detailed plan and schedule clearly illustrating the method and sequence by which the excavation will be advanced to respect the requirements of the Contract Drawings and this Section.

.3 A detailed plan and schedule clearly illustrating the method and sequence by which he proposes to control water in the excavations for the duration of the Work in accordance this Specification and Section 01555 – Erosion and Sediment Control.

.4 A detailed soil management plan clearly illustrating the method and sequence by which the Contractor proposes to manage soil excavation in accordance with this Specification and Section 01555 – Erosion and Sediment Control.

2. PRODUCTS

2.1 MATERIALS

1. Granular B type II to OPSS 1010.

3. EXECUTION

3.1 LIMITS OF EXCAVATION

1. Excavate only material that is necessary for the construction of the Work and shall not excavate outside the limits of excavation indicated on the Drawings.

3.2 DEPTH AND SEQUENCING OF EXCAVATION AND CONDITION OF BASE

1. Complete excavations to the elevations and dimensions and to respect the sequence as shown on the Drawings, or to the elevations directed by the Contract Administrator in the field in order to obtain firm, stable foundations.

2. Provide all equipment, materials, and labor to excavate the materials from within the confines of the temporary shoring wall to the elevations required to install the permanent structural concrete, piping, and other items as indicated.

3. Excavate to the depths proposed on the submitted and reviewed and approved shop drawings. Install any bracing, or other lateral supports required by the excavation geometry in accordance with approved shop drawings, and properly sequenced with excavation to ensure stability and to minimize deformations at all times. Continue excavation to completion once the excavation has been started. Check the temporary shoring wall for compliance with the specified dimensional tolerances as the excavation proceeds.

4. After the shaft excavation is completed to the design depth, a concrete working slab shall be installed to provide a dry surface suitable for the construction of the structure.

3.3 PUMPING/DEWATERING

1. Maintain excavations free of surface runoff and other water so that the material is excavated in its natural state and construction of the foundations is completed in the dry. Keep the bottom of the excavation free from excessive moisture or free-flowing water.
2. Control groundwater in accordance with Section 02319 – Groundwater Management System.
3. Discharge shall be in accordance with the requirements of Section 01555 – Erosion and Sediment Control.
4. Perform any other work incidental to the disposal, caring for and handling of water in the shafts in order to properly perform the construction work in accordance with the specifications and the requirements of all jurisdictional authorities.

3.4 EXCAVATED MATERIAL

1. Dispose of excavated material or any other debris within the construction limits in accordance with Section 01555 Erosion and Sediment Control and before it freezes.

3.5 BACKFILLING

1. Do not proceed with backfilling operations until permanent structure has achieved 75% of the specified 28-day strength.
2. Do not proceed with backfilling operations until Contract Administrator has inspected and approved installations.
3. Areas to be backfilled to be free from debris, snow, ice, water and frozen ground.
4. Do not use backfill material which is frozen or contains ice, snow or debris.
5. Backfill gallery between permanent structure and temporary protection system with multiple lifts of granular B backfill. Height of each lift not to exceed 0.3m.
6. Place layers simultaneously around all sides of installed work to equalize loading. Differential elevation within any given width around installed work not to exceed 0.5 m.

3.6 QUALITY CONTROL

1. Provide quality control in accordance with the reviewed and accepted Quality Control Plan. Include provision of notice to the Contract Administrator (who shall notify the design Geotechnical Engineer) for visual confirmation of the condition of the base of the excavation as each excavation is completed and before any further work can proceed.

END OF SECTION

SECTION 02315
TEMPORARY PROTECTION SYSTEMS

1.1 SCOPE 2
1.2 REFERENCES 2
1.3 DEFINITIONS 2
1.4 DESIGN AND SUBMISSION REQUIREMENTS FOR TEMPORARY PROTECTION SYSTEM 2
1.5 QUALIFICATIONS 3
1.6 SUBMISSIONS AND DESIGN REQUIREMENTS 3

2. PRODUCTS 4

2.1 MATERIALS 4

3. EXECUTION 4

3.1 GENERAL 4
3.2 INSPECTION AND MONITORING 4
3.3 REMOVAL OF PROTECTION SYSTEMS 4
3.4 QUALITY CONTROL 5
3.5 APPENDICES 5

SECTION 02315
TEMPORARY PROTECTION SYSTEMS

GENERAL

1.1 SCOPE

1. The Scope work under this specification covers the requirements for design, construction, maintenance and, monitoring of Temporary Protection Systems made necessary by excavation construction for Pumping station and Reservoir.

1.2 REFERENCES

1. Section 02327 – Vibration Monitoring
2. All reference standards and related specifications shall be current issue or latest revision at the first date of tender advertisement.
3. References in accordance with OPSS 539, OPSS 903, OPSS 904, OPSS 906, OPSS 942, and OPSS 1350 and OPSS 1601.
4. Ontario Ministry of Labour, Occupational Health and Safety Act, R.S.O. 1990, cO.1 as amended.
5. OPSS 180 Management of Excess Materials
6. Geotechnical Report prepared by Terraprobe, Ref No. 7-16-0090-01, “Geotechnical Investigation West Harbour Pumping Station and Associated Works, Hamilton, Ontario, November 2016”

1.3 DEFINITIONS

1. Definitions in accordance with OPSS 539.03
2. Quality Verification Engineer: means the Engineer, retained by the Contractor, qualified to determine that the work is in general conformance with the Contract Documents and issue Certificate(s) of Conformance.

1.4 DESIGN AND SUBMISSION REQUIREMENTS FOR TEMPORARY PROTECTION SYSTEM

1. Provide Design and Submissions requirements in accordance with OPSS 539.04.
2. Performance Level for Reservoir and Pumping Station Protection system shall be “LEVEL 2”
3. Temporary protection systems involving tie-backs into rock or soil are not permitted.
4. For Protection Systems to facilitate excavation depths that exceed three (3) metres, the Contractor shall submit to the Contract Administrator a Certificate of Conformance sealed and signed by the Quality Verification Engineer upon completion of each of the following operations, prior to commencement of each subsequent operation:

1. Layout and Extent of Protection System
2. Piling Installation of Protection System including excavation to Dredge Line
3. Removal of Protection System
4. Management of Excess Material (in accordance with OPSS 180 and as specified in the Contract).
5. Dewatering operations (in accordance with OPSS 517 and 902 and as specified in the Contract).

5. The Certificates of Conformance shall state that the materials and work have been supplied and installed in general conformance with the working drawings.

6. Upon completion of the operation of the Protection System and removal of the system, the Contractor shall submit to the Contract Administrator a final Certificate of Conformance sealed and signed by the Quality Verification Engineer. The Certificate shall state that the Protection System was monitored and removed, and it performed in general conformance with the stamped working drawings and contract documents.

1.5 QUALIFICATIONS

1. Submit Qualifications in accordance with OPS 539 except as modified herein:

    1. Erector: All supervisory personnel involved in the work performed under this specification shall be experienced in the method of construction of Protection Systems. Such experience shall have been obtained within the preceding five years on projects of similar nature and scope to the required work.
    2. Quality Verification Engineer: The Quality Verification Engineer shall have a minimum of five (10) years experience in the design of comparable Protection Systems, or alternatively with demonstrated expertise through providing satisfactory quality verification services for a minimum of two (2) projects in which the work was of similar scope to that in the Contract. The Quality Verification Engineer shall be retained by the Contractor to determine if the work is in general conformance with the Contract Documents and to issue Certificate(s) of Conformance.

1.6 SUBMISSIONS AND DESIGN REQUIREMENTS

1. Working Drawings Submission

    1. Submit Working Drawings in accordance with OPS 539 except as modified herein:
    2. Six (6) copies of stamped working drawings shall be submitted to the Contract Administrator for information purposes at least three (3) weeks before commencement of construction of the Protection System.

3. Work shall not proceed on amendments to the Protection System until the Contractor has received sealed and signed approval to proceed from the original Design Engineer and Design Checking Engineer and has submitted a copy of the approval to the Contract Administrator.
4. Amendments to the Protection System shall be submitted to the Contract Administrator on revised Working Drawings/Details bearing the seal and signature of the original Design Engineer and Design Checking Engineer.

2. PRODUCTS

2.1 MATERIALS

1. Materials shall comply with OPSS 539.

3. EXECUTION

3.1 GENERAL

1. Execution shall comply with OPS 539 except as modified herein:

3.2 INSPECTION AND MONITORING

1. Conduct pre-construction building and structure inspection survey, building elevation monitoring and vibration monitoring during pile installations in accordance with Section 02320 – Pre-Construction Inspection and Building Elevation Monitoring.

3.3 REMOVAL OF PROTECTION SYSTEMS

1. Protection Systems shall be removed from the site unless otherwise specified in the Contract that the Protection System shall be left in place.
2. Where Protection Systems are specified to be left in place, the top section and piles shall be removed to the limit shown on the Contract Drawings or 1m below finished grade. The method and sequence of shoring removal must be such that the ground movement permitted by the specified performance level shall not be exceeded.
3. The method and sequence of removal shall be such that there will be no damage to new work, existing work and the facility being protected. Temporary supports shall not be removed until so agreed by the Contract Administrator and the work for which they are required has been completed and the structure is capable of carrying the imposed loads.
4. Unless otherwise specified, the area remaining disturbed after removal of the Protection System shall be restored to as close to its original condition as possible.

3.4 QUALITY CONTROL

1. Monitoring of the Protection System shall be conducted by an Ontario Land Surveyor according to the program submitted with the construction drawings/details and in accordance with the requirements of Section 02320 – Pre-Construction Inspection and Building Elevation Monitoring.

2. In addition to the requirements of Section 02320 – Pre-Construction Inspection and Building Elevation Monitoring, the following requirements shall apply:

    1. The minimum requirements for monitoring shall include the survey measurements of scaled targets attached to the shoring wall at the elevations specified. The scaled targets shall be placed at a maximum spacing of 6 metres with targets placed at the extreme ends and the targets distributed between the outer limits. The survey targets shall be monitored for horizontal displacement from the vertical at the frequency specified.
    2. All test results, observations and records, including the survey taken during construction and operation of the Protection System shall be available on the site for review by the Contract Administrator.
    3. If movement of the Protection System is more rapid than is expected, or if movement approaches the allowable limit, the Contract Administrator shall be notified immediately, and suitable measures shall be taken to ensure stability of the Protection System and to ensure movement does not exceed the performance level specified.
    4. The Protection Systems shall be monitored during construction. Readings shall be taken during installation of the Protection System at the top, at each restraint point, at the dredge line and halfway between the restraint points at each construction stage during the installation of the Protection System. After installation the above readings shall be taken weekly.

3.5 APPENDICES

1. OPSS 539

END OF SECTION

SECTION 02327
VIBRATION MONITORING

PART 1 – GENERAL 1

1.1 SCOPE 1
1.2 RELATED WORK: 1
1.3 SUBMITTALS: 1

PART 2 - PRODUCTS 1

2.1 NOT USED 1

PART 3 – EXECUTION 1

3.1 GROUND VIBRATION MONITORING: 1

SECTION 02327
VIBRATION MONITORING

PART 1 – GENERAL

1.1 SCOPE

.1 This Section of the Specifications covers the work for the Vibration Monitoring during Deep Excavation and Backfilling Work, Temporary Protection System Work and Pile Foundation Work to ensure that the vibration levels at existing structure(s) are maintained below specified levels.

1.2 RELATED WORK:

.1 Section 02314: Deep Excavations and Backfilling

.2 Section 02315: Temporary Protection Systems

.3 Section 02451: Pile Foundations – General

1.3 SUBMITTALS:

.1 The Contractor shall prepare and submit a Vibration Monitoring Plan to the Contract Administrator prior to undertaking work under Sections 02314, 02315, and 02451.

PART 2 - PRODUCTS

2.1 NOT USED

PART 3 – EXECUTION

3.1 GROUND VIBRATION MONITORING:

.1 The Contractor shall undertake the monitoring of ground vibrations intensities (peak ground vibration and accelerations) from the deep excavations and backfilling work, temporary protection work, and pile foundations work on the ground adjacent to the closest structure and within the closest structure and in accordance with the reviewed detailed vibration monitoring plan for the duration of the noted Works.

.2 The piles furthest from the existing structures should be driven first, in order to check the vibration levels at the existing adjacent structures and, if necessary, alter the work. The Contractor shall pre-drill the piles, if required, to reduce ground vibrations to the specified maximum levels.

.3 The Contractor shall limit the frequency dependent peak vibration observed in the ground and within the nearest existing structures and services to a maximum peak particle velocity of 15 millimetres per second (mm/s).

END OF SECTION

SECTION 02370
EROSION CONTROL

1 PART 1 – GENERAL 1

1.1 DESCRIPTION 1
1.2 RELATED WORK SPECIFIED ELSEWHERE 1
1.3 GENERAL 1

2 PART 2 – PRODUCTS 1

2.1 FILTER FABRIC (GEOTEXTILE) 1
2.2 STRAW BALES 2
2.3 SILT FENCES 2
2.4 EROSION CONTROL BLANKETS 2

3 PART 3 – EXECUTION 2

3.1 SEDIMENT BASINS AND SETTLING PONDS 2
3.2 SEDIMENT TRAPS 3
3.3 STRAW BALE FILTER 3
3.4 SILT FENCES 3
3.5 EROSION CONTROL BLANKETS 3

SECTION 02370
EROSION CONTROL

1 PART 1 – GENERAL

1.1 DESCRIPTION

.1 This Section specifies the requirements for permanent slope protection and temporary erosion control measures.

1.2 RELATED WORK SPECIFIED ELSEWHERE

.1 Site Preparation: Section 02100

.2 Temporary Protection Systems: Section 02315

1.3 GENERAL

.1 It is intended that the Works proposed be executed in such a manner that will, to the fullest extent possible, minimize any adverse effects on the natural environment of the overall project area.

.2 The environmental conditions of the Contract as stated herein and as shown on the Contract Drawings must be complied with in all respects.

.3 It is the responsibility of the Contractor that all of his personnel be sufficiently instructed so that the work is carried out in a manner consistent with minimizing environmental damage.

.4 The Contractor shall be responsible for the design and implementation of all temporary works required to control and manage surface runoff and construction water within the limits of the site. The release of water or deleterious materials from the site is not permitted. The Contractor shall maintain all erosion control temporary measures in good working condition including the regular removal of any buildup of mud against the silt fence and the repair of any torn fabric, loose posts, etc. Any such damage shall be remedied by the Contractor at their own cost and at no liability to the Owner. Heavy duty silt fence indicated in Drawings is a minimum requirement only.

2 PART 2 – PRODUCTS

2.1 FILTER FABRIC (GEOTEXTILE)

.1 Synthetic filter fabric is to be non-woven in accordance with OPSS 1860, by Terrafix Geosynthetics Inc., Armtec, or Mirafi Inc.

2.2 STRAW BALES

.1 Straw or hay bales of a consistent size with straight sides and square corners tightly packed and bound with two loops of wire or twine. Each bale shall weigh at least 12 kg.

2.3 SILT FENCES

.1 Support silt fences on either 100 mm diameter wood or 'T' bar metal fence posts, with a minimum length 1.5 m.

.2 Wire fencing is to have a maximum mesh spacing of 150 mm, minimum height of 1.1 m and a minimum of 2 mm wire diameter.

.3 Use woven filter fabric in accordance with OPSS 1860, type 100X by Terrafix Geosynthetics Inc., Armtec, or Mirafi Inc.

2.4 EROSION CONTROL BLANKETS

.1 Top and bottom nets of 100% biodegradable two nets, 70% straw and 30% coconut fibre matrix by Terrafix (SC200B), Nilex (SC150BN), or Armtec (SC150).

3 PART 3 – EXECUTION

3.1 SEDIMENT BASINS AND SETTLING PONDS

.1 Incorporate appropriate sedimentation measures into the Works to ensure that sediment discharge to watercourses in or adjacent to the Site is minimized.

.2 These retention measures may include sediment basins or ponds to which pumped water or runoff is directed prior to discharge to adjacent watercourses.

.3 In general intercept concentrated runoff from destabilized areas and divert to stabilized areas under sheet flow conditions.

.4 Direct any water pumped for the purposes of trench excavation or dewatering to a settling basin or other such device to reduce suspended solids content prior to discharge to a storm sewer or natural watercourse.

.5 Minimize solids carryover overflow rate from settling or sedimentation ponds. Use straw bale filters, berms, sand bags and sediment traps to retard and filter the runoff prior to discharge.

.6 Implement settling ponds and siltation controls as part of the Site preparation and maintain them throughout the period of construction.

.7 Carry out regular inspections and cleaning of the protective measures. Replace as required by the Engineer, clogged filter materials such as straw bales.

3.2 SEDIMENT TRAPS

.1 Sediment traps are required at all ditch inlets, catchbasins or culverts.

.2 Sediment traps can be formed from using sod, straw bales, rock or filter fabrics, which traps the sediment.

.3 Inspect all sediment traps after each rainfall. Remove sediment deposits when the level of deposition reaches one half of the height of the filter barrier.

.4 When removing sediment traps after construction work, remove the sediment carefully and completely before the barrier is removed.

3.3 STRAW BALE FILTER

.1 Place straw bales in a single row, lengthways, with the ends tightly abutting adjacent bales.

.2 Embed the bales in the soil to a minimum depth of 100 mm.

.3 Securely anchor each bale by two stakes or metal bars driven through the bale.

.4 After staking and chinking the bales backfill the excavated soil against the bales.

3.4 SILT FENCES

.1 Set the posts at a maximum spacing of 3 m and drive them at least 350 mm into the ground.

.2 Excavate an anchor trench 100 mm x 100 mm at the base and along the post on the upslope side of the barrier.

.3 Securely fasten the steel-reinforcing fence to the upslope sides of the posts with heavy-duty staples, or tiewires. Extend the fence a minimum of 50 mm into the trench.

.4 Place the filter fabric on the upslope side of the barrier over the wire fence. Extend the fabric 200 mm into the ground and a maximum of 1.0 m above the ground. Staple or wire the fabric to the posts.

.5 Backfill and compact the soil in the trench.

3.5 EROSION CONTROL BLANKETS

.1 Install erosion control blankets in accordance with manufacturer recommendations and as indicated on the Contract Drawings.

END OF SECTION

SECTION 02451
PILE FOUNDATIONS

1 GENERAL 1

1.1 SCOPE 1
1.2 RELATED SECTIONS 1
1.3 REFERENCES 1
1.4 DELIVERY, STORAGE AND HANDLING 1
1.5 WASTE MANAGEMENT AND DISPOSAL 1
1.6 EXISTING CONDITIONS 1
1.7 SCHEDULING 2
1.8 SUBMITTALS 2

2 PRODUCTS 2

1.9 MATERIALS 2

3 EXECUTION 2

1.10 EQUIPMENT 2
1.11 PREPARATION 3
1.12 PILE DRIVING ANALYZER 3
1.13 FIELD MEASUREMENT 4
1.14 DRIVING 4
1.15 DESIGN LOAD CAPACITY 5
1.16 DRIVING TOLERANCES 6
1.17 OBSTRUCTIONS 6
1.18 LOAD TESTING 6
1.19 REPAIR/RESTORATION 6
1.20 PROTECTION 6

SECTION 02451
PILE FOUNDATIONS

1 GENERAL

1.1 SCOPE

.1 This Section covers the Work for pile foundations

1.2 RELATED SECTIONS

.1 Section 01330 – Submittals

.2 Section 02327 – Vibration Monitoring

.3 Section 02452 – Pile Tests

.4 Section 02459 – Steel H-Piles

1.3 REFERENCES

.1 Geotechnical Report prepared by Terraprobe, Ref No. 7-16-0090-01, "Geotechnical Investigation West Harbour Pumping Station and Associated Works, Hamilton, Ontario, November 2016"

1.4 DELIVERY, STORAGE AND HANDLING

.1 Protect piles from damage due to excessive bending stresses, impact, abrasion or other causes during delivery, storage and handling.

.2 Replace damaged piles as directed by Contract Administrator.

1.5 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with 01113 – Management and Disposal of Excess Material

.2 Collect and separate plastic, paper packaging, corrugated cardboard in accordance with Waste Management Plan.

1.6 EXISTING CONDITIONS

.1 Geotechnical Report prepared by Terraprobe, provides subsurface investigation details.

.2 Notify Contract Administrator in writing if subsurface conditions at site differ from those indicated and await further instructions from Contract Administrator.

1.7 SCHEDULING

.1 Submit schedule of planned sequence of driving to Contract Administrator for review, not less than two weeks prior to commencement of pile driving.

1.8 SUBMITTALS

.1 Submit WEAP analysis and pile test results in accordance with Section 01331 – Shop Drawing, Product Data and Samples.

2 PRODUCTS

1.9 MATERIALS

.1 Material requirements for piles are specified in Section 02459.

.2 Do not splice piles without written approval of Contract Administrator. When permitted, provide details for Contract Administrator review. Design details of splice to bear dated signature and stamp of professional engineer registered or licensed in Province of Ontario, Canada.

3 EXECUTION

1.10 EQUIPMENT

.1 General

.1 Prior to pile installation submit to Contract Administrator for review, details of equipment for installation of piles.

.2 Impact hammers: provide manufacturer's name, type, rated energy per blow at normal working rate, mass of striking parts of hammer, mass of driving cap and type and elastic properties of hammer and pile cushions.

.3 Non-impact methods of installation such as augering, jacking, vibratory hammers or other means: provide full details of characteristics necessary to evaluate performance.

.2 Hammer:

.1 Hammers to be selected on basis of driveability analysis using wave equation theory, performed to show that piles can be driven to levels indicated (i.e., WEAP analysis to be submitted for review, prior to driving piles).

.2 Driveability analysis to include, but not be limited to, following: hammer, cushion, and capblock details; static soil parameters; quake and damping factors, total soil resistance, blow count, pile stresses and energy throughput at representative penetrations.

.3 Submit driveability analysis to Contract Administrator for approval of hammer and set criteria.

.4 When required criteria cannot be achieved with the proposed hammer, use larger hammer and take other measures as required.

.3 Leads:

.1 Construct pile driver leads to provide free movement of hammer. Hold leads in position at top and bottom, with guys, stiff braces, or other means reviewed by Contract Administrator, to ensure support to pile while being driven.

.2 Length: provide sufficient length of leads to ensure that use of follower is unnecessary.

.4 Swing leads:

.1 Not permitted.

.5 Followers:

.1 Not permitted.

1.11 PREPARATION

.1 Ensure that ground conditions at pile locations are adequate to support pile driving operation and load testing operation. Make provision for access and support of piling equipment during performance of Work.

1.12 PILE DRIVING ANALYZER

.1 Use Pile Driving Analyser and Wave Equation Analysis to determine and confirm driving criteria such as hammer size and variation in impact, suitability of driving cap and cushions, and penetration resistance relative to set, on 3 piles which are to be selected/identified by the Contract Administrator.

.1 Perform CAPWAP analysis on one of the tested piles with test results submitted no later than one week following the testing.

.2 Work to be performed by geotechnical engineer registered or licensed in Province of Ontario, Canada.

.2 Carry out all PDA testing on restrike, 48 hours after initial set.

.3 Make allowance for probable interruption in driving for:

.1 Changing/modifying hammer, cap, cushions, or other equipment

.2 Replacing/adjusting of transducers and accelerometers;

.3 Assessing monitored results

.4 Replace/adjust hammer and modify cap, cushions, and other equipment, as required.

.5 Perform load test in accordance with Section 02452 - Pile Tests.

1.13 FIELD MEASUREMENT

.1 Maintain accurate records of driving for each pile, including:

.1 Type and make of hammer, stroke or related energy

.2 Other driving equipment including driving cap, cushion.

.3 Pile size and length, location of pile in pile group, location or designation of pile group

.4 Sequence of driving piles in group

.5 Number of blows per metre for entire length of pile, and number of blows per 12.5 mm for last 50 mm.

.6 Final tip and cut-off elevations.

.7 Other pertinent information such as interruption of continuous driving, pile damage.

.8 Record elevation taken on adjacent piles before and after driving of each pile.

.2 All measurements, observations and calculations associated with pile driving analyzer and wave equation analysis.

.3 Provide Contract Administrator with three copies of records.

1.14 DRIVING

.1 Use driving caps and cushions to protect piles. Reinforce pile heads as required to prevent damage. Piles with damaged heads as determined by Contract Administrator will be rejected.

.2 Hold piles securely and accurately in position while driving.

.3 Deliver hammer blows along axis of pile.

.4 Restrike all piles, to confirm permanence of set, no sooner than 48 hours after the previous set. If pile fails restrike, then redrive to design set, and restrike again 48 hours later. Repeat as required until set is sustained and pile meets set upon start of restrike.

.5 Remove loose and displaced material from around piles after completion of driving, and leave clean, solid surfaces to receive foundation concrete.

.6 Use of water jet:

.1 Not permitted.

.7 Cut off piles neatly and squarely at elevations as indicated to tolerance of plus or minus 25 mm. Provide sufficient length above cut-off elevation so that part damaged during driving is cut off.

.8 Remove cut-off lengths from site on completion of work.

1.15 DESIGN LOAD CAPACITY

.1 Design load (i.e., required capacity) of piles is as indicated on the drawings.

.2 Installation of each pile will be subject to review of Contract Administrator and Geotechnical Engineer.

.1 Contract Administrator will be sole judge of acceptability of each pile with respect to final driving resistance, depth of penetration or other criteria used to determine load capacity.

.2 Contract Administrator to approve final driving of all piles prior to removal of pile driving rig from site.

.3 Drive each pile to design set

.1 Determine required driving resistance from load test on a test pile as directed by Contract Administrator.

.4 Drive each pile to also reach bedrock.

.1 Do not overdrive to cause damage to piles in bedrock.

1.16 DRIVING TOLERANCES

.1 Pile heads to be within 75 mm of locations as indicated.

.2 Piles not to be more than 2% of length out of vertical alignment

1.17 OBSTRUCTIONS

.1 Where obstruction is encountered that causes sudden unexpected change in penetration resistance or deviation from specified tolerances, proceed as directed by Contract Administrator.

1.18 LOAD TESTING

.1 In accordance with Section 02452 - Pile Tests.

1.19 REPAIR/RESTORATION

.1 Remove rejected pile and replace with a new, and if necessary, a longer pile.

.2 No extra compensation will be made for removing and replacing or other work made necessary through rejection of defective piles.

1.20 PROTECTION

.1 Monitoring of the pile driving shall be according to the program submitted with the construction drawings/details and in accordance with the requirements of Section 02320 Pre-Construction Inspection and Building Elevation Monitoring..

.2 In addition to the requirements of Section 02320, the following requirements shall apply:

.1 Protect adjacent structures, services and work of other sections from hazards due to pile driving operations.

.2 All test results, observations and records shall be available on the site for review by the Contract Administrator.

.3 If vibrations from the piling approaches the allowable limit, the Contract Administrator shall be notified immediately and suitable measures shall be taken to ensure vibrations from the pile installation does not exceed the maximum peak particle velocities specified.

.4 Arrange sequencing of pile driving operations and methods to avoid damages to adjacent existing structures. When damages occur, remedy damaged items to restore to original or better condition at own expense.

END OF SECTION

SECTION 02452
PILE TESTS

1 GENERAL 1

1.1 REFERENCES 1

2 PRODUCTS 1

1.2 MATERIALS 1

3 EXECUTION 1

1.3 GENERAL 1
1.4 TESTING 2
1.5 TEST EVALUATION 2

SECTION 02452
PILE TESTS

1 GENERAL

1.1 REFERENCES

.1 All reference standards and related specifications shall be current issue or latest revision at the first date of tender advertisement.

.2 SPEC NOTE: Edit the following paragraphs to suit Project.

.3 American Society for Testing and Materials (ASTM)

.1 ASTM D4945, Standard Test Method for High-Strain Dynamic Testing of Piles.

2 PRODUCTS

1.2 MATERIALS

.1 Not Used.

3 EXECUTION

1.3 GENERAL

.1 Design load (i.e., required capacity) of piles is as indicated on the drawings.

.2 Two weeks before proceeding with preparatory work associated with test, provide Contract Administrator with outline of test method to be employed in accordance with ASTM D4945. Include drawings showing details of test set up.

.3 Supply and erect equipment and temporary structures necessary for making tests.

.4 Contract Administrator to identify 3 piles for testing during performance of Work.

.5 Carry out all PDA testing on restrike, 48 hours after initial set.

.6 Perform CAPWAP analysis on one of the tested piles with test results submitted no later than one week following the testing

.7 Contract Administrator will observe tests performed by contractor.

.8 Provide suitable shelter, enclosures and lighting to allow observation, testing and recording of data to proceed under adverse weather conditions and at night.

1.4 TESTING

.1 Do dynamic tests and prepare reports in accordance with ASTM D4945 except as specified.

.2 Remove all apparatus and equipment on completion of test.

1.5 TEST EVALUATION

.1 Qualified geotechnical engineer to interpret results for predicting pile performance and capacity.

.2 Carry out additional load tests as directed by Contract Administrator if pile fails to sustain test load.

.3 Test validity determined by Contract Administrator.

END OF SECTION

SECTION 02459
H-PILES

1 GENERAL 1

1.1 RELATED SECTIONS 1
1.2 REFERENCES 1
1.3 SHOP DRAWINGS 1
1.4 TEST REPORTS 2
1.5 WASTE MANAGEMENT AND DISPOSAL 2

2 PRODUCTS 2

1.6 MATERIALS 2

3 EXECUTION 2

1.7 INSTALLATION 2
1.8 WELDING 3

SECTION 02459
H-PILES

1 GENERAL

1.1 RELATED SECTIONS

.1 Section 01330 – Submittals.

.2 Section 02451 - Pile Foundations, General.

.3 Section 02452 - Pile Tests.

1.2 REFERENCES

.1 All reference standards and related specifications shall be current issue or latest revision at the first date of tender advertisement.

.2 Canadian Standards Association (CSA)

.1 CSA W47.1, Certification of Companies for Fusion Welding of Steel Structures.

.2 CSA W47.1S1, Supplement No.1-M1989 to W47.1-1983, Certification of Companies for Fusion Welding of Steel Structures.

.3 CSA W48.1, Carbon Steel Covered Electrodes for Shielded Metal Arc Welding Withdrawn replaced by CSA W48, (Developed in cooperation with the Canadian Welding Bureau

.4 CSA W48, Filler Metals and Allied Materials for Metal Arc Welding.

.5 CSA W59, Welded Steel Construction (Metal Arc Welding) (Metric Version)

.6 CSA W59S1, Supplement No.1-M1989, Steel Fixed Offshore Structures to W59-M1989, Welded Steel Construction (Metal Arc Welding).

.7 CSA-G40.20/G40.21, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steels.

1.3 SHOP DRAWINGS

.1 Submit shop drawings in accordance with Section 01330 – Submittals.

.2 Indicate: pile shoes, splice detail

.3 Each drawing submitted shall bear the signature and stamp of qualified professional engineer registered or licensed in Province of Ontario, Canada.

1.4 TEST REPORTS

.1 Furnish mill test reports indicating yield and chemical analysis of steel piles if requested by Contract Administrator.

1.5 WASTE MANAGEMENT AND DISPOSAL

.1 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard, packaging material for recycling in accordance with Waste Management Plan.

.2 Place materials defined as hazardous or toxic in designated containers.

.3 Divert unused metal materials from landfill to metal recycling facility as approved by Contract Administrator

.4 Fold up metal banding, flatten and place in designated area for recycling.

2 PRODUCTS

1.6 MATERIALS

.1 Steel H piles: to CSA-G40.20/G40.21, Type and Grade 350W. Size and weight as specified.

.2 Welding materials: to CSA W48.

.3 Steel plates: to CSA-G40.20/G40.21, Type and grade 350W.

.4 Pile driving shoes: Titus Bearing Points or approved equivalent.

3 EXECUTION

1.7 INSTALLATION

.1 Install piling in accordance with Section 02451 - Pile Foundations, General.

.2 Provide driving shoes for all piles.

.3 Splice pile extensions, to details on reviewed shop drawings, by using splice plates or butt-welded splices.

.1 Align extension with driven pile when splicing.

.2 Provide full bearing of spliced parts for butt-welded construction.

.4 Cut off piles squarely at required elevation.

1.8 WELDING

.1 Weld to CSA W59 and CSA W59S1.

.2 Welding certification of companies: to CSA W47.1 and CSA W47.1S1.

END OF SECTION

SECTION 02460
HELICAL PILE FOUNDATION

1 GENERAL 1

2 APPROVED HELICAL PILE MANUFACTURER 1

3 SUBMITTALS 2

4 MATERIALS 3

4.1 HELICAL PILES 3
4.2 CORROSION PROTECTION 4
4.3 GROUTING MATERIAL 4

5 EXAMINATION AND ACCEPTANCE OF SITE CONDITION 4

6 INSTALLATION 5

7 PRE-PRODUCTION LOAD TEST 5

8 PRODUCTION LOAD TEST 7

9 FIELD QUALITY CONTROL 8

10 MEASUREMENT AND PAYMENT 8

SECTION 02460
HELICAL PILE FOUNDATION

1 GENERAL

1.1 The work covered by this section includes the furnishing of all labor, materials, and equipment for the construction of the helical piles as specified within the Contract Documents.

2 HELICAL PILE MANUFACTURER

2.1 The request must include all the following information to be considered:

2.1.1 Documentation of at least five (5) years of production experience manufacturing helical piles,

2.1.2 Documentation that the manufacturer's helical piles have been used successfully in at least five engineered construction projects within the last three years,

2.1.3 Documentation that the helical pile manufacturer has a current Evaluation Report completed by Canadian Construction Materials Center (CCMC),

2.1.4 Certificate that the helical pile components shall be manufactured by a facility whose quality systems comply with ISO (International Organization of Standards) 9001 requirements, and

2.1.5 Documentation that the helical pile components shall be hot-dipped galvanized in accordance with ASTM A153

2.1.6 Design drawings sealed by a professional engineer of Ontario stating the proposed helical pile and associated geotechnical resistance factor. It is recommended that the geotechnical resistance factor be taken from the most recent version of the Canadian Foundation Engineering manual.

2.1.7 Documentation that all materials meet the requirements specified elsewhere within the contract documents.

2.2 Helical Pile Installer Qualifications

2.2.1 Installation shall be completed by a contractor who is approved and certified to install the manufacturer's material.

3 SUBMITTALS

3.1 In accordance with the General Conditions of the Contract and Division 1 Submittal Procedures Section.

3.2 One (1) set of site specific shop drawings sealed by a registered Professional Engineer in the province of Ontario. Shop drawings shall include:

a. Helical Pile number, location, and pattern by assigned identification number

b. Helical Pile design load

c. Assumed geotechnical resistance factor

d. Type and Size of Helical Pile shaft

e. Helical configuration (number and diameter of helical plates)

f. Minimum effective torque requirement

g. Grout column diameter and length

h. Connection details

3.3 Calibration reports for installation equipment utilized on the project. The calibration tests shall have been completed within one year of the date submitted.

3.4 The Contractor shall submit plans for pre-production test(s) for the helical piles to the Owner for review and acceptance prior to beginning load tests, as specified elsewhere within this specification. The purpose of the test is to determine the load versus displacement response of the helical pile in general conformance with ASTM D1143 Quick Test Method and provide an estimation of ultimate capacity.

3.5 After completion of the test(s) piles the Contractor shall submit the results to the Owner for approval to begin production helical pile installation.

3.6 After completion of the installation of the helical piles, the Contractor shall provide the Owner with a report of all helical piles installed on the project certifying the ultimate load capacity of the piles installed, sealed by a Professional Engineer registered in the province of Ontario.

4 MATERIALS

4.1 Helical Piles

4.1.1 Helical pile should consist of at least one helix-shaped steel bearing plate attached to central steel shaft.

4.1.2 Helix plates should be high strength steel (150mm to 400mm in Dia and 50mm thick)

4.1.3 Each helix should be formed into a screw thread with a 75mm pitch.

SIZE	TYPE	WALL THICKNESS	MATERIAL	TORQUE STRENGTH	YIELD STRENGTH
Mm		mm		N-m	Mpa
38x38	Solid Square		Hot rolled Round-Cornered-Square solid steel bars meeting dimensional and workmanship of ASTM A29.	7730	483
44x44	Solid Square		Hot rolled Round-Cornered-Square solid steel bars meeting dimensional and workmanship of ASTM A29	14900	621
73	Circular	5.2	Structural Steel Tube or Pipe, welded or seamless with ASTM A500 or A618.	7500	345
89	Circular	7.6	Structural Steel Tube or Pipe, welded or seamless with ASTM A500 or A618.	17600	345

4.2 **Corrosion Protection**

4.2.1 All helical pile shafts and helices shall be hot-dipped galvanized in accordance with ASTM A153 after fabrication.

4.3 **Grouting Material**

4.3.1 Cement for Helical Pulldown grout shall be Type G Portland cement conforming to CSA A3000 Cementitious Material Compendium.

4.3.2 Water for mixing grout shall be potable, clean and free from impurities, which may be detrimental to grout or steel. Potable water shall be available in quantities sufficient to mix grout and for equipment clean-up.

4.3.3 Sand fillers may be used in the grout mix as an extender with large diameter grout columns, subject to the approval of the engineer. Use fine sand only. Medium or coarse sand not be permitted. Small diameter grout columns shall not include aggregate.

5 EXAMINATION AND ACCEPTANCE OF SITE CONDITIONS

5.1 General Contractor shall inspect, accept and certify in writing to the helical pile subcontractor that site conditions meet specifications for the following items prior to installation of the helical piles;

5.1.1 Verify sub-grade preparation and elevations conform to the specified requirement.

5.1.2 Verify location, alignment, and elevations of helical piles.

5.1.3 Verify location, alignment, and elevations of any services within work area.

5.1.4 The General Contractor shall verify that all helical piles may be installed in accordance with all pertinent codes and regulations regarding such items as underground obstructions, right-of-way limitations, utilities, etc.

5.1.5 In the event of a discrepancy, the General Contractor shall notify the Owner. The General Contractor shall not proceed with helical pile installation in areas of discrepancies until said discrepancies have been resolved. All costs associated with unresolved discrepancies shall be the responsibility of the Owner.

5.1.6 Do not proceed with installation of helical piles until sub-grade soil conditions are corrected by the General Contractor.

6 INSTALLATION

6.1 A torque indicator shall be used during helical pile installation. The torque indicator can be an integral part of the installation equipment or externally mounted in-line with the installation tooling. Torque indicators shall meet requirements set forth by helical pile manufacturer.

6.2 If the helical pile is refused or deflected by a subsurface obstruction, the installation shall be terminated, and the pile removed. The obstruction shall be removed, if feasible, and the helical pile re-installed. If the obstruction cannot be removed, the helical pile shall be installed at an adjacent location, subject to review and acceptance of the owner.

6.3 If the torsional strength rating of the central steel shaft and/or installation equipment has been reached prior to proper positioning of the last plain extension section relative to the final elevation, the contractor may remove the last plain extension and replace it with a shorter length extension. If it is not feasible to remove the last plain extension, the Contractor may cut said extension shaft to the correct elevation. The Contractor shall not reverse (back-out) the helical pile to facilitate extension removal.

6.4 The Contractor shall record the torque values for each individual helical pile at 300mm (1 foot) increments during installation. These records shall be available to the Owner at their request.

7 PRE-PRODUCTION LOAD TEST

7.1 Perform the load test in compression as described below. The tests shall be completed according to ASTM D1143 Quick Test Method.

7.2 Determine the depth to the target stratum of soil from the geotechnical site investigation report that includes boring logs. Use these data to select a pile design capacity, ultimate capacity and estimate the installation torque at the target stratum and depth.

7.3 Set the spacing and install the four reaction anchors at the test site. The recommended spacing between the test pile and the reaction anchors is at least 5D, where D = diameter of the largest helical plate. For tension only tests, the reaction anchors are not required.

7.4 Install the test helical pile at the centroid of the reaction anchors to the target depth and torque resistance. For tension tests, install the test anchor at the desired location to the target depth and torque resistance.

7.5 Mount the two anchor beams on the four reaction piles and the reaction beam between the anchor beams. For tension tests, center the reaction beam over the anchor and support each end of the beam on cribbing or dunnage. The helical reaction piles are not required if the surface soils have sufficient bearing strength to support the cribbing/dunnage under the applied loading without excessive deflections.

7.6 Install a load cell, hydraulic load jack, actuator and pressure gauge. The center hole load jack will be mounted below the reaction beam for a bearing test. A solid core hydraulic jack can be used for compression tests.

7.7 Set the displacement measuring devices. Deflection measuring devices can include analog dial or electronic digital gauges (must be accurate to .001") mounted on an independent reference beam, a transit level surveying system, or other types of devices as may be specified by the engineer.

7.8 Apply and record a small alignment or seating load, usually 5% to 10% of the design load. Unless otherwise defined, the ultimate test load shall be assumed equal to 200% of the design load. Hold the seating load constant for 10 minutes or until no further displacement is measured.

7.9 Set the displacement measuring device(s) to zero.

7.10 Axial compression load tests shall be conducted by loading the helical pile in step-wise fashion as shown in Table 1 to the extent practical. Pile head displacement shall be recorded at the beginning of each step and after the end of the hold time. The beginning of the hold time shall be defined as the moment when the load equipment achieves the required load step. There is a generalized form for recording the applied load, hold periods, and pile head deflections provided at the end of this Section.

7.11 Test loads shall be applied until continuous jacking is required to maintain the load step or until the test load increment equals 200% of the design load (i.e., 2.0 x DL), whichever occurs first. The observation period for this last load increment shall be 10 minutes or as otherwise specified. Displacement readings shall be recorded at 1, 2, 3, 4, 5 and 10 minutes.

7.12 The applied test load shall be removed in four approximately equal decrements per the schedule in Table 1. The hold time for these load decrements shall be 1 minute, except for the last decrement, which shall be held for 5 minutes.

7.13 Tested helical piles shall not exceed 25 mm of total movement when loaded to ULS capacity, and no more than 40 mm total movement when loaded to ultimate resistance capacity.

PRE-PRODUCTION TEST SCHEDULE	
Load Increment	Hold Period (Min.)
AL	1.0
0.50DL	4.0
1.00DL	4.0
1.20DL	4.0
1.40DL	4.0
1.60DL	4.0
1.80DL	4.0
2.00DL	10.0
1.50DL	4.0
1.00DL	4.0
0.50DL	4.0
AL	5.0
AL = Alignment Load, usually 10% of DL; DL = Design (Working) Load	

TABLE 1

8 PRODUCTION LOAD TEST

8.1 Follow the test setup procedures listed under Pre-Production Load Test Procedures (Items 1 through 8), except the maximum test load to be applied to the pile is the Design Load (DL).

8.2 The Contractor shall perform axial load tests on the number and location of helical piles as specified by the Owner. At the Contractor's suggestion, but with the Owner's permission, compression test may be performed up to 1.00 DL for helical piles with sufficient structural capacity.

8.3 Axial compression or tension load tests shall be conducted by loading the helical pile in the load sequence as shown in Table 2. Pile head displacement shall be recorded at the beginning of each step and after the end of the hold time. The beginning of the hold time shall be defined as the moment when the load equipment achieves the required load step. The observation period for this last load increment shall be 5 minutes or as otherwise specified. Displacement readings shall be recorded at 0.5, 1, 2, 3, 4, and 5 minutes.

8.4 The applied test load shall be removed in four approximately equal decrements per the schedule in Table 2. The hold time for these load decrements shall be 1 minute, except for the last decrement, which shall be held for 5 minutes.

PRODUCTION TEST SCHEDULE	
LOAD INCREMENT	HOLD PERIOD (MIN.)
AL	0
0.20 DL	4.0
0.40 DL	4.0
0.60 DL	4.0
0.80 DL	4.0
1.00 DL	5.0
0.60 DL	1.0
0.40 DL	1.0
0.20 DL	1.0
AL	5.0
AL = Alignment Load, usually 10 of DL. DL = Design (Working) Load	

TABLE 2

9 FIELD QUALITY CONTROL

9.1 Centerline of helical pile shall not be more than 75 mm (3 inches) from indicated plan location.

9.2 Helical pile plumbness shall be within 2° of design alignment

9.3 Top elevation of helical pile shall be within ±50mm (2 inches) of the design vertical elevation.

10 MEASUREMENT AND PAYMENT

Measurement for payment shall be as follows:

QUANTITY	DESCRIPTION	UNIT
6	Mobilization	Lump Sum
1	Pre-Production test in compression	Each
1	Helical Piles to a depth of (15) meters per pile	Lump Sum
As required	Per each additional 1.5 m (5 foot) extension or portion thereof	Each

Payment at the Contract price for the above tender items shall be full compensation for all labor, Equipment, and Material to do the work.

END OF SPECIFICATION

SECTION 02505
GRANULAR BASE COARSE

PART 1 GENERAL

1.01 GENERAL REQUIREMENTS

A. General Conditions, Supplementary Conditions and Division 01 apply to this Section.

1.02 SECTION INCLUDES

A. Construction of granular base

B. Construction of full depth asphalt base

1.03 RELATED SECTIONS

A. Section 02100 - Site Preparation

B. Section 02200 - Earthwork

C. Section 02223 - Excavation, Backfill and Compaction for Pavement

D. Section 02227 - Aggregate Materials

E. Section 02245 - Soil Stabilization

F. Section 02511 - Asphaltic Concrete Paving

G. Section 02520 - Portland Cement Concrete Paving

H. Section 02525 - Curbs and Sidewalks

I. Section 02900 - Landscaping

1.04 REFERENCES

A. Not Used.

PART 2 PRODUCTS

2.01 FILL MATERIALS

A. Submit materials certificate to on-site independent testing laboratory which is signed by material producer and Contractor, certifying that materials comply with, or exceed, the requirements herein.

PART 3 EXECUTION

3.01 EXAMINATION

A. Contractor shall verify that the subgrade has been inspected, tested and the gradients and elevations are correct, dry and properly prepared.

3.02 CONSTRUCTION

A. Perform base course construction in a manner that will drain surface properly at all times and at the same time prevent runoff from adjacent areas from draining onto base course construction. Paving base course tolerances shall be not more than 15 mm above design elevation which will allow for paving thicknesses as shown in the Drawings.

B. Compact base material to not less than 100% SPMDD, unless otherwise indicated on the Drawings.

C. Granular Base: Construct to thickness indicated on Drawings. Apply in lifts or layers not exceeding 200 mm, measured loose.

3.03 QUALITY ASSURANCE

A. An independent testing laboratory, selected and paid by Owner, shall be retained to perform construction testing of in-place base courses for compliance with requirements for compaction and density.

B. The following minimum tests shall be performed on each type of material used as base course material:

1. Moisture and Density Relationship: ASTM D 698 or ASTM D 1557.
2. Mechanical Analysis: AASHTO T-88.
3. Plasticity Index: ASTM D-4318.
4. Base material thickness: Perform one test for each 950 square metres of in-place base material area in parking areas and one every 50 linear meters within roadways.
5. Base material compaction: Perform one test in each lift for each 950 square metres of in-place base material area in parking areas and one every 50 linear meters within roadways.
6. Test each source of base material for compliance with Specifications.

C. Field density tests for in-place materials shall be performed according to one of the following standards as part of construction testing requirements:

1. Nuclear Method: ASTM D 2922, Method B (Direct Transmission).

D. Independent testing laboratory shall prepare test reports that indicate test location, elevation data, and test results. The Owner, Sitework Engineer of Record and Contractor shall be provided with copies of reports. In event that any test performed fails to meet these Specifications, the Owner, Sitework Engineer of Record and Contractor shall be notified immediately by independent testing laboratory. The Owner reserves right to employ independent testing laboratory and to direct any testing that is deemed by them to be necessary. Contractor shall Provide free access to site for testing activities.

Costs related to retesting due to failure shall be paid for by Contractor at no additional expense to Owner.

3.04 TRANSPORTATION

A. Off-site materials shall be transported to the Project using well maintained and operating vehicles. Once on the job site, all transporting vehicles shall stay on designated haul roads and shall at no time endanger any of the improvements by rutting, overloading or pumping the haul road.

END OF SECTION

SECTION 02511
ASPHALTIC CONCRETE PAVING

PART 1 GENERAL

1.01 GENERAL REQUIREMENTS

A. General Conditions, Supplementary Conditions and Division 01 apply to this Section.

1.02 SECTION INCLUDES

A. Asphaltic concrete paving; surface course, binder course and base course.

1.03 RELATED SECTIONS

A. Section 02223 – Excavation, Backfill and Compacting for

B. Pavement Section 02505 – Granular Base Course

C. Section 02525 – Curbs and Sidewalks

D. Section 02584 – Pavement Markings

1.04 SUBMITTALS

A. Mix Design: Before any asphaltic concrete paving is constructed, submit actual mix design to the Owner for review and/or approval. Design mix submittal shall follow the format as indicated in the Asphalt Institute Manual MS-2, Marshall Stability Method; and shall include the type/name of the mix, gradation analysis, grade of asphalt cement used, Marshall Stability (lbs.), flow, and effective asphalt content (percent), for each material. The design shall be for a mixture listed in the current edition of the Specifications.

B. Material Certificates: Submit materials certificate to on-site independent testing laboratory which is signed by material producer and Contractor, certifying that materials comply with, or exceed, the requirements herein.

1.05 A. PROJECT CONDITIONS

Weather Limitations:

1. Apply prime and tack coats when ambient temperature is above 4.5 degrees Celsius, and when temperature has been above 2 degrees Celsius for 12 hours immediately prior to application. Do not apply when base is wet, contains excess moisture, or during rain.
2. Construct asphaltic concrete base course paving when atmospheric temperature is above 2.0 degrees Celsius.
3. Construct asphaltic concrete surface course paving when atmospheric temperature is above 7.0 degrees Celsius.

B. **PAVING** Construction Limitations:

1. Due to Work by others, it may be necessary to construct portions of Work in phases. The Contractor shall allow for mobilization of his forces to complete top coat asphalt in a minimum of two phases.

1.06 REFERENCES

A. MS-2-Mix design methods for asphaltic concrete and other hot mixes per Asphalt Institute (AI)

B. MS-3-Asphalt Plant Manual per The Asphalt Institute (AI)

C. Hot Mix Asphalt Paving Handbook per US Army Corp of Engineers, UN-13 (CE MP-ET)

D. MS-19-Basic Asphalt Emulsion Manual per The Asphalt Institute (AI)

E. ASTM D946 - Penetration - Graded Asphalt Cement for use in Pavement Construction AASHTO

F. M-226/ASTM D3381 Asphalt Cement

G. AASHTO M-140/ASTM D997 or AASHTO M-208/ASTM D-2397 Tack Coat

H. AASHTO M-117/ASTM D242 Mineral Filler

I. AASHTO T-245/ASTM D1559 Marshall Mix Design

PART 2 PRODUCTS

2.01 MATERIALS

A. Provide asphalt-aggregate mixture as recommended by local authorities to suit Project conditions. Use locally available materials and gradations which meet local authority requirements and exhibit satisfactory records of previous installations.

B. Asphalt cement: Comply with requirements of municipality.

C. Tack coat: Emulsified asphalt; AASHTO M-140/ASTM D 997 or AASHTO M 208/ASTM D 2397, SS-1h, CSS-1, or CSS-1h, diluted with one part water to one part emulsified asphalt.

D. Rubberized asphalt sealant: ASTM-D6690-7/ AASHTO M-173.

E. Mineral filler: Rock or slag dust, hydraulic cement, or other inert material complying with AASHTO M-17/ASTM D 242, if recommended by applicable highway standards.

F. Asphalt-aggregate mixture: Unless otherwise noted on the Drawings, the design mix shall have a minimum stability based on a 50-blow Marshall complying with ASTM D 1559 of 1000 lb with a flow between 8 and 16.

G. Percent bitumen by weight of total mix: 5.0
- 8.5. Air voids: 3-6%

H. Percent aggregate voids filled with asphalt cement: 70 - 82%.
Allowable variance of percent bitumen by weight of total mix = 0.4, or as otherwise specified.

2.02 EQUIPMENT

A. Maintain Construction Equipment in satisfactory operating condition and correct breakdowns in a manner that will not delay or be detrimental to progress of paving operations.

PART 3 EXECUTION

3.01 PREPARATION

A. Proof roll prepared granular base material surface to check for areas requiring additional compaction and areas requiring removal and re-compaction.

B. Do not begin paving Work until deficient base material areas have been corrected and are ready to receive paving.

C. Remove loose material from compacted base asphalt material surface immediately before applying tack coat.

3.02 APPLICATIONS

A. Tack Coat:

1. Apply to contact surfaces of previously constructed asphaltic concrete base courses or portland cement concrete and surfaces abutting or projecting into asphaltic concrete or into asphaltic concrete pavement.
2. Apply tack coat to asphaltic concrete base course or sand asphalt base course. Apply emulsified asphalt tack coat between each lift or layer of full depth asphaltic concrete and sand asphalt bases and on surface of all such bases where asphaltic concrete paving will be constructed.
3. Apply emulsified asphalt tack coat in accordance with APWA Section 2204 or latest amendment.
4. Apply at minimum rate of 0.25 litres per square metre of surface.
5. Allow to dry until at proper condition to receive paving.

3.03 ASPHALTIC CONCRETE PLACEMENT

A. Place asphaltic concrete mixture on completed compacted subgrade surface, spread, and strike off. Spread mixture at following minimum temperatures or as otherwise specified:

1. When ambient temperature is between 2.0 degrees Celsius and 10 degrees Celsius, mixture temp. = 149 degrees Celsius
2. When ambient temperature is between 10 degrees Celsius and 15 degrees Celsius, mixture temp. = 146 degrees Celsius

3. When ambient temperature is between 15 degrees Celsius and 32 degrees Celsius, mixture temp. = 141 – 132 degrees Celsius

B. Whenever possible, all pavements shall be spread by a finishing machine; however, inaccessible or irregular areas may be placed by hand methods. The hot mixture shall be spread uniformly to the required depth with hot shovels and rakes. After spreading, the hot mixture shall be carefully smoothed to remove all segregated course aggregate and rake marks. Rakes and lutes used for hand spreading shall be of the type designed for use on asphalt mixtures. Loads shall not be dumped faster that they can be properly spread. Workers shall not stand on the loose mixture while spreading.

C. Paving machine placement: Apply successive lifts of asphaltic concrete in transverse directions with the surface course placed in the direction of surface-water flow. Place in typical strips not less than 3.0 m wide.

D. Joints: Make joints between old and new pavements or between successive days and Work in a manner that will Provide a continuous bond between adjoining Work. Construction joints shall have same texture, density, and smoothness as other sections of asphaltic concrete course. Clean contact surfaces of all joints and apply tack coat.

E. The Contractor shall be responsible for providing machined, sealed joints in all areas of existing asphalt. These joints are mandatory and must be completed as per the detail provided. If the Contractor is negligent in construction of this item, the asphalt will be replaced at the Contractor's expense.

3.04 ROLLING AND COMPACTION

A. The mixture, after being spread, shall be thoroughly compacted by rolling as soon as it will bear the weight of the rollers without undue displacement. The number, weight, and types of rollers and sequences of rolling operations shall be such that the required density and surface are consistently attained while the mixture is in a workable condition.

B. Compact mixture with hot hand tampers or vibrating plate compactors in areas inaccessible to rollers.

C. Breakdown rolling: Accomplish breakdown or initial rolling immediately following rolling of joints and outside edge. Check surface after breakdown rolling, and repair displaced areas by loosening and filling with hot material.

D. Second rolling: Follow breakdown rolling as soon as possible, while mixture is hot. Continue second rolling until mixture has been thoroughly compacted.

E. Finish rolling: Perform finish rolling while mixture is still warm enough for removal of roller marks. Continue rolling until roller marks are eliminated and course has attained maximum density.

F. Patching: Remove and replace paving areas mixed with foreign materials and defective areas. Cut out such areas and fill with fresh, hot asphaltic concrete. Compact by rolling to maximum surface density and smoothness.

G. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

3.05 FIELD QUALITY CONTROL

A. Independent testing laboratory, selected and paid by Owner, shall be retained to perform construction testing of in-place asphaltic concrete courses for compliance with requirements for thickness, compaction and surface smoothness. Asphaltic surface and base courses shall be randomly cored at a minimum rate of one core for every 1,850 square metres of paving. However, no less than three cores in light duty areas and three cores in heavy duty areas shall be obtained. Coring holes shall be immediately filled with full-depth asphalt or with concrete. Asphaltic concrete pavement Samples shall be tested for conformance with the mix design.

B. Grade control: Establish and maintain required lines and elevations specified on the Drawings. Areas of deficient paving thickness shall receive a tack coat and a minimum 25 mm overlay; or shall be removed and replaced to the proper thickness, at the discretion of the Owner; until specified thickness of the course is met or exceeded at no additional expense to the Owner.

C. Surface smoothness: Testing shall be performed on the finished surface of each asphalt concrete course for smoothness, using 3.0 m straightedge applied parallel with, and at right angles to centre line of paved area. The results of these tests shall be made available to the Owner upon request. Surfaces will not be acceptable if the following 3.0 m straightedge tolerances for smoothness are exceeded.

1. Base Course Surface: 6 mm
2. Wearing Course Surface: 5 mm

D. Check surface areas at intervals necessary to eliminate ponding areas. Remove and replace unacceptable paving as directed by Owner.

E. Compaction: Field density test for in place materials shall be performed by examination of field cores in accordance with one of the following standards, and shall meet or exceed the Marshall Density specified in the geotechnical recommendations:

1. Bulk specific gravity of paraffin-coated specimens: ASTM D-1188.
2. Bulk specific gravity using saturated surface-dry specimens: ASTM D-2726.
3. Rate of testing shall be one core per 1,850 square metres of pavement, with a minimum of 3 cores from heavy-duty areas and 3 cores from standard-duty areas. Cores shall be cut from areas representative of the Project.
4. Areas of insufficient compaction shall be delineated, removed, and replaced in compliance with the Specifications at no expense to the Owner.

3.06 TRANSPORTATION

A. Off-site materials shall be transported to the Project using well maintained and operating vehicles. Once on the job site, all transporting vehicles shall stay on designated haul roads and shall at no time endanger any of the improvements by rutting, overloading or pumping the haul road.

END OF SECTION

SECTION 02525
CURBS AND SIDEWALKS

PART 1 GENERAL

1.01 GENERAL REQUIREMENTS

A. General Conditions, Supplementary Conditions and Division 01 apply to this Section.

1.02 SECTION INCLUDES

A. Combination concrete curb and gutter

B. Concrete curb

C. Concrete sidewalk

1.03 RELATED SECTIONS

A. Section 02100 - Site Preparation

B. Section 02227 - Aggregate Material

C. Section 02505 - Granular Base Course

D. Section 02584 - Pavement Markings

1.04 REFERENCES

A. American Concrete Institute (ACI) latest edition.

1. 304R Recommended Practice for Measuring, Mixing, Transporting, and Placing Concrete
2. 308 Standard Practice for Curing Concrete

B. CSA A23-04 – Concrete materials and methods of concrete construction/methods of test and standard practice for concrete.

C. American Society for Testing and Materials (ASTM) latest edition.

1. A 615 Deformed and Plain Billet-Steel for Concrete Reinforcement
2. C 33 Concrete Aggregates
3. C 94 Ready-Mixed Concrete
4. C 150 Portland Cement

5. C 260 Air-Entraining Admixtures for Concrete

6. C 309 Liquid Membrane-Forming Compounds for Curing Concrete

7. C 494 Chemical Admixtures for Concrete

8. D 1751Performed Expansion Joint Fillers for Concrete Paving and Structural Construction Nonextruding and Resilent Bitumious Types)

1.05 PERFORMANCE REQUIREMENTS

A. Contractor shall maintain access for vehicular and pedestrian traffic as required for other construction activities. Utilize temporary striping, flagmen, barricades, warning signs, and warning lights as required.

1.06 PROJECT CONDITIONS

A. All curbs, as shown on the grading plan, are to be priced within the site Work portion of the Contract including/excluding curbs surrounding the proposed building. Concrete islands and sidewalks not abutting the building walls are also to be included within the site Work portion of this Contract. All concrete features including but not limited to concrete aprons, concrete pads, monolithic sidewalks and curbs abutting the building walls are not to be priced within the site Work portion of this Contract as they are deemed to be included in the "building package".

PART 2 PRODUCTS

2.01 MATERIALS

A. Unless otherwise specified in the Contract Documents.

1. Forms: Steel, wood, or other suitable material of size and strength to resist movement during concrete placement and to retain horizontal and vertical alignment until removal. Use straight forms, free of distortion and defects. Use flexible spring steel forms or laminated boards to form radius bends as required. The forms shall be of a depth equal to the depth of curbing or sidewalk, and so designed as to permit secure fastening together at the tops. Coat forms with nonstaining type coating that will not discolour or deface surface of concrete.

2. Joint fillers: Resilient premolded bituminous impregnated fiberboard units complying with ASTM D 1751 FS HH-F-341, Type II, Class A; or AASHTO M 153, Type I.

3. Joint sealers: Non-priming, pourable, self-leveling polyurethane. Acceptable sealants are Sonneborn "Sonolastic Paving Joint Seal-ant", Sonneborn "Sonomeric CT 1 Sealant", Sonneborn "Sonomeric CT 2 Sealant", Mameco "Vulken 45", or Woodmont Products "Chem-Caulk".

4. Reinforcing bars: Deformed steel bars, ASTM, A 615, Grade 40.

2.02 MIX DESIGN AND TESTING

A. Design mix to produce normal weight concrete consisting of Portland cement, approved supplementary cementing materials, aggregate, water-reducing admixture, air-entraining admixture, and water to produce the following properties:

1. Compressive strength: 32 MPA, minimum at 28 days, unless otherwise indicated on the Drawings or Specifications.

2. Slump range curbs: maximum of 60 mm at time of placement.

3. Slump range sidewalks: 80 mm +/- 20 mm at time of placement.

4. Air entrainment: 5% to 8%.

PART 3 EXECUTION

3.01 PREPARATION

A. Proof-roll prepared base material surface to check for unstable areas. The paving Work shall begin after any unsuitable areas have been corrected and are ready to receive paving. Compaction testing for the base material shall be completed prior to the placement of the paving.

B. Surface preparation: Remove loose material from compacted base material surface to produce a firm, smooth surface immediately before placing concrete.

3.02 INSTALLATION

A. Form construction:

1. Set forms to the required grades and lines, rigidly braced and secured.

2. Install sufficient quantity of forms to allow continuance of Work and so that forms remain in place a minimum of 24 hours after concrete placement.

3. Check completed formwork for grade and alignment to following tolerances:

a) Top of forms not more than 3 mm in 3.0 m.

b) Vertical face on longitudinal axis, not more than 6 mm in 3.0 m.

4. Clean forms after each use, and coat with form release agent as often as required to ensure separation from concrete without damage.

B. Concrete placement:

1. Do not place concrete until base material and forms have been checked for line and grade. Moisten base material if required to Provide uniform dampened condition at time concrete is placed. Concrete shall not be placed around manholes or other structures until they are at the required finish elevation and alignment.

2. Place concrete using methods which prevent segregation of mix. Consolidate concrete along face of forms and adjacent to transverse joints with internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Consolidate with care to prevent dislocation of dowels, and joint devices.

3. Deposit and spread concrete in continuous operation between transverse joints, as far as possible. If interrupted for more than 1/2 hour, place construction joint. Automatic machine may be used for curb and gutter placement at Contractor's option. Machine placement must produce curbs and gutters to required cross section, lines, grades, finish, and jointing as specified for formed concrete. When the machine placement option is utilized, the granular base must be graded to within 30mm of the underside of curb prior to curb installation commencement. If results are not acceptable, remove and replace with formed concrete as specified.

C. Joint construction:

1. Contraction joints: Concrete curb, concrete gutter or concrete curb and gutter, where specified on the plans, shall be constructed in uniform sections of the length specified on the plans. The joints between sections shall be formed either by steel templates 3.0 mm in thickness, of a length equal to the width of the gutter and/or curb, and with a depth which will penetrate at least 50 mm below the surface of the curb and/or gutter; or with 19 mm thick preformed expansion joint filler cut to the exact cross section of the curb and/or gutter; or by sawing to a depth of at least 50 mm while the concrete is between 4 to 24 hours old. If steel templates are used, they shall be left in place until the concrete has set sufficiently to hold its shape, but shall be removed while the forms are still in place.

2. Longitudinal construction joints: Concrete curb, concrete gutter or combination concrete curb and gutter, where specified on the plans, shall be tied to concrete pavement with 15 mm round deformed reinforcement bars of the length and spacing shown on the plans.

3. Transverse expansion joints: Transverse expansion joint in curb, curb and gutter, gutter or sidewalk shall have the filler cut to the exact cross section of the curb, curb and gutter, gutter or sidewalk. The joints shall be similar to the type of expansion joint used in the adjacent pavement.

D. Joint fillers: Extend joint fillers full-width and depth of joint, and not less than 13 mm or more than 25 mm below finished surface where joint sealer is indicated. Furnish joint fillers in one-piece lengths for full width being placed, wherever possible. Where more than one length is required, lace or clip joint filler sections together.

E. Joint sealants: All joints shall be sealed with approved exterior pavement joint sealants and shall be installed per manufacturer's recommendations.

3.03 CONCRETE FINISHING

A. After striking off and consolidating concrete, smooth surface by screeding and floating. Adjust floating to compact surface and produce uniform texture. After floating, test surface for trueness with 3.0 m straightedge. Distribute concrete as required to remove surface irregularities, and refloat repaired areas to Provide continuous smooth finish.

B. Work edges of sidewalks, gutters, back top edge of integral curb, and formed joints with an edging tool, and round to 13 mm radius. Eliminate tool marks on concrete surface. After completion of floating and trowelling when excess moisture or surface sheen has disappeared, complete surface finishing, as follows:

1. Inclined slab surfaces: Provide coarse, nonslip finish by scoring surface with stiff-bristled broom perpendicular to line of traffic.

2. Curbs, gutters, and walks: Broom finish by drawing fine-hair broom across surface perpendicular to line of traffic. Repeat operation as necessary to produce a fine line texture.

C. Do not remove forms for 24 hours after concrete has been placed. After form removal, clean ends of joints and point up any minor honeycombed areas. Remove and replace areas or sections with major defects, as directed.

D. Protect and cure finished concrete paving using acceptable moist-curing methods, more particularly described in the "water-curing" section of ACI 308 or approved curing compound.

3.04 BACKFILL

A. After the concrete has set sufficiently, the spaces in front and back of the curb and gutter or sidewalk shall be refilled to the required elevation with suitable material which shall be compacted until firm and solid and neatly graded.

3.05 CLEANING AND ADJUSTING

A. Sweep concrete pavement and wash free of stains, discolorations, dirt, and other foreign material just prior to final inspection.

B. Protect concrete from damage until acceptance of Work. Exclude traffic from pavement for at least 14 days after placement. When construction traffic is permitted, maintain pavement as clean as possible by removing surface stains and spillage of materials.

3.06 TRANSPORTATION

A. Off-site materials shall be transported to the Project using well maintained and operating vehicles. Once on the job site, all transporting vehicles shall stay on designated haul roads and shall at no time endanger any of the improvements by rutting, overloading or pumping the haul road.

END OF SECTION

SECTION 02530
SANITARY SEWERS

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1 PART 1 – GENERAL

1.1 REFERENCES

.1 City of Hamilton Form 500 – Specification for Sewer Pipe Materials and CCTV Inspection

.2 City of Hamilton Form 600 – Specification for Granular Fill Materials

.3 City of Hamilton Form 600 – Specification for Standard Compaction Requirements

.4 City of Hamilton Approved Product List

.5 ASTM D 3034, Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and fittings.

.6 CAN/CSA B182.2, PVC Sewer Pipe and Fittings (PSM Type).

.7 OPSS.PROV 1841 Material Specification for Non-Pressure Polyvinyl Chloride (PVC) Pipe Products

.8 OPSS.PROV 410 Construction Specification for Pipe Sewer Installation in Open Cut

.9 OPSD 802.010 – Flexible Pipe Embedment and Backfill Earth Excavation (latest revision)

.10 CAN/CSA-A5, Portland Cement.

1.2 DESCRIPTION

.1 The Contractor shall examine the site to ascertain any special condition and become familiar with any object which may affect the work of this section. No extra payment will be made for work resulting from a failure to know existing conditions. Examine all Contract Drawings for work that might affect Sanitary Sewer construction.

.2 Include all jointing, cement grouting and packing, couplings, fittings, gaskets, flanges, bolts and nuts, wall pieces, blocking, tracer wires, cathodic protection, all pipe supports including wall brackets and all other material necessary to properly install the work shown and specified. Include all connections to facility piping, and similar items associated with the work.

.3 A 0.3 metre separation is required to be from outside of pipe barrels, refer to Contract Drawings.

1.3 MATERIAL CERTIFICATION

.1 Submit manufacturer's test data and certification at least 2 weeks prior to commencing work.

.2 Ensure certification is marked on pipe.

1.4 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials.

.2 Since emptied containers retain product residues (vapours, liquids and/or solids) extreme caution should still be exercised in their handling. Keep out of the reach of children.

.3 Place materials defined as hazardous or toxic waste in designated containers.

.4 Ensure emptied containers are sealed and stored safely for disposal away from children.

1.5 SEWAGE SEWERS

.1 Locate all bends, lines, branches, appurtenances, and points of intersection in accordance with the Contract Drawings.

.2 Carry out any detailed surveying necessary to accurately locate these items and co-ordinate this information with the shop drawings of the pipe manufacturer.

.3 It is a requirement of this Contract that a representative of the manufacturer be provided to instruct the Contractor in the proper procedures for the completing of pipe joints. Accordingly, the Contractor will direct his superintendent and foreman to attend such instruction during the presence of the manufacturer’s representative on the Site, and to adhere to all directions and recommendations issued by the manufacturer’s representative.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Take every precaution to prevent damage to any and all materials during transit from the place of manufacture to the Site of work. Exercise care in loading and unloading materials to prevent damage. Replace all damaged materials without additional cost to the Owner.

.2 Deliver, store and handle material in accordance with manufacture’s specifications.

1.7 PROTECTION AGAINST FLOTATION

.1 Prevent damage to any pipeline/fitting/maintenance hole/crossing utilities due to hydrostatic pressure during construction and until completion of the work. Comply with OPSS 410 and including its clause 441.07.03 (Protection against Floatation) and protect the sewers and structures from damage due to floatation during construction and until completion of the works. Any damage arising from failure to comply with the requirements of OPSS 410 shall be replaced new at the Contractor's cost and to the satisfaction of the Engineer.

1.8 COLD WEATHER WORK

.1 Protect all work and materials from freezing.

.2 Do not lay pipes on frozen ground.

1.9 RELATED WORK SPECIFIED IN OTHER SECTIONS

.1 Excavation, Trenching and Backfilling: Section 02220

.2 Cast-in-Place Concrete: Section 03300

.3 Precast Structural Concrete: Section 03410

1.10 SHOP DRAWINGS

.1 Prepare and submit Shop Drawings of all piping units in accordance with Division 1.

2 PART 2 – MATERIALS

2.1 PIPE MATERIALS

.1 All materials are to be new and not previously used.

.2 Supply the pipe in size, material and class as shown on the Contract Drawings and specified herein.

.3 Supply fittings suitable for and compatible with the class and type of pipe with which they will be used.

2.2 POLYVINYL CHLORIDE (PVC)

.1 Comply with City of Hamilton Form 500 – Specification for Sewer Pipe Materials and CCTV Inspection

.2 All pipe materials shall meet the requirements of OPSS 1841, City of Hamilton Form 500 and be selected from the City of Hamilton Approved Sewer Products List, latest edition.

2.3 CEMENT MORTAR

.1 Portland cement: to CAN/CSA-A5/A8/A362, normal type 10.

.2 Mix mortar one part by volume of cement to two parts of clean, sharp sand mixed dry. Add only sufficient water after mixing to give optimum consistency for placement. Do not use additives.

2.4 PIPE BEDDING AND SURROUND MATERIALS

.1 See drawings for pipe bedding and surround details.

.2 Concrete mixes and materials for cradles, encasement, supports: to Section 03300 - Cast-in-Place Concrete.

3 PART 3 – EXECUTION

3.1 PREPARATION

.1 See reference specifications.

3.2 TRENCHING

.1 Do trenching work in accordance with Section 02220 - Excavating, Trenching and Backfilling.

.2 See reference specifications.

3.3 CONCRETE BEDDING AND ENCASEMENT

.1 Do concrete work in accordance with Section 03300 - Cast-in-Place Concrete. Place concrete to details as indicated.

3.4 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.

.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 D 698.

.6 Fill authorized or unauthorized excavation below design elevation of bottom of specified bedding in accordance with Section 02220 - Excavating Trenching and Backfilling with compacted bedding material.

3.5 INSTALLATION

.1 See reference specifications.

.2 See notes on drawings.

3.6 PIPE SURROUND

.1 Upon completion of pipe laying and after the Engineer has inspected the 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 into the trench.

.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 95% maximum density to ASTM D 698.

.6 Compact each layer from mid height of pipe to underside of backfill to at least 95% of maximum density to ASTM D 698.

3.7 BACKFILL

.1 Use unshrinkable fill to underside of pavement.

.2 Do not place backfill in frozen condition.

.3 Place unshrinkable fill in accordance with Section 02220 - Excavating, Trenching and Backfilling.

3.8 UNDERCROSSING

.1 See reference specifications.

3.9 SERVICE CONNECTIONS

.1 See reference specifications.

3.10 FIELD TESTING

.1 See reference specifications.

.2 Repair and retest sewer line as required, until test results are within limits specified.

.3 Repair visible leaks regardless of test results.

.4 Television and photographic inspections:

.1 See reference specifications.

.2 Contractor to carry out inspection of installed sewers by television camera, photographic camera (CCTV) at Substantial Completion and at the end of the Warranty Period.

.3 Remedy all deficiencies in the work at Substantial Completion and at the end of the Warranty Period.

3.11 DEFECTS TO BE MADE GOOD

.1 If, in the final inspection, any defects are found in the pipes or sewers or in any part of their appurtenances, repair the same. If this is not possible, remove and replace them with proper materials and workmanship, without any extra compensation.

3.12 CONNECTIONS TO EXISTING SERVICES

.1 Supply all materials and equipment necessary to make all connections to the existing services in the locations shown on the Contract Drawings.

.2 Co-ordinate the connection to existing services with the Engineer and the Owner.

END OF SECTION

SECTION 02610
HIGH DENSITY POLYETHYLENE PIPE AND FITTINGS

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1 PART 1 – GENERAL

1.1 REFERENCES

.1 ASTM D2774 - Standard Practice for Underground Installation of Thermoplastic Pressure Piping

.2 ASTM D2321 – Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers

.3 ASTM D2683 – Standard Specification for Fabricated Fittings of Butt-Fused Polyethylene (PE)

.4 ASTM D3261 – Standard Specification for Butt Heat Fusion

.5 ASTM D3350 – Standard Specification for Polyethylene Plastics Pipe and Fittings Materials

.6 ASTM F1055 – Electro-fusion Fittings Manufacturing

.7 ASTM F2206 – Standard Specification for Fabricated Fittings

.8 AWWA C217 – Petrolatum and Petroleum Wax Tape Coatings

.9 AWWA C901 – Polyethylene (PE) Pressure Pipe and Tubing

.10 AWWA C906 - Polyethylene (PE) Pressure Pipe and Fittings

.11 AWWA manual of Practice M55 Chapter 7

.12 OPSS 407 - Construction Specification for Maintenance Hole, Catch Basin, Ditch Inlet, and Valve Chamber Installation

.13 OPSS 412 – Construction Specification for Sewage Forcemain Installation in Open Cut (latest revision)

.14 OPSD 701.050 – Precast Concrete Maintenance Hole Components (latest revision)

.15 OPSD 802.010 – Flexible Pipe Embedment and Backfill Earth Excavation (latest revision)

1.2 DESCRIPTION

.1 The Contractor shall examine the site to ascertain any special condition and become familiar with any object which may affect the work of this section. No extra payment will be made for work resulting from a failure to know existing

conditions. Examine all Contract Drawings for work that might affect High Density Polyethylene Pipe and Fittings construction.

.2 Supply and install pipe and other related materials, plant and labour for exterior piping terminating at 600 mm from the point of entry to all buildings and structures, complete as shown on the Contract Drawings, specified herein, or both.

.3 Include all jointing, cement grouting and packing, couplings, fittings, gaskets, flanges, bolts and nuts, wall pieces, blocking, tracer wires, cathodic protection, all pipe supports including wall brackets and all other material necessary to properly install the work shown and specified. Include all connections to facility piping, and similar items associated with the work.

.4 A 0.3 metre separation is required to be from outside of pipe barrels, refer to Contract Drawings.

1.3 SEWAGE FORCEMAINS

.1 Locate all bends, lines, branches, appurtenances, and points of intersection in accordance with the Contract Drawings.

.2 Carry out any detailed surveying necessary to accurately locate these items and co-ordinate this information with the shop drawings of the pipe manufacturer.

.3 It is a requirement of this Contract that a representative of the manufacturer be provided to instruct the Contractor in the proper procedures for the completing of pipe joints. Accordingly, the Contractor will direct his superintendent and foreman to attend such instruction during the presence of the manufacturer's representative on the Site, and to adhere to all directions and recommendations issued by the manufacturer's representative.

1.4 PROTECTION IN SHIPPING

.1 Take every precaution to prevent damage to any and all materials during transit from the place of manufacture to the Site of work. Exercise care in loading and unloading materials to prevent damage. Replace all damaged materials without additional cost to the Owner.

1.5 PROTECTION AGAINST FLOTATION

.1 Prevent damage to any pipeline/fitting/maintenance hole/crossing utilities due to hydrostatic pressure during construction and until completion of the work. Comply with OPSS 412 (Construction Specification for Sewage Forcemain Installation in Open Cut) and including its clause 441.07.03 (Protection against Floatation) and protect the forcemains and structures from damage due to floatation during construction and until completion of the works. Any damage arising from

failure to comply with the requirements of OPSS 412 shall be replaced new at the Contractor's cost and to the satisfaction of the Engineer.

1.6 COLD WEATHER WORK

.1 Protect all work and materials from freezing.

.2 Do not lay pipes on frozen ground.

1.7 RELATED WORK SPECIFIED IN OTHER SECTIONS

.1 Excavation, Trenching and Backfilling: Section 02220

.2 Cast-in-Place Concrete: Section 03300

.3 Precast Structural Concrete: Section 03410

1.8 SHOP DRAWINGS

.1 Prepare and submit Shop Drawings of all yard piping units (e.g. HDPE forcemains and fittings) in accordance with Division 1.

1.9 MEASUREMENT/PAYMENT

.1 The forcemain installed shall be measured in linear meters of HDPE 250mmØ DR17 and 100mmØ DR17 watermain pipe installed. Payment at the bid price shall be compensation in full for all labour, equipment and materials required to complete the work as specified here and as shown on the Drawings, including trench dewatering, measures to prevent the buoyancy of the HDPE pipes during installation, import and proper placement of specified granular materials for construction of bedding and surround material, installation of the HDPE fittings, warning tapes and all related work even though not specified in minute detail.

2 PART 2 – MATERIALS

2.1 PIPE MATERIALS

.1 All materials are to be new and not previously used.

.2 Supply the pipe in size, material and class as shown on the Contract Drawings and specified herein.

.3 Supply fittings suitable for and compatible with the class and type of pipe with which they will be used.

2.2 HIGH DENSITY POLYETHYLENE PIPE AND FITTINGS (HDPE)

.1 Pipe:

.1 Polyethylene pipe shall be made from a HDPE material having a minimum material designation code of PE 4710. The material shall meet the requirements of ASTM D3350 and shall have a minimum cell classification of PE445574C for PE 4710.

.2 The pipe shall meet the requirements of AWWA C906. The pipe and fittings shall be extruded, moulded, machined or fabricated by the same name-brand manufacturer.

.3 HDPE pipe shall be DR17 rated for use at a pressure class of at least 100-psi. The outside diameter of the pipe shall be based upon the DIPS sizing system.

.2 Fittings

.1 Butt fusion Fittings – Fittings shall be made of HDPE material with a minimum material designation code of PE4710 with a minimum Cell Classification as noted in 2B.01A. Butt-Fusion Moulded and Machined Fittings shall meet the requirements of ASTM D3261. Moulded and fabricated fittings shall have a pressure rating equal to the pipe PC, unless otherwise specified in the plans. Markings for moulded fittings shall comply with the requirements of ASTM D3261. Fabricated fittings shall be made and marked in accordance with the requirements of ASTM F2206. All fittings shall meet the fittings requirements of AWWA C906. Socket fittings shall meet ASTM D2683.

.2 Electro-fusion Fittings - Fittings shall be made of HDPE material with a minimum material designation code of PE4710 and with a minimum Cell Classification as noted in 2B.01A. Electro-fusion Fittings shall have a manufacturing standard of ASTM F1055. Fittings shall have a pressure rating equal to the pipe unless otherwise specified on the plans. All electro-fusion fittings shall be suitable for use as pressure components and, shall have nominal burst values of four times the Working Pressure Rating (WPR) of the fitting. Markings shall be according to ASTM F1055.

.3 Corrosion prevention - All metallic components in the water distribution system in contact with earth shall be protected from corrosion. Petrolatum Coatings meeting AWWA C217 are the preferred method of corrosion.

.4 Polyethylene Encasement is NOT permitted for corrosion protection of metallic watermain and appurtenances.

.3 Pipe and Fitting Identification

.1 Pipes to be coextruded green or green stripes for reclaimed water.

.2 Underground warning tapes (green) with wording “BURIED SEWER LINE BELOW” by Seton or approved equal shall be laid in the trench on

top of the embedment material and must follow the alignment of both 250mmØ and 100mmØ forcemains.

2.3 PIPE BEDDING AND SURROUND MATERIAL

.1 Granular A material embedment as shown on the Contract Drawings. Refer to OPSD 802.010 (Flexible Pipe Embedment and Backfill) for more details.

.2 Excavations shall be dewatered and maintained dewatered so that the material is excavated in its natural state and construction of the pipe bed is completed in the dry. The bottom of the excavation shall be kept free from excessive moisture or free-flowing water. Refer to section 02140 for dewatering. Only in wet areas where dewatering is not feasible, Granular A will be replaced with 19mm clear crushed limestone as directed by the Engineer. No additional payment will be made for the substitution of the 19mm clear crushed limestone.

2.4 PRECAST CONCRETE CHAMBERS

.1 Size and details as shown on the Contract Drawings. Refer to OPSD 701.050 (Precast Concrete Maintenance Hole Components) for more details.

.2 Protect against flotation: Comply with OPSS 407 (Construction Specification for Maintenance Hole, Catch Basin, Ditch Inlet, and Valve Chamber Installation), clause 407.07.05 (Protection against Floatation). Protect the watermain and structures from damage due to floatation during construction and until completion of the works. Any damage arising from failure to comply with the requirements of OPSS 407 (407.07.05) shall be replaced new at the Contractor's cost and to the satisfaction of the Engineer.

.3 HDPE Wall Anchors embedded in fresh concrete as indicated on drawings.

.4 Concrete supports for flanged tees as shown on drawings. Ensure proper contact between concrete and pipes.

.5 Connect 600mmØ x 150 mm deep sump to the existing 300mmØ sanitary sewer using 150mmØ PVC pipe.

.6 Set precast concrete base on 150 mm minimum of 19mm crusher-run limestone bedding compacted to 95% Standard Proctor Maximum Dry Density (SPMDD).

.7 Refer to section 15070 for stainless steel non-slam combination air valves.

.8 Provide flanged tees, adapters, wall anchors and backup rings as shown on the contract drawings.

3 PART 3 – EXECUTION

3.1 ALIGNMENT AND GRADE

.1 After placing the bedding material as shown in contract drawings lay the pipes out and maintain all pipe in accordance with the sizes, locations, dimensions, alignment, grades and other particulars as shown on the Contract Drawings. Lay all pipes true to the line and grade.

.2 Take up and re-lay, to the satisfaction of the Engineer and at the expense of the Contractor, all pipe which is not true in alignment or which shows any settlement after laying.

3.2 INSTALLATION

.1 HDPE pipe and fittings shall be installed in accordance with ASTM D2774 for pressure systems and AWWA Manual of Practice M55 Chapter 7.

.2 Pipe embedment - Embedment material as indicated above (Clause 2.3).

.3 Bedding: Geotechnical Engineer review/approval of the subgrade prior to placing bedding material is required. Pipe bedding shall be in conformance with ASTM D2321 Section 8. Compaction rates should be as specified in ASTM D2321. Deviations shall be approved by the engineer.

.4 Haunching and backfill shall be as specified in ASTM D2321 Section 9 with Class I, II, or III materials. Compaction shall be in excess of 85% Standard Proctor Density for soils.

3.3 PREPARATION OF TRENCH, PIPE LAYING AND BACKFILLING TRENCH

.1 Remove all lumps, blisters and excess coating from the ends of each pipe. Wire brush and wipe clean each pipe, making certain they are dry and free from oil and grease before the pipe is laid.

.2 The contractor’s facilities for lowering pipe into the trench shall be such that neither the pipe nor the trench will be damaged or disturbed.

.3 Set all pipes firmly and accurately, with the inverts smooth and uniform.

.4 Provide temporary bracing or supports where necessary to adequately support pipe during installation. Take care to prevent damage to pipe and pipe coatings and to adjacent structures and appurtenances. Substantially complete pipe bedding before temporary supports and bracings are removed.

.5 Support all piping which would otherwise be supported on backfill material at any structure on fill concrete poured against undisturbed ground or by other means as specified elsewhere herein or as shown on the Contract Drawings.

.6 At all times when pipe laying is not in progress, close the open ends of the pipe by a watertight bulkhead or plug which has been approved by the Engineer.

.7 Do not lay pipes on frozen ground.

3.4 PIPES TO BE KEPT CLEAN

.1 During the progress of the work, and until the completion and final acceptance thereof, keep the pipe work and connections thoroughly clean throughout and leave them clean on final acceptance.

3.5 JOINING – GENERAL

.1 Joints between plain end pipes and fittings shall be made by butt fusion as recommended by the HDPE pipe manufacturer.

.2 The Contractor shall ensure that persons making heat fusion joints have received training in the Manufacturer's recommended procedures. The following QA/QC controls for fusion joint quality are required:

.1 Operator training and certification in identifying a properly made fusion joint.

.2 Log and verify that the proper fusion procedures were conducted.

.3 The maximum offset between the two pipe ends (casing or watermain pipe) shall not be more than 5% of the wall thickness. Otherwise, the joint must be cut-out and redone until the offset is within this limit.

.3 The Contractor at his expense shall make all necessary corrections to equipment, set-up, operation and fusion procedure, and shall re-make the rejected fusions all the cost of the Contractor.

.4 Keep piping parallel to previously laid pipe. Sling the pipe only at the centre.

.5 Pull or push the pipe only by hand or power operated winch.

3.6 JOINING DUCTILE IRON FLANGE TEES

.1 Mechanical Joints:

.1 Slip the gland on the pipe with the lip extension toward the joint. Slip the gasket on the pipe with the thick edge toward the gland.

.2 HDPE flange adapters with backup rings as shown on drawings. Press the gasket to the seat evenly around the joint.

.3 Position the gland for bolting and insert the bolts. Make up all the nuts tightly with fingers.

.4 Tighten nuts half a turn at a time with a calibrated torque wrench. Tighten all nuts uniformly to torque specified in AWWA C111/A21.11.

3.7 CUTTING OF PIPE

.1 Whenever cutting of pipe is required, cut pipes as recommended by the pipe manufacturer.

.2 The method of cutting and cutting equipment is to be subject to the approval of the Engineer.

3.8 THRUST RESTRAINT

.1 Protect all connections, caps and bends that are liable to "draw" or blow-off by means of mechanically restrained joints or thrust blocks.

.2 Concrete thrust blocks are to be placed against undisturbed ground, making sure the joints and couplings are free from the concrete.

3.9 FIELD TESTING FOR SANITARY SEWERS

.1 Repair or replace any pipe, pipe joint or bedding found to be defective.

.2 When directed by the Engineer, draw a tapered wooden plug with a diameter of 50 mm less than nominal pipe diameter through the sewer to ensure that the pipe is free of obstruction.

.3 Remove foreign material from the sewers and related appurtenances by flushing them with water.

.4 Perform infiltration and exfiltration testing as soon as practicable after jointing and bedding are complete.

.5 Do infiltration and exfiltration testing as directed by the Engineer. Perform the tests in the presence of the Engineer. Notify the Engineer 24 hours in advance of the proposed tests.

.6 Install watertight bulkheads in a suitable manner to isolate the test section from the rest of the pipeline.

.7 Exfiltration test:

.1 Fill the test section with water in such a manner as to allow displacement of air in the line.

.2 Immediately prior to the test period add water to the pipeline until there is a head of 1 m over the interior crown of the pipe. This is to be measured at

the highest point of the test section or the water in the manhole is 1 m above the static ground water level, whichever is greater.

.3 Duration of the exfiltration test: 2 hours.

.4 Water loss at the end of the test period: not to exceed the maximum allowable exfiltration over any section of pipe between manholes.

.8 Infiltration test:

.1 Conduct the infiltration test in lieu of the exfiltration test where the static ground water level is 750 mm or more above the top of the pipe measured at the highest point in the line to be used.

.2 Do not interpolate a head greater than 750 mm to obtain an increase in the allowable infiltration rate.

.3 Install a watertight plug at the upstream end of the pipeline test section.

.4 Discontinue pumping operations for at least 3 days before the test measurements are to commence and during this time, keep thoroughly wet at least one-third of the pipe invert perimeter.

.5 Prevent damage to the pipe and bedding material due to flotation and erosion.

.6 Place a 90º V-notch weir, or other measuring device approved by the Engineer in the invert of the sewer at each manhole.

.7 Measure the rate of flow over a minimum of 1 hour, with recorded flows for each 5-min. interval.

.9 Leakage: not to exceed the following limits in litres per hour per mm of diameter per 100 m of sewer including service connections:

.1 Exfiltration (based on a 600 mm head): 0.175 L

.2 Infiltration: 0.150 L

.10 Repair and retest the sewer line as required at the contractor cost, until the test results are within the limits specified.

.11 Repair visible leaks regardless of the test results.

3.10 HYDROSTATIC TESTING OF MAINS

.1 Conduct hydrostatic pressure and hydrostatic leakage tests under the supervision of the Engineer, upon completion of the forcemain.

.2 Hydrostatic pressure and hydrostatic leakage tests may be conducted either simultaneously or separately, if both tests are required.

.3 Duration of the test is to be two hours or longer if so directed by the Engineer, or if tests are to be performed simultaneously.

.4 If the two tests are performed separately, conduct the hydrostatic pressure test before the hydrostatic leakage test. Duration of the pressure test is to be one hour or longer if so directed by the Engineer. Duration of the leakage test is to be two hours or longer if so directed by the Engineer.

.5 Test pressures are to be 1035 kPa (150 psi) for watermains.

.6 Test pressures are to be 1380 kPa (200 psi) for sewage forcemains.

.7 Hydrostatic pressure test:

.1 Fill the test section slowly with water making sure that all air is removed from the pipeline. Provide blow-offs at the high points in the system.

.2 Allow a period of 24 hours before starting the test.

.3 Subject the test section to continuous test pressure of 1035 kPa (watermains) or 1380 kPa (sewage forcemains) for one hour or as directed by the Engineer.

.4 On successful completion of this test the remove blow-offs and insert plugs.

.5 Examine all parts of the test section while under pressure. If the test pressure is maintained with no pressure drop for the specified test duration, the test results are satisfactory.

.6 If the test is not satisfactory, repair all deficient parts of the section and retest until a satisfactory result is attained.

3.11 FIELD INSPECTION

.1 All pipes, bends and junctions will be subject to inspection by the Engineer. Remove from the Site those pieces rejected as not conforming to the requirements of this Specification.

3.12 DEFECTS TO BE MADE GOOD

.1 If, in the final inspection, any defects are found in the pipes or sewers or in any part of their appurtenances, repair the same. If this is not possible, remove and replace them with proper materials and workmanship, without any extra compensation.

3.13 CONNECTIONS TO EXISTING SERVICES

.1 Supply all materials and equipment necessary to make all connections to the existing services in the locations shown on the Contract Drawings.

.2 Co-ordinate the connection to existing services with the Engineer and the Owner.

END OF SECTION

SECTION 02631
MAINTENANCE HOLES

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SECTION 02631
MAINTENANCE HOLES

PART 1 GENERAL

1.1 WORK INCLUDED

.1 Materials and installation for constructing precast and cast in place maintenance holes and catch basins.

1.2 RELATED SPECIFICATION

.1 Section 02220 – Excavation, Trenching, and Backfilling.

.2 Section 02530 – Sanitary Sewers

1.3 REFERENCES

.1 OPSS 407 - Construction Specification for Maintenance Hole, Catch Basin, Ditch Inlet and Valve Chamber Installation

.2 OPSS 408 - Construction Specification for Adjusting or Rebuilding Maintenance Holes, Catch Basins, Ditch Inlets and Valve Chambers

.3 ASTM A48/A48M, Standard Specification for Gray Iron Castings.

.4 ASTM C139, Specification for Concrete Masonry Units for Construction of Catch Basins and Manholes.

.5 ASTM C478M, Specification for Precast Reinforced Concrete Manhole Sections [Metric].

.6 ASTM C618, Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Concrete.

.7 Drawings and Contract Documents

1.4 GENERAL

.1 Work for Maintenance Holes, Valve Chambers, and Catch Basins shall include all labour, equipment and materials as specified, including but not limited to:

.1 Excavation to grade and disposal of surplus materials.

.2 Bulkheads as required.

.3 Supply, place and compact bedding material.

.4 Cast-in-place concrete and reinforcing steel

.5 Precast concrete structures and sections.

.6 Supply and installation of associated appurtenances in structures as specified and shown on Contract Drawings.

.7 Benching, where specified.

.8 Drop structures where specified.

.9 Steps or ladders, as specified.

.10 Insulation where specified.

.11 Frames and covers/grates as specified.

.12 Modular adjustment units.

.13 Backfill and compaction.

.14 Restoration and clean up.

.15 All other work necessary to complete installation of structure.

.2 The work shall also include any adjustment in grade to the within plus or minus 0.3 metres of what is shown on the Contract Drawings. No increase is to be given or deduction taken for adjustment within the 0.3 metre vertical tolerance.

PART 2 PRODUCTS

2.1 BEDDING AND BACKFILL MATERIALS

.1 Bedding and backfill materials shall be as specified in Section 02220.

2.2 MANHOLES AND CATCHBASINS

.1 Manholes in size and class shown on the Contract Drawings and specified herein.

.2 OPSD standards: OPSD 701.010 – 1200 mm diameter MH.

.3 Precast manhole sections: to OPSD standards.

.4 Manhole joints to be made watertight using rubber gaskets to ASTM C443, bituminous compound, epoxy resin cement or cement mortar.

.5 Ladder Rungs to OPSD-405.01; Solid circular aluminum with polyethylene encasement.

.6 Adjustment rings: to OPSD - 704.010.

.7 Concrete brick: to CAN3-A165 series.

.8 Catch basins to OPSD – 705.010, and 705.020.

2.3 FRAMES, SAFETY PLATFORMS AND COVERS

.1 To dimensions as indicated and following requirements:

.1 Metal gratings and covers to bear evenly on frames. A frame with grating or cover to constitute one unit. Assemble and mark unit components before shipment.

.2 Grey iron castings: to ASTM A48, strength Class 30B.

.3 Catch basin frame and grates to OPSD – 400.120, and 400.020.

.4 Structural aluminum: to Alcan 6061-T6.

.5 Castings to be coated with two applications of asphalt varnish, sand blasted or cleaned and ground to eliminate surface imperfections.

.6 Manhole frames and covers: heavy duty municipal type for road service; closed cover and complete with two lifting holes as per OPSD 401.010.

.7 Diversion Manhole Stainless Steel safety platform: as detailed on Contract drawings.

PART 3 EXECUTION

3.1 EXCAVATION AND BACKFILLING

.1 See reference specifications.

3.2 INSTALLATION

.1 See reference specifications.

.2 See notes on Drawings.

.3 Dewater excavation in accordance with Section 02315 and to approval of The Consultant. Remove soft and foreign material before placing concrete base.

.4 Cast bottom slabs directly on undisturbed ground.

.5 Set precast concrete base on 150 mm minimum of granular bedding compacted to 100% maximum density to ASTM D698.

.6 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 the Consultant 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 cement mortar or mastic compound.

.7 For sewers:

.1 Bench to provide a smooth U shaped channel. Side height of channel to be 0.75 times diameter of sewer. Slope adjacent floor at 1 in 20. Curve channels smoothly. Slope invert to establish sewer grade.

.8 Place unshrinkable backfill under roads in accordance with Section 02220 Excavating, Trenching and Backfill.

.9 Installing units in existing systems:

.1 Where new unit is to be installed in existing run of pipe, ensure full support of existing pipe during installation, and carefully remove that portion of existing pipe to dimensions required] and install new unit as specified.

.2 Make joints watertight between new unit and existing pipe.

.3 Where deemed expedient to maintain service around existing pipes and when systems constructed under this Project are ready to be put in operation, complete installation with appropriate break outs, removals, redirection of flows, blocking unused pipes or other necessary work.

.10 Maintenance holes shall be complete with all components, frames and close covers, backfill all around with unshrinkable fill including connections, benching and parging as required.

.11 Catch basins shall be complete with all components, frames and covers, backfill all around with unshrinkable fill including connections and Goss Traps.

.12 Pipe Connections to Existing Maintenance Holes.

.1 All inlets and outlets to and from existing maintenance holes shall be concrete pipes. For a PVC sanitary pipe, install a 1m long concrete pipe (stub) to the maintenance hole and the stub shall be connected to the PVC pipe with a coupling. The stub shall be encased in 20MPa concrete.

.13 Pipe Connections to Proposed Maintenance Holes.

.1 Use Kor-N-Seal assembly to connect all PVC pipes to proposed maintenance holes. A minimum 600mm of the pipe from the maintenance hole shall be encased with 20MPa concrete.

.2 For the purpose of installing Kor-N-Seal on proposed maintenance holes, the holes shall be cored and seals shall be installed by the manufacturer of the maintenance holes. No site adjustments or modifications will be permitted, unless it is authorized by the manufacturer.

.14 Complete structures as pipe laying progresses.

3.3 ADJUSTING STRUCTURES

.1 Ring Adjustments:

.1 After the addition or removal of brick or adjustment units, the existing bricks and adjustment units shall be cleaned and patched/parged to the satisfaction of the Engineer.

.2 The total height of adjustment units installed shall not exceed 300 mm.

.2 Sectional units:

.1 Raise or lower straight walled sectional units by adding or removing precast sections as required.

.2 If required, raise or lower tapered units by removing cone section, adding, removing, or substituting riser sections to obtain required elevation, then replace cone section.

.3 Monolithic units:

.1 Raise monolithic units by roughening existing top to ensure proper bond and extend to required elevation with mortared brick course for 150 mm or less alteration.

.2 Lower monolithic units with straight wall by removing concrete to elevation indicated for rebuilding.

.3 When monolithic units with tapered upper section are to be lowered more than 150 mm, remove concrete for entire depth of taper plus as much straight wall as necessary, then rebuild upper section to required elevation with cast-in-place concrete.

.4 Install additional manhole ladder rungs in adjusted portion of units as required.

.5 Re-use existing gratings and frames.

3.4 INSULATION

.1 Install insulation to manufacturer's recommendation.

3.5 LEAKAGE TESTING

.1 Install watertight plugs or seals on inlets and outlets of each new sanitary sewer manhole and fill manhole with water. Leakage not to exceed 0.3% per hour of volume of manhole.

.2 If permissible leakage is exceeded, correct defects. Repeat until approved by the Consultant.

.3 Consultant shall issue Test Certificate for each manhole passing test.

END OF SECTION

SECTION 02652
HYDROSTATIC TESTING WATER RETAINING STRUCTURES

1 PART 1 – GENERAL 1

1.1 SCOPE 1
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SECTION 02652
HYDROSTATIC TESTING WATER RETAINING STRUCTURES

1 PART 1 – GENERAL

1.1 SCOPE

.1 This section covers the hydrostatic testing procedures for the wet wells and the inlet chamber.

1.2 GENERAL

.1 The Owner will supply the water to fill the structure for the hydrostatic testing of the wet wells and inlet chamber.

.2 The Contractor shall furnish all additional water to that cited above, suitable temporary service connections, all labour required, without additional compensation, preparatory to commissioning the project.

2 PART 2 – PRODUCTS

2.1 WATER

.1 Water for one hydrostatic test will be available free of charge from the owner. Any water required for further testing or retesting will be at the Contractor's expense.

.2 The Contractor shall provide and supply all necessary equipment for obtaining water necessary to carry out all work involved in this section.

.3 The Contractor will be responsible for coordinating the rate and conditions for supply of this water with the Owner and shall abide by all directions given by the Owner. No extra payment will be made to the Contractor for delays resulting from a curtailment of supply by the Owner due to consumer demand, operational difficulties or emergencies.

2.2 HYDROSTATIC TEST

.1 Carry out hydrostatic testing after the structure has been completely constructed and structural concrete has achieved design strength. Do not begin backfilling until testing has shown that the wet wells and the inlet chamber are watertight.

.2 Close all connection valves and ensure that there is no leakage through valves and piping.

.3 Prior to commencing the hydrostatic test for the structures, repair all visible cracks and all defects in the walls, roof, and/or floor slabs of the wet wells or the inlet chamber and fill with sealer.

.4 Fill the reservoir with water to the overflow level. Allow the water to stand for a period of 72 hours to saturate the concrete. At the end of this period refill the wet wells and the inlet chamber to the same level. Begin the test at this time and continue for a further 48 hours. No water is to be added to the structure during the test period.

.5 Measure the water level at regular intervals (at least twice daily). After compensating for evaporation losses, the maximum drop in water level shall not exceed 5 mm per day.

.6 Use the Standard Weather Bureau Class A evaporation pan to measure the evaporation losses with a coefficient of 0.7 or other approved evaporation measurement to estimate the evaporation loss.

.7 Total leakage from the structure over a period of 24 hours shall not exceed 0.1% of the volume of water contained in the structure. No visible leaks to appear on the exterior face of the structure.

.8 If any test shows leakage or if leaks or damp patches are visible, empty the structure and carefully examine for the cause of leakage. Repair all defects by methods agreed by the Engineer. Repeat the tests until no leak is detected.

3 PART 3 – EXECUTION

3.1 CLEANING

.1 Ensure that the wet wells are cleaned and free from debris prior to the hydrostatic test.

END OF SECTION

SECTION 02825
ORNAMENTAL METAL FENCE

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2.2 MATERIAL....2
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PART 3 EXECUTION....3

3.1 INSTALLATION....3

SECTION 02825
ORNAMENTAL METAL FENCE

PART 1 GENERAL

1.1 DESCRIPTION

.1 Labour, products and services necessary for the complete fabrication of, and installation of ornamental metal fence and gate Work in accordance with the Contract Documents.

1.2 REFERENCED STANDARDS

.1 ASTM A36M, Specification for Structural Steel

.2 ASTM A591, Specification for Steel Sheet, Electrolytic, Zinc-Coated, for Light Coating Mass Application

.3 CSA W47.1, Certification of Companies for Fusion Welding of Steel Structures.

.4 CSA W47.2M, Certification for Fusion Welding of Aluminum.

.5 CSA W59-M, Welded Steel Construction

.6 CAN3-S157-M, Strength Design in Aluminum.

1.3 DESIGN REQUIREMENTS

.1 Ornamental fences, gates and their foundations shall be designed and certified by a Professional Engineer to resist lateral loads of 2.2 kN/m and vertical loads of 1.5 kN/m in accordance with OBC Subsection 4.1.10.1(1) and 4.1.10.1(2) to (4).

.2 Design foundations to be minimum 1200mm below grade.

1.4 SHOP DRAWINGS

.1 Submit shop drawings in accordance with Section 01300 of the fabrication and installation details of items, components and assemblies listed in Part 2. The shop drawings shall be on the basis of field measurements.

.2 For ornamental fences and gates, indicate lateral strength, foundation details, dimensions, gauges, tensile and yield strength of members and welds, post settings and picket interspaces. Shop drawings shall be stamped by a Professional Engineer registered in the province of Ontario, having experience in design of this type and scope. Proof of experience to be verified.

1.5 SAMPLES

.1 Submit samples in accordance with Section 01300.

1.6 EXTENDED WARRANTY

.1 Submit written warranty for ornamental metal fence Work of this Section, except that warranty period is extended to five (5) years. Warranty shall cover complete replacement of defective work.

1.7 PRODUCT HANDLING AND STORAGE

.1 Deliver all materials to the site free of damage, and store in protected area. Any damage occurring to the fence and gates prior to the final acceptance of the installation of the project will be corrected at no cost to the City.

PART 2 PRODUCTS

2.1 PRODUCT – ORNAMENTAL FENCE , HORIZONTAL SLIDING VEHICULAR GATE AND TWO PEDESTRIAN GATES

.1 Fence, Horizontal Sliding Gate, and 2 pedestrian gates:

.1 Powder coated architectural ornamental fence as per contract documents.

2.2 MATERIAL

.1 Architectural ornamental fence, Horizontal Sliding Gate and 2 pedestrian gates:

.1 Steel posts: ASTM A36M cold formed steel tubes

.2 All fittings shall be 14 gauge Galvalume material, polyester powder coated with minimum 2.5 mils thickness.

2.3 FABRICATION

.1 Ornamental Fence, 2-Swing Gate, and 1 pedestrian gates:

.1 Fabricate fence and gate to sizes and gauges shown as per contract documents.

.2 Finish: Polyester powder coating, 0.064 mm (2.5 mils) thick, electrostatically applied and thermally fused. Colour: White.

.2 Powder Coating Fence and Gates :

.1 Finish: Polyester powder coating, 0.064 mm (2.5 mils) thick, electrostatically applied and thermally fused. Colour: White.

.2 Hot dip galvanize and do not water or chromate quench.

.3 Remove all drainage spikes and surface defects. Thoroughly wash galvanized surfaces prior to powder coating.

.4 Engineer to review cleaned galvanized surface prior to powder-coating.

.5 Powdercoat within 12 hours of galvanizing according to current practice. Do not get surfaces wet. Do not leave outside.

.6 Keep the surface clean. Do not transport uncovered loads. Protect from diesel fumes.

.7 If surface contamination has occurred or is suspected, clean surface with proprietary solvent / detergent designed for pre-cleaning prior to powdercoating.

.8 Use zinc phosphate pretreatment for high quality adhesion. Surface must be perfectly clean.

.9 Pre-heat work prior to powder application.

.10 Use de-gassing grade polyester powder only.

.11 Check for correct curing by solvent testing. Adjust pre-heat and line speed to ensure full cure.

.3 Welding:

.1 Perform welding of steel in accordance with CSA W59-M and CSA W47.1.

PART 3 EXECUTION

3.1 INSTALLATION

.1 Install ornamental fence posts, rails, pickets and sliding horizontal gate in accordance with locations and details indicated on Contract Drawings.

.2 Excavate post holes to suit foundation size shown on Drawings and remove excavated material from Site in accordance with Section 03300.

.3 Place posts in holes plumb and true, encased in concrete. Use concrete that meets design requirements specified in Part 1, but in no case less than 20 MPa.

END OF SECTION

DIVISION 3
CONCRETE

03100	Concrete Forms and Accessories
03200	Concrete Reinforcement
03300	Cast In Place Concrete
03350	Concrete Floor Sealer
03370	Portland Cement Grout
03400	Architectural Precast Concrete
03620	Non-Shrink Grout

SECTION 03100
CONCRETE FORMS AND ACCESORIES

1 GENERAL 1

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1.2 RELATED WORK 1
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1.4 SHOP DRAWINGS 1

2 PRODUCTS 2

1.5 MATERIALS 2

3 EXECUTION 2

1.6 FABRICATION AND ERECTION 2
1.7 REMOVAL 3

SECTION 03100
CONCRETE FORMS AND ACCESORIES

1 GENERAL

1.1 SCOPE

.1 This Section covers the Work for concrete forms

1.2 RELATED WORK

.1 Section 03200 Concrete Reinforcement

.2 Section 03300 Cast-in-Place Concrete

1.3 REFERENCES

.1 All reference standards and related specifications shall be current issue or latest revision at the first date of tender advertisement.

.2 Canadian Standards Association (CSA)

.1 CAN/CSA-A23.1, Concrete Materials and Methods of Concrete Construction.

.2 CAN/CSA-O86.1, Engineering Design in Wood (Limit States Design).

.3 CSA O121, Douglas Fir Plywood.

.4 CSA O151, Canadian Softwood Plywood.

.5 CSA O153, Poplar Plywood.

.6 CSA S269.1, Falsework for Construction Purposes.

.7 CAN/CSA-S269.3, Concrete Formwork.

.3 Council of Forest Industries of British Columbia (COFI)

.4 COFI Exterior Plywood for Concrete Formwork.

1.4 SHOP DRAWINGS

.1 Submit shop drawings for formwork and falsework in accordance with Section 01330.

.2 Indicate method and schedule of construction, shoring, stripping and re-shoring procedures, materials, arrangement of joints, special architectural exposed finishes, ties, liners, and locations of temporary embedded parts. Comply with CSA S269.1 for falsework drawings. Comply with CAN/CSA-S269.3 for formwork drawings.

.3 Indicate formwork design data, such as permissible rate of concrete placement, and temperature of concrete, in forms.

.4 Indicate sequence of erection and removal of formwork/falsework as directed by Contract Administrator.

.5 Each shop drawing submission shall bear stamp and signature of qualified professional engineer registered or licensed in Province of Ontario, Canada.

2 PRODUCTS

1.5 MATERIALS

.1 Formwork materials:

.1 For concrete without special architectural features, use wood and wood product formwork materials to CSA-O121, CAN/CSA-O86.1.

.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 dia. in concrete surface.

.3 Form liner:

.1 Plywood: Douglas Fir to CSA O121.

.4 Form release agent: non-toxic.

.5 Form stripping agent: colourless mineral oil, non-toxic, free of kerosene,

.6 Falsework materials: to CSA-S269.1.

3 Execution

1.6 FABRICATION AND ERECTION

.1 Verify lines, levels and centres before proceeding with formwork/falsework and ensure dimensions agree with drawings.

.2 Obtain Contract Administrator's approval for use of earth forms framing openings not indicated on drawings.

.3 Hand trim sides and bottoms and remove loose earth from earth forms before placing concrete.

.4 Fabricate and erect falsework in accordance with CSA S269.1 and COFI Exterior Plywood for Concrete Formwork.

.5 Do not place shores and mud sills on frozen ground.

.6 Provide site drainage to prevent washout of soil supporting mud sills and shores.

.7 Fabricate and erect formwork in accordance with CAN/CSA-S269.3 to produce finished concrete conforming to shape, dimensions, locations and levels indicated within tolerances required by CAN/CSA-A23.1.

.8 Align form joints and make watertight. Keep form joints to minimum.

.9 Use 20 mm chamfer strips on external corners and/or 20 mm fillets at interior corners, joints, unless specified otherwise.

.10 Form chases, slots, openings, drips, recesses, expansion and control joints as indicated.

.11 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.

.12 Clean formwork in accordance with CAN/CSA-A23.1, before placing concrete.

1.7 REMOVAL

.1 Leave formwork in place for following minimum periods of time after placing concrete.

.1 3 days for slabs, decks and other structural members.

.2 3 days for footings.

.2 Remove formwork when concrete has reached 75% of its design strength or minimum period noted above, whichever comes later, and prevent from full loading until 28 day strength is achieved.

.3 Re-use formwork and falsework subject to requirements of CAN/CSA-A23.1.

END OF SECTION

SECTION 03200
CONCRETE REINFORCEMENT

1 GENERAL 1

1.1 SCOPE 1
1.2 RELATED WORK 1
1.3 REFERENCES 1
1.4 SHOP DRAWINGS 1

2 PRODUCTS 2

1.5 MATERIALS 2
1.6 FABRICATION 2
1.7 SOURCE QUALITY CONTROL 2

3 EXECUTION 3

1.8 FIELD BENDING 3
1.9 PLACING REINFORCEMENT 3

SECTION 03200
CONCRETE REINFORCEMENT

1 GENERAL

1.1 SCOPE

.1 This Section covers the Work for concrete reinforcement

1.2 RELATED WORK

.1 Section 03100 Concrete Forms and Accessories

.2 Section 03300 Cast-in-Place Concrete

1.3 REFERENCES

.1 All reference standards and related specifications shall be current issue or latest revision at the first date of tender advertisement.

.1 American Concrete Institute (ACI)

.2 ACI 315R, Manual of Engineering and Placing Drawings for Reinforced Concrete Structure.

.3 American National Standards Institute/American Concrete Institute (ANSI/ACI)

.4 ANSI/ACI 315, Details and Detailing of Concrete Reinforcement.

.2 Canadian Standards Association (CSA)

.1 CAN/CSA-A23.1, Concrete Materials and Methods of Concrete Construction.

.2 CAN3-A23.3, Design of Concrete Structures for Buildings.

.3 CAN/CSA-G30.18, Billet-Steel Bars for Concrete Reinforcement.

.4 CAN/CSA-G40.21, Structural Quality Steels.

1.4 SHOP DRAWINGS

.1 Submit shop drawings including placing of reinforcement in accordance with Section 01331

.2 Indicate on shop drawings, bar bending details, lists, quantities of reinforcement, sizes, spacings, locations of reinforcement and mechanical splices if approved by Contract Administrator, with identifying code

marks to permit correct placement without reference to structural drawings. Indicate sizes, spacings and locations of chairs, spacers and hangers. Prepare reinforcement drawings in accordance with Reinforcing Steel Manual of Standard Practice - by Reinforcing Steel Institute of Canada.

.3 Detail lap lengths and bar development lengths to CAN3-A23.3, unless otherwise indicated. Provide Class B tension lap splices unless otherwise indicated.

2 PRODUCTS

1.5 MATERIALS

.1 Reinforcing steel: billet steel, grade 400, deformed bars to CAN/CSA-G30.18, unless indicated otherwise.

.2 Reinforcing steel: weldable low alloy steel deformed bars to CAN/CSA-30.18.

.3 Cold-drawn annealed steel wire ties: to CSA G30.3.

.4 Chairs, bolsters, bar supports, spacers: to CAN/CSA-A23.1.

1.6 FABRICATION

.1 Fabricate reinforcing steel in accordance with CAN/CSA-A23.1, ANSI/ACI 315, and Reinforcing Steel Manual of Standard Practice by the Reinforcing Steel Institute of Canada unless indicated otherwise.

.2 Obtain Contract Administrator's approval for locations of reinforcement splices other than those shown on placing drawings.

.3 Ship bundles of bar reinforcement, clearly identified in accordance with bar bending details and lists.

1.7 SOURCE QUALITY CONTROL

.1 Upon request, provide Contract Administrator with certified copy of mill test report of reinforcing steel, showing physical and chemical analysis, minimum 4 weeks prior to commencing reinforcing work.

.2 Upon request inform Contract Administrator of proposed source of material to be supplied.

3 EXECUTION

1.8 FIELD BENDING

.1 Do not field bend or field weld reinforcement except where indicated or authorized by Contract Administrator.

.2 When field bending is authorized, bend without heat, applying a slow and steady pressure.

.3 Replace bars which develop cracks or splits.

1.9 PLACING REINFORCEMENT

.1 Place reinforcing steel as indicated on reviewed placing drawings and in accordance with CAN/CSA-A23.1.

.2 Prior to placing concrete, obtain Contract Administrator's approval of reinforcing material and placement.

.3 Ensure cover to reinforcement is maintained during concrete pour.

END OF SECTION

SECTION 03300
CAST-IN-PLACE CONCRETE

1 GENERAL 1

1.1 RELATED SECTIONS 1
1.2 REFERENCES 1
1.3 CERTIFICATES 2
1.4 QUALITY ASSURANCE 2

2 PRODUCTS 3

1.1 MATERIALS 3
1.2 MIXES 4

3 EXECUTION 5

1.3 PREPARATION 5
1.4 CONSTRUCTION 5
1.5 CONSTRUCTION TOLERANCES 7
1.6 FIELD QUALITY CONTROL 7

SECTION 03300
CAST-IN-PLACE CONCRETE

1 GENERAL

1.1 RELATED SECTIONS

.1 Section 03100 Concrete Forms and Accessories.

.2 Section 03200 Concrete Reinforcement.

1.2 REFERENCES

.1 All reference standards and related specifications shall be current issue or latest revision at the first date of tender advertisement.

.2 American Society for Testing and Materials (ASTM)

.1 ASTM C109/C109M, Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2 in. or 50 mm Cube Specimens).

.2 ASTM C260, Specification for Air Entraining Admixtures for Concrete.

.3 ASTM C309, Specification for Liquid Membrane Forming Compounds for Curing Concrete.

.4 ASTM C494, Specification for Chemical Admixtures for Concrete.

.5 ASTM C827, Test Method for Change in Height at Early Ages of Cylindrical Specimens from Cementitious Mixtures.

.3 Canadian General Standards Board (CGSB)

.1 CAN/CGSB 51.34, Vapour Barrier, Polyethylene Sheet for Use in Building Construction.

.2 CAN/CGSB 37.2, Emulsified Asphalt, Mineral Colloid Type, Unfilled, for Dampproofing and Waterproofing and for Roof Coatings.

.4 Canadian Standards Association (CSA)

.1 CAN/CSA A5, Portland Cement

.2 CAN/CSA A23.1, Concrete Materials and Methods of Concrete Construction.

.3 CAN/CSA A23.2, Methods of Test for Concrete

.4 CAN/CSA A23.5, Supplementary Cementing Materials.

.5 CAN/CSA A363, Cementitious Hydraulic Slag

1.3 CERTIFICATES

.1 Submit certificates in accordance with Section 01330 – Submittal Procedures

.2 Submit manufacturer's test data and certification by qualified independent inspection and testing laboratory that following materials will meet specified requirements:

.1 Portland cement

.2 Blended hydraulic cement

.3 Supplementary cementing materials

.4 Water

.5 Waterstops

.6 Joint filler

.3 Provide certification that mix proportions selected will produce concrete of quality, yield and strength as specified in concrete mixes, and will comply with CAN/CSA A23.1.

.4 Provide certification that plant, equipment, and materials to be used in concrete comply with requirements of CAN/CSA A23.1.

1.4 QUALITY ASSURANCE

.1 Submit proposed quality control procedures for Contract Administrator's approval for following items:

.1 Falsework erection

.2 Hot weather concrete

.3 Cold weather concrete

.4 Curing

.5 Finishes

.6 Formwork removal

.7 Joints

2 PRODUCTS

1.1 MATERIALS

.1 Portland cement to CAN/CSA A5.

.2 Blended hydraulic cement: to CSA A362.

.3 Supplementary cementing materials: to CAN/CSA A23.5.

.4 Cementitious hydraulic slag: to CAN/CSA A363.

.5 Water: to CAN/CSA A23.1.

.6 Aggregates: to CAN/CSA A23.1. Coarse aggregates to be normal density.

.7 Air entraining admixture: to ASTM C260.

.8 Chemical admixtures: to ASTM C494. Contract Administrator to approve accelerating or set retarding admixtures during cold and hot weather placing.

.9 Concrete retarders: to ASTM C494 water based. Do not allow moisture to come in contact with the retarder film.

.10 Waterstops: Hydrotite by Multiurethanes Ltd.

.1 Hydrotite CJ-1020 at all locations below elevation EL 45 m

.2 Hydrotite CJ-0725 at all locations above elevation EL 45 m

.11 Adhesive (for Hydrotite waterstops): Hydrotite Leakmaster by Multiurethanes Ltd.

.12 Shrinkage compensating grout: Sika 212 SR pre-mixed compound or approved alternate.

.13 Polyethylene film for water curing: 0.1 mm thickness to CAN/CGSB 51.34. Comply with maximum allowable moisture loss requirements of ASTM C156.

.14 Bonding adhesive: Sikatop Armatec 110 EpoCem or approved alternate.

.15 Concrete surface clear sealing compound: Sikagard Clear/Seal 2.

.16 Epoxy resin: Sikadur 52 Epoxy Injection Resin

.17 Polyurethane resin: Multiurethanes Flexible Resin

1.2 MIXES

.1 Proportion normal density concrete in accordance with CAN/CSA A23.1, Alternative 1 to the strength and class noted on the Contract Drawings.

.2 Project level concrete mix data submissions are required for all concrete supplied on City projects. Detailed concrete mix data submissions are required for concrete designated as structural concrete by the Contract Administrator.

.3 Project Level Concrete Mix Data Submission (Structural and Non Structural Concrete):

.1 At least 2 weeks prior to the delivery of concrete, submit the following concrete mix information to the Contract Administrator:

.1 Purchaser's name

.2 Contract number

.3 Concrete supplier name

.4 Suppliers mix design number

.5 Primary and secondary plant locations

.6 Cement type

.7 Minimum cement content of the mix

.8 W/C ratio

.9 Maximum content of each supplementary cementing material

.10 Material source information including inventory number

.11 General admixtures usage including manufacture and brand name

.12 Air and slump requirements

.13 All relevant information pertaining to mix use

.2 Include a declaration verifying that the mix supplied meets the CAN/CSA-A23.1 and City of Ottawa requirements for the project.

.4 Detailed Concrete Mix Data Submission (Structural Concrete):

.1 For specific structural elements as determined by the Contract Administrator, submit detailed mix design information in addition to the above including:

.1 Cement content

.2 Supplementary cementing materials contents

.3 Quantity of water used in mix

.4 Detailed aggregate source information including physical properties and material grading

.5 Detailed admixture usage including dosages

3 EXECUTION

1.3 PREPARATION

.1 Obtain Contract Administrator's written approval before placing concrete with 24 hours notice of intention to placement.

.2 Pump concrete only with the approval of equipment and mix by the Contract Administrator.

.3 Ensure reinforcement and inserts are not disturbed during concrete placement.

.4 Prior to placing of concrete obtain Contract Administrator's approval of proposed method for protection of concrete during placing and curing.

.5 Maintain accurate records of poured concrete items to indicate date, location of pour, quality and air temperature and test samples taken.

.6 Do not place load on new concrete until authorized by Contract Administrator.

1.4 CONSTRUCTION

.1 Place concrete work in accordance with CAN/CSA A23.1.

.2 Hydrotite waterstops

.1 Clean concrete surface using wire brush to remove laitance, dirt and debris.

.2 Apply Hydrotite Leakmaster adhesive to fill surface irregularities, install Hydrotite waterstop and press securely to bond with adhesive.

.3 Mechanically anchor Hydrotite waterstop after securing with adhesive, in accordance with supplier's recommendations.

.3 Sleeves and inserts

.1 Where approved by Contract Administrator, set sleeves, ties, pipe hangers and other inserts and openings as indicated or specified elsewhere. Sleeves and openings greater than 100 x 100 mm not indicated must be approved by Contract Administrator.

.2 Do not eliminate or displace reinforcement to accommodate hardware. If inserts cannot be located as specified, obtain approval of modifications from Contract Administrator before placing of concrete.

.3 Check locations and sizes of sleeves and openings shown on drawings.

.4 Set special inserts for strength testing as indicated and as required by non destructive method of testing concrete.

.4 Anchor bolts

.1 Set anchor bolts to templates under supervision of appropriate trade prior to placing concrete.

.2 With approval of Contract Administrator, grout anchor bolts in preformed holes or holes drilled after concrete has set. Formed holes to be in accordance with relevant Section. Drilled holes to be in accordance with relevant Section.

.3 Protect anchor bolt holes from water accumulations, snow and ice build ups.

.4 Set bolts and fill holes in accordance with relevant Section.

.5 Grout under base plates and machinery using procedures to ensure in 100% contact over grouted area.

.6 Finishing

.1 Finish concrete in accordance with CAN/CSA A23.1.

.2 Use procedures acceptable to those noted in CAN/CSA A23.1 to remove excess bleed water.

.3 Cure in accordance with CAN/CSA A23.1 without use of curing compounds unless specifically approved by the Contract Administrator

.4 Provide float finish on horizontal surfaces unless otherwise indicated.

.5 Rub exposed sharp edges of concrete with Carborundum to produce 3 mm radius edges unless otherwise indicated.

.6 Apply concrete surface clear sealing compound in accordance with the manufacturer's recommendations on all interior floor and wall surfaces.

.7 Repair all cracks greater than 1 mm wide in finished concrete structure to the satisfaction of the Contract Administrator using epoxy injection resin by an approved injection means.

.8 Repair all cracks which exhibit signs of leakage or water infiltration in the finished structure on completion of backfilling to the satisfaction of the Contract Administrator using polyurethane injection resin by an approved injection means.

1.5 CONSTRUCTION TOLERANCES

.1 In accordance with CAN/CSA A23.1.

1.6 FIELD QUALITY CONTROL

.1 Conduct all necessary on-site inspection and testing of concrete to confirm compliance with the mix design.

.2 Supply all test cylinders and cast and cure in accordance with CAN/CSA A23.2 under site conditions.

.3 Pay all costs associated the casting and delivery of cylinders and testing by an independent certified laboratory.

END OF SECTION

SECTION 03350
CONCRETE FLOOR SEALER

PART 1 – GENERAL 1

1.1 SCOPE 1
1.2 WORK INCLUDED: 1
1.3 RELATED WORK: 1
1.4 QUALITY ASSURANCE: 1
1.5 REFERENCE STANDARDS: 1

PART 2 - PRODUCTS 1

2.1 MATERIALS 1

PART 3 – EXECUTION 2

3.1 FLOOR FINISH: 2
3.2 APPLICATION: 2
3.3 CLEAN-UP: 2

SECTION 03350
CONCRETE FLOOR SEALER

PART 1 – GENERAL

1.1 SCOPE

.1 This Section of the Specifications shall be read in conjunction with Section 03000 - Concrete, which shall apply to and govern the work of this Section.

1.2 WORK INCLUDED:

.1 Install sealer on all interior concrete floors not designated to receive other floor finish/treatment.

1.3 RELATED WORK:

.1 Section 03300: Cast-in-Place Concrete

.2 Section 03375: Concrete Floor Toppings

1.4 QUALITY ASSURANCE:

.1 Qualification:

.1 Work of this section to be carried out by an approved fabricator/installer of the material/product supplier specified herein. The fabricator/installer to possess a minimum of 5 years proven experience in this type of work.

1.5 REFERENCE STANDARDS:

.1 Concrete floor finishing work in accordance with CSA-A23.1/A23.2-04 except where specified otherwise.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Chemical Hardener: “Sikafloor 3S” single-component liquid sodium silicate surface hardener or approved equal.

.2 Colouring: clear.

PART 3 – EXECUTION

3.1 FLOOR FINISH:

.1 Concrete surface must be clean and sound. Remove dust, laitance, grease, oil, dirt, and curing agents.

.2 Apply floor hardener at rate of 4-5 m^2/L to manufacturer's instructions. Cure to manufacturers recommendations (min. 4 – 6 hours).

3.2 APPLICATION:

.1 Apply directly from container, undiluted uniform coating at the rate of 4-5 m^2/L. Brush material into the surface with a stiff-bristle floor-scrubbing machine until the product begins to gel.

.2 Wet material lightly with a water spray and rework into the concrete surface for 10-20 min. Rinse the floor and remove excess material with a squeegee and wet vacuum.

.3 Allow first coat to cure and install a second application. Second application installed min. 2 hours following the first application.

3.3 CLEAN-UP:

.1 Wash off over-spray from glass, aluminum, or polished surfaces with water to avoid etching of surfaces. Do not allow floor sealer to dry before flushing excess from surfaces.

END OF SECTION

SECTION 03370
PORTLAND CEMENT GROUT

PART 1 – GENERAL 1

1.1 SCOPE 1
1.2 WORK INCLUDED: 1
1.3 JOB CONDITIONS: 1

PART 2 - PRODUCTS 1

2.1 MATERIALS: 1
2.2 GROUT MIX (PROPORTIONS BY VOLUME): 1

PART 3 – EXECUTION 2

3.1 PREPARATION: 2
3.2 PLACING, FINISHING, CURING AND PROTECTION: 2

SECTION 03370
PORTLAND CEMENT GROUT

PART 1 – GENERAL

1.1 SCOPE

.1 This Section of the Specifications shall be read in conjunction with Section 03000 - Concrete, which shall apply to and govern the work of this Section.

1.2 WORK INCLUDED:

.1 Supply and place all Portland cement grout as detailed on the Drawings or as directed by the Engineer.

.2 Portland cement grout and non-shrink grout may be used as required for benching in manholes, pipe penetrations through walls, or other requirements identified during construction.

1.3 JOB CONDITIONS:

.1 Comply with Job Conditions of Section 03300.

PART 2 - PRODUCTS

2.1 MATERIALS:

.1 Comply with material requirements of Section 03300.

2.2 GROUT MIX (PROPORTIONS BY VOLUME):

.1 1 part Portland cement

.2 1 1/4 parts fine aggregate

.3 2 1/2 parts coarse aggregate (10 mm to 5 mm size)

.4 Admixture: 125 mL water reducing admixture/100 kg cement

.5 Slump: 0 to 25 mm.

PART 3 – EXECUTION

3.1 PREPARATION:

.1 Thoroughly roughen and clean surface of all laitance and dirt. Moisten immediately before placing grout.

3.2 PLACING, FINISHING, CURING AND PROTECTION:

.1 Comply with Section 03300.

END OF SECTION

SECTION 03400
ARCHITECTURAL PRECAST CONCRETE

PART 1 GENERAL

1.01 GENERAL REQUIREMENTS

.A General Conditions, Supplementary Conditions and Division 01 apply to this Section.

1.02 SUMMARY

.A Description:

.1 Complete all architectural precast concrete work including structural steel elements such as bracing and plates to the full intent of the drawings and as specified.

.2 Caulking between precast concrete units including joints between precast concrete units and adjacent structure.

.B Related Sections:

.1 Section 03300 – Cast-in-Place Concrete

.2 Section 04220 – Masonry

.3 Section 05120 – Structural Steel

.4 Section 05500 – Metal Fabrications

.5 Section 06100 – Rough Carpentry

.6 Section 07240 – Exterior Insulation and Finish System

.7 Section 07544 – PVC Fully Adhered Single Ply Roofing System

.8 Section 07620 – Sheet Metal Flashing and Trim

.9 Section 07900 – Joint Sealers

.10 Section 08110 – Steel Door and Frames

.11 Section 08360 – Sectional Insulated Overhead Doors

.12 Section 08410 – Aluminum Entrances and Storefronts

.13 Section 09900 – Painting

1.03 REFERENCES

.A American Society for Testing and Materials (ASTM):

.1 ASTM C260 – Standard Specification for Air-Entraining Admixtures for Concrete

.2 ASTM C920 – Standard Specification for Elastomeric Joint Sealants

.B Canadian Standards Association (CSA):

.1 CSA A23.1/A23.2 – Concrete Materials and Methods of Concrete Constructions/Methods of Test for Concrete, Includes all Updates

.2 CSA A23.3 – Design of Concrete Structures, Includes all Updates

.3 CSA A23.4 – Precast Concrete – Materials and Construction, Includes all Updates

.4 CSA A3000 – Cementitious Materials Compendium

.5 CSA W47.1 – Certification of companies for fusion welding of steel, Includes all updates

.C National Building Code.

.D Provincial Building Codes (where applicable).

1.04 SUBMITTALS

.A Section 01300 - Submittals: Procedures for submittals.

.B Contract Closeout Submittals: Submit under provisions of section 01700.

.C Submit Shop Drawings within twenty-one (21) Working Days of award of Contract:

.D Submit copy of Contractor's Shop Drawing Review form at end of this Section within twenty-one (21) Working Days of award of Contract.

.E Shop Drawings:

.1 Submit shop drawings showing (but not limited to) the following:

.a Location of each unit in completed structure;

.b All jointing details;

.c Dimensions of each unit including holes, irregularities and thickness of facing units;

.d Reinforcing details, grade of reinforcing and bar lists;

.e Concrete strengths and any admixtures proposed;

.f Jointing clearances and clearances between units and structural building formwork.

.2 Complete connection and insert details including materials, size and length of welds. Provide other trades with detailed drawings and setting information so

connection material and back-up material can be readily erected in required location. Finish designation number and location on each precast until as well as identifying marks for each precast unit.

.3 Special precautions to be taken by other trades affecting Work of this Section.

.4 Manufacturer and trade names for sealant and insulation including data sheets.

.5 Verify with submission of shop drawings that all components, anchors, supports and reinforcing will safely support superimposed loads without reaction detrimental to function, appearance or safety.

.6 Shop drawings shall bear seal of qualified professional engineer registered to practice in the place of work, employed by precast unit manufacturer and shall show calculated short-term and long-term panel deformations due to curing, shrinkage, creep and temperature effects.

.F Submit proof of plant certification according to CSA A23.4, Qualification Code for manufacturers of architectural structural concrete.

.G Samples:

.1 Submit three 24" square sample panels of each texture for approval to the Consultant. Adjust mix and finish and resubmit until approval is obtained. Final panels to match approved samples.

1.05 QUALITY ASSURANCE

.A Concrete materials: To CSA A23.1.

.B Methods of test for concrete: To CSA A23.2.

.C Design of concrete structures for buildings: To CSA A23.3.

.D Precast concrete materials and construction: To CSA A23.4.

.E Certification of companies for fusion welding of steel structures: To CSA W47.1.

.F The precast concrete elements shall be fabricated and erected by a manufacturing plant certified by the Canadian Standards Association in the appropriate category(ies) according to CSA A23.4, Qualification Code for Manufacturers of Architectural and Structural Concrete. The precast concrete manufacturer shall be certified in accordance with CSA's certification procedures for precast concrete plants prior to submitting his tender and shall specifically verify as part of his tender that his plant is currently certified in the appropriate category(ies).

.1 Only precast elements fabricated in such certified plants shall be acceptable to the Owner and plant certification shall be maintained for the duration of the fabrication and erection for this project.

.G Submit references indicating history of successful Work of this type and evidence of certification to Consultant for approval, within five (5) days, prior to tender closing.

.H Design precast and connections for seismic conditions in accordance with all local authorities having jurisdiction.

1.06 DELIVERY, STORAGE AND HANDLING

.A Transport, handle and store units by approved methods to prevent chipping, cracking and other damage. Store units by methods to prevent physical damage and straining.

1.07 WARRANTY

.A Warrant Work of this Section against defects in materials and workmanship in accordance with general Conditions but for an extended period of five (5) years.

.B Agree to promptly make good defects which become evident during warranty period without cost to the Owner. Defects include, but not limited to, spalling, cracking, splitting, deformation, loosening of facing panels, joint failure and leakage. The Contractor further agrees to repair to Owner's satisfaction or replace all the work which fails in any of the aforesaid respects, making good all damage to other property and the Owner's property due to replacement.

PART 2 PRODUCTS

2.01 MATERIALS

.A Cement and Aggregates:

.1 Conform to applicable requirements of CSA A3000 and CSA A23.1 cement.

.2 Reinforcing Steel, Metal Connections, Bearing Materials, Concrete Inserts and Lifting Devices:

.a Comply in all respects with CSA A23.4 or requirements of authorities having jurisdiction, whichever are more stringent.

.3 Anchors and Supports:

.a Mild steel or structural steel sections of sizes and thickness to adequately secure and/or support units. All material cast in concrete to be hot dipped galvanized after fabrication.

.4 Aggregates:

.a Conforming to CSA A23.1, 5/32" to 23/32", aggregate size.

.5 Air Entraining Agent:

.a 'MBVR' by Master Builders Co. Ltd., 'DAREX' A.E.A. by W.R. Grace of Canada or other approved alternate conforming to ASTM C260.

.6 Insulation:

.a Rigid type insulation, extruded polystyrene type III, Styrofoam Panelmate Ultra by Dow or Celfort 200 by Owens Corning, provide minimum R-value rating of R-12 and to conform to the requirements of the Local Building Code.

.7 Sealant:

.a Multi component chemical curing sealant compound conforming to ASTM C920, Tremco 'DYmeric' by Tremco Ltd. Colour to match painted precast panels. Allow for two colours.

.8 Back-Up For Sealant:

.a Insert foam filler type (expanded polyethylene or polyurethane). Compression not less than 25%, non-staining type, ‘Ethafoam’ by Dow Chemical Canada Inc. or approved equal.

.9 Sealant Primer:

.a As recommended by sealant manufacturer, non-staining type.

.10 Breathing Tubes with Screen:

.a '#341S', round plastic weep tube with stainless steel insert, by Hohmann & Barnard, Inc.

.11 Metal Primer:

.a Ready mixed, organic, zinc rich paint conforming to CAN/CGSB 1.181M, for shop priming of exposed metal and field touch-up after erection.

2.02 FINISH

.A Finishing:

.1 Execute the work using the required gun technique, proceeding progressively over the entire are being finished to produce a uniform even texture throughout with the same degree of aggregate exposure as that of the approved sample area.

.B Smooth finish: as cast using smooth steel form liners.

.1 Smooth float back surface of precast units exposed on both sides.

2.03 DESIGN

.A Design of precast units, anchors, joints, connections, reinforcing, etc. shall be a qualified professional engineer registered to practice in the place of the Work and employed by precast unit manufacturer. Design panels to provide profiles and joint locations as shown on drawings.

.B Whereas certain of the details and sections show anchors, clips, etc., these are indicative and diagrammatic only, and are shown to alert trades, other than Section 03400, presence of such items, to be aware of and co-ordinate to, Work of their Sections. Design, positioning, sizes and configuration of all precast concrete anchoring devices, clips, angles, etc. shall be sole responsibility of precast concrete sub-contractor. Ensure that there is at least one connection at the mid height of precast panels to eliminate differential lateral deflection between adjacent panels. Mid height connections to be within panel so as not to be visible.

.C Design precast concrete units to withstand anticipated temperature changes and load requirements in accordance with local Building Code. Climatic design criteria, based on 30 year return where required.

.D Design units to withstand all other dead or live loads and to provide maximum deflection of 1/360 of span underweight of the live and dead loads.

.E Design units with the following characteristics:

.1 Compressive strength – 35 MPa minimum

.2 Absorption – not to exceed 3% measured after 48 hour soaking.

.3 Porosity – air entraining agent to produce “in place” 6% nominal (5% to 7%).

.4 Waterproofing – additive – to be added in ratio as specified by manufacturer and mixed in strict accordance with their recommendations.

.5 Thickness – refer to Drawings for particular units. Units to be insulated and un-insulated.

2.04 OPENINGS, BUILT-INS, ETC.

.A Provide all holes, openings, dips, reglets, etc. and build-in all items requiring building-in for Work of all Sections as required to complete project.

2.05 FABRICATION AND MANUFACTURE

.A Fabricate insulated and un-insulated units as indicated on Drawings and in accordance with reviewed shop drawings and to meet requirements of local by-laws and this Section.

.B Reinforce units with welded steel reinforcing and shear ties sufficient to withstand handling stresses, temperature changes, wind load, dead loads and live loads, in accordance with requirements of Local Building Code.

.C Cast-in anchors, blocking and inserts as required. Where possible, permanently attach anchors and inserts to reinforcing, provide required holes and sinkages. Include plastic inserts for nailing wood blocking at top of precast.

.D Fabricate weld plates, threaded inserts or other connection fitting of steel, properly located and anchored to reinforcement.

.E Handle slabs during stripping, utilizing embedded inserts in slab ends only, to prevent marking of slabs through conventional use of slings or ropes.

.F Handling of units shall be so designed that no face handling methods will be employed. Panels handled by inserts on exposed faces requiring subsequent patching, filling, etc. are unacceptable.

.G Cast-in all necessary lintels, and the like, to support openings up to 12'-0" in width. Refer to drawings for extent. Provide all necessary reglets for flashing and other necessary attachment thereto.

.H Execute Work accurately, true to dimensions, square in true planes, free from waves, twists, cracks, checks and broken edges. Edges shall be straight and clean with accurate arrises.

.I All reinforcing steel hooks, anchors, or other ferrous metal cast into concrete shall be galvanized after cutting, bending or fabrication to G-90 zinc coating. All steel units cut after fabrication shall be dipped in zinc rich paint.

2.06 TOLERANCES

.A Conform to CSA A23.4, and the following:

.1 Lengths and widths Plus or minus 1/8" in 10'-0".

.2 Thickness Plus or minus 1/16".

.3 Warpage Plus or minus 1/8" in 10'-0".

.4 Deviation from horizontal Plus or minus 1/16" vertical lines in 10'-0".

.B In event of conflict, the more stringent of the above CSA and specified tolerances shall apply. Tolerances are non-cumulative.

.C Design and provide mid-span restraints at corners and any other panels as may be required to maintain uniformity of plane and joints between adjacent panels within required tolerance.

PART 3 EXECUTION

3.01 INSTALLATION

.A Do Work with workmen skilled in this trade. Co-ordinate with Section 05120: Structural Steel.

.B Set plumb, true and square, with joints parallel and uniform in accordance with reviewed shop drawings.

.C Provide all metal anchors, connectors, angles and fastening devices to secure units, including bolts, nuts, washers, locks and expansion shields. Deliver anchors, plates, etc. to be built into Work to trades requiring them.

.D Repair or replace chipped, cracked, blemished or defective units to the Consultant's satisfaction. Replace units where variance of colour or shade of adjacent units are unacceptable.

.E Construct connections such that forces are transferred in directions of reactions indicated on drawings.

.F Install breathing tubes with stainless steel insect screens at bottom of all vertical exterior joints.

.G Apply sealant and joint backing at exterior and interior joints between precast units, against dissimilar materials and between precast units and foundation walls, for complete weather tight installation in accordance with Section 07900.

.H Prime paint all exposed metal. Following erection, touch-up paint damaged by welding and installation operations with zinc-rich prime paint.

.I Clean precast panels using approved methods.

END OF SECTION

SECTION 03620
NON-SHRINK GROUT

PART 1 – GENERAL 1

1.1 SCOPE 1
1.2 WORK INCLUDED: 1
1.3 JOB CONDITIONS: 1

PART 2 - PRODUCTS 1

2.1 MATERIALS: 1

PART 3 – EXECUTION 1

3.1 PREPARATION: 1
3.2 PROPORTIONING: 1
3.3 PLACING, FINISHING, CURING AND PROTECTION: 2

SECTION 03620
NON-SHRINK GROUT

PART 1 – GENERAL

1.1 SCOPE

.1 This Section of the Specifications shall be read in conjunction with Section 03000 - Concrete, which shall apply to and govern the work of this Section.

1.2 WORK INCLUDED:

.1 Supply and place all non-shrink grout as detailed on the Drawings or as directed by the Engineer.

.2 Non-shrink grout may be used as required for benching in manholes, pipe penetrations through walls, or other requirements identified during construction.

1.3 JOB CONDITIONS:

.1 Comply with Job Conditions of Section 03300.

PART 2 - PRODUCTS

2.1 MATERIALS:

.1 Proprietary non-shrink grout:

.1 IN-PAKT Pre-Mix by C.C. Chemicals Limited.

.2 Non-shrink Construction Grout (Pre-mixed) by CPD, or approved equal.

.2 Aggregates – comply with material requirements of Section 03300

PART 3 – EXECUTION

3.1 PREPARATION:

.1 Thoroughly roughen and clean surfaces of all laitance and dirt. Moisten immediately before placing grout.

3.2 PROPORTIONING:

.1 Comply with manufacturer’s recommendations.

3.3 PLACING, FINISHING, CURING AND PROTECTION:

.1 Comply with Section 03300 and manufacturer’s recommendations.

.2 Finish grout surfaces to match adjacent surfaces or as specified on the drawings.

END OF SECTION

DIVISION 4
MASONRY

04200 Masonry

SECTION 04200
MASONRY

GENERAL

1.01 GENERAL REQUIREMENTS

.A General Conditions, Supplementary Conditions and Division 01 apply to this Section.

1.02 SUMMARY

.A Section includes:

.1 Decorative Block

.2 Concrete Masonry Unit

.3 Mortar & Grout for Unit Masonry

.4 Reinforcement, Anchorage & Accessories

.5 Dampproof course/membrane flashing

.B Related Sections:

.1 Section 03300 – Cast-in-Place Concrete

.2 Section 05120 – Structural Steel

.3 Section 05400 – Cold Formed Metal Framing

.4 Section 05500 – Metal Fabrications

.5 Section 06100 – Rough Carpentry

.6 Section 07195 – Air Barrier Membrane

.7 Section 07210 – Building Insulation

.8 Section 07900 – Joint Sealers

.9 Section 08110 – Steel Doors and Frames

.10 Section 08360 – Sectional Insulated Overhead Doors

.11 Section 09260 – Gypsum Board Systems

.12 Section 09900 – Painting

1.03 REFERENCES

.A American Society for Testing and Materials (ASTM)

.1 ASTM C207 – Standard Specification for Hydrated Lime for Masonry Purposes

.2 ASTM C260 – Standard Specification for Air-Entraining Admixtures for Concrete

.B Canadian Standards Association (CSA):

.1 CSA A23.1/A23.2 – Concrete Materials and Methods of Concrete Constructions/Methods of Test for Concrete, Includes all Updates

.2 CAN/CSA A165 – CSA Standards on Concrete Masonry Units, Includes all Updates

.3 CAN/CSA A179 – Mortar and Grout for Unit Masonry, Includes all Updates

.4 CSA A3000 – Cementitious Materials Compendium

.5 CSA G30.3-M – Cold-Drawn Steel Wire for Concrete Reinforcement

.6 CSA G30.5-M – Welded Steel Wire Fabric for Concrete Reinforcement

.7 CSA G30.18-M – Carbon Steel Bars for Concrete Reinforcement, Includes all Updates

.8 CAN3-S304-M – Masonry Design for Buildings

1.04 SUBMITTALS

.A Section 01300 - Submittals: Procedures for Submittals.

.B Submit Shop Drawings within twenty-one (21) Working Days of award of Contract.

.C Submit copy of Contractor's Shop Drawing Review form at end of this Section within twenty-one (21) Working Days of award of Contract.

.D Shop Drawings:

.1 Submit elevations of all masonry walls showing full height and length of masonry walls, weep vents, reinforcing size, quantity and spacing, location, length and grade of steel and control joint locations. Reinforcing shall include, but is not limited to vertical and horizontal wall reinforcement, dowels, bond beam reinforcement, embedded steel items and anchor bolts. Shop Drawings shall include top of bearing plate elevations, and elevations to the centrelines of embedded plate, anchor bolts, and all control joint locations.

.E Grout and Mortar:

.1 Submit the following Product Data within twenty-one (21) Working Days of award of Contract:

.a Design Mix.

.b Proportion Method Used.

.c Required Environmental Conditions.

.d Assurance That Mix is Free of Admixtures.

1.05 Test Results of Trial Design Mix.quality assurance

.A Samples:

.1 Submit samples of each block type mortar, masonry accessories, counterflashing, air barrier and cavity wall insulation for Consultant's approval before commencing work.

1.06 DELIVERY AND STORAGE

.A Deliver and store masonry units on site on pallets well away from roads. If this cannot be done, stick masonry units carefully and neatly on high ground and on solid planks. If not used immediately after delivery, cover with tarpaulins or 6 mil polyethylene adequately weighted or anchored down. Keep units protected form roofing bitumen, concrete, mortar and other work and materials which could stain them.

.B Store baggage products such as lime, cement and metal accessories in dry, waterproof sheds.

1.07 JOB CONDITIONS

.A Protection:

.1 Protect laid masonry from damage by weather. At end of each day or shutdown period, cover exposed tops of masonry with canvas or strong waterproof membrane securely clamped down and overhanging on each side of wall at least 2'-0". Use wire spring clamps which extent 8" down each side of wall, spaced 8'-0" maximum or other approved method.

.B Cold Weather Protection:

.1 Keep masonry materials completely free from ice and frost. Use approved smokeless heaters. Do not use salts, admixtures or antifreezes.

.2 Conform to the following construction requirements.

AIR TEMPERATURE	HEATING OF MATERIALS	PROTECTION
Above 5°C	Normal masonry procedures	Cover walls and materials.
Below 5°C	Heat mixing water. Mortar temperature between 5° and 30°C until placed.	Cover walls and materials to prevent wetting and freezing.

Below 0°C	In addition to above, heat sand. Thaw frozen sand and frozen wet masonry units before use.	With wind velocities over 35 K.P.H. provide windbreaks during the workday and cover materials at the end of each workday to prevent wetting and freezing. Maintain masonry above 0℃ by using auxiliary heat or insulated blankets for 16 hours after laying masonry units.
Below -6°C	In addition to above, heat dry masonry.	Provide enclosure and supply sufficient heat to maintain masonry enclosure above 0℃ for 24 hours after laying masonry units.

.C Hot Weather Protection:

.1 When the ambient air temperature exceeds 38℃, or 33℃ with a wind velocity greater than 8 mph, execute the following:

.a Store masonry units out of direct sunlight.

.b Do not spread mortar beds more than 4'0" ahead of masonry.

.c Set masonry units within one (1) minute of spreading mortar.

PRODUCTS

1.08 DECORATIVE BLOCK

.A Decorative Concrete Block; Modular, conforming to CAN/CSA A165.

.B Block Types:

.1 Type 1: textured face, running bond masonry block, Colour: Charcoal, by Brampton Brick, or Thames Valley Brick or Shouldice Stone, refer to drawings for size and location.

.2 Type 2: Smooth Face, 90 mm h x +/- 590 mm w, raked mortar joint horizontally, "Colby" by Shouldice Stone in Biege or similar as approved by Consultant by Brampton Brick or Thames Valley Brick, refer to drawings for type, size and location.

.C Include for special shapes and solid units as detailed as required. Special shapes shall be manufactured and fired at the same time and with the same batch as standard clock to be used.

1.09 CONCRETE BLOCK

.A Blocks, CAN/CSA A165, modular, conforming to lineal shrinkage and moisture movement not to exceed 0.035% and shall be as follows:

.1 SF/15.0/A/M, 100% solid (without cores) for all locations where structural members bear on concrete block.

.2 SS/15.0/A/M, 75% solid for all locations requiring a 2-hour fire rating, or where indicated on drawings. Lightweight concrete block may be used upon approved by Consultant.

.3 H/15.0/A/M, for all other block work.

.4 Exposed block shall all be made by one manufacturer and shall be uniform in colour, shade and texture.

.5 Where concrete block walls are required as fire separations or barriers, they shall conform to the National Building Code, with respect to equivalent thickness and type of concrete. Consult with Consultant for locations and special conditions.

.B Include for special shapes and solid units as detailed or as required. Special shapes shall be manufactured and fired at the same time and with the same batch as standard block to be used.

1.10 MORTAR MATERIALS

.A Mortar materials shall conform to CAN/CSA A179. All mortars to be factory mixed, only water to be added at the jobsite.

.B Water: Potable (clean, exempt of ice, oils, acid, alkalis, organic matter, sediments or any other harmful matter).

.C Aggregate: CAN/CSA A179

.D Cement: Normal portland, CSA A3000, Type 10.

.E Hydrated Lime: ASTM C207, Type S

.F All mortar shall be premixed bulk silo or bagged mortar, supplied by Daubois, Maxi-Mix or Forwell.

1.11 MORTAR MIXES:

.A Mixing:

.1 Prepare and mix mortar materials under strict supervision and in small batches for immediate use only. Mix proprietary mortars in strict accordance with CAN/CSA A179. Do not use re-tempered mortars.

.B For Beddings Lintels:

.1 Use premixed Type ‘S’ mortar as per property specifications, CAN/CSA A179, Table 6, having a minimum compressive strength of 8.5 MPa at 28 days, jobsite tested.

.C For Masonry Below Grade and In Contact With Earth:

.1 Use premixed silo or bagged Type 'S' masonry cement mortar having minimum compressive strength of 8.5 MPa at28 days, jobsite tested.

.D For Masonry Veneer Tied To Steel Stud or Masonry Back-Up Wall:

.1 Use Type 'N', 1:1:6 pre-mixed, Portland cement/lime/sand mortar, 'Betomix Plus' by Daubois Inc., or Maxi-Mix silo.

.E For All Other Masonry:

.1 Use Type 'N', premixed silo or bagged masonry mortar having a minimum compressive strength of 3.5 MPa at 28 days, jobsite tested, as per property specification, Table 6, CAN/CSA A179.

1.12 NON-SHRINK GROUT

.A "Masterflow 713" manufactured by Master Builders Ltd. or "M-Bed Standard" manufactured by Sika Canada Inc or 'CPD Non-Shrink Grout' by CPD Construction Products.

1.13 MASONRY TIES AND ANCHORS

.A Masonry Reinforcement:

.1 "Dur-O-Wal Truss" or "Ladur" manufactured by Dur-O-Wal Ltd., or "Blok-Lok" or "Blok-Trus" manufactured by Blok-Lok Ltd., wire shall be 9 gauge (Imperial) deformed, 'Brite' finish for interior wall locations and hot dipped galvanized after fabrication at exterior wall locations, sized 1-5/8" to 2" narrower than wall partitions. Provide prefabricated corners and intersections.

.B Masonry Pier Anchoring System to Steel Columns:

.1 “Flex-O-Lok” anchors by Bloc-Loc Ltd. or “MSSA” anchors by Dur-O-Wal Ltd. complete with wire ties. Welded to columns at masonry piers.

.C Masonry Veneer Anchoring System For Steel Stud Back-up:

.1 Refer to Section 05400: Cold Formed Metal Framing.

.2 Receive stainless steel V-wire ties for installation by this section.

.D Cavity Wall Masonry Reinforcement For Masonry Back-up:

.1 Econo-Cavity Lok by Blok-Lok Ltd., or 'Dur-O-Wal Wall Ties' truss type by Dur-O-Wal Limited, or 'Wire Bond Cavity Wall Truss Type' by Masonry Reinforcing

Corporation of America and distributed by JV Building Supply, division of Consolidated Materials Corporation, 9 gauge (Imperial) deformed wire, hot-dip galvanized after fabrication, and sized 1-1/2" to 2" narrower than wall partition with side rods centred on face shells. Provide prefabricated corners and intersections.

1.14 PACKING INSULTATION

.A Loose, glass fibre insulation, 1 pound per cubic foot density, or mineral wool.

1.15 WEEPHOLES

.A Flexible ultraviolet resistant polypropylene co-polymer type 'DA 1006 Cell Vent' by Dur-O-Wal Limited, or 'Cell-Vent' by Blok-Lok Limited, set on 32" centres in the following locations:

.B Bottom course of block veneer throughout.

.C Top courses of block veneer throughout;

.D Block veneer course resting on lintels and intermediate angles.

1.16 MEMBRANE FLASHING

.A 40 mils thick glass fibre reinforced SBS modified bitumen membrane flashing, ‘Blueskin TWF’ by Bakor Inc.

.B Membrane Flashing Primer:

.1 Synthetics rubber, solvent base, trowel consistency type primer, 'Blueskin Primer' by Bakor Inc., or polymer emulsion type, 'Blueskin Aquatac' by Bakor Inc., as recommended by manufacturer to suit conditions.

.C Flashing Adhesive:

.1 As recommended by the manufacturer to suit the application.

.D Dampproof Course/Thru-Wall Membrane Flashing Primer:

.1 Synthetic rubber, solvent base, trowel consistency type primer, 'Blueskin Primer' by Bakor Inc., or polymer emulsion type, 'Blueskin Aquatac' by Bakor Inc., as recommended by manufacturer to suit conditions.

.E Damp Course/Thru-Wall Flashing Adhesive:

.1 As recommended by the manufacturer to suit the application.

EXECUTION

1.17 INSTALLATION: GENERAL

.A Maintain dimensions, lines and levels.

.B Keep exposed faces free from stains, chips and cracks. Keep tolerance in plane 1/8" in 8'-O". Do not use chipped, cracked or deformed units in exposed work.

.C Buttering corners of units, throwing mortar droppings into joints, will not be permitted. Do not shift or tap units after mortar has taken initial set, where adjustments must be made after mortar has started to set, remove mortar and replace with fresh supply.

.D When mortar is "thumbprint" hard, tool all masonry joints (exposed or concealed) concave. Use sufficient force to press mortar tight against masonry units on both sides of joints. Remove excess material or burrs left after jointing. Use trowel or rub with burlap bag.

.E Lay all joints 3/8" thick unless otherwise specified or otherwise indicated. Fill all joints solidly with mortar except where specifically designated to be left open.

.F "Exposed" means visible in complete work, unpainted and painted.

.G Stagger joints in every course. Align joints plumb over each other in every other course. Vertical and horizontal joints to be uniform in thickness.

.H Distribute exposed masonry of varying colours, tones and textures evenly over all surfaces to avoid patches and streaks, and to produce homogeneous blend. Do not install units which are too contrasting for satisfactory blend. If masonry units of too contrasting a colour are used and blend is not satisfactory to the Consultant, then this Contractor shall be responsible for removing those units and replace with units of more even colour, tone and textures to Consultant's approval.

1.18 DECORATIVE BLOCK

.A Lay units in full bed of mortar with all joints solid in every course. In general units shall be laid in running bond.

.B Install continuous membrane course at bottom of first block course. Lap and seal joints. Install metal drip flashing at angle lintels as indicated.

.C Ensure 1/8" clearance is maintained between bottom surface of intermediate shelf angles and top of block in first course below. Clean away all mortar from this space and apply continuous bead of sealant at face joint. Refer to Canadian building digest No. CBD 185, latest edition, issued by division of Building research, National Research Council of Canada.

.D Keep air space clean of mortar droppings and other foreign materials.

1.19 BLOCKWORK

.A Provide special shapes and sizes as required such as halves, jambs, lintels, solids, corners, semi-solids, etc.

.B Lay block webs to align plumb over each other with thick ends of webs up. Leave no cells open in exposed work. Reinforce all blockwork.

.C Minimize cutting block. Cut exposed work with power driven abrasive cutting disc or diamond cutting wheel for flush mounted electrical outlets, grilles, pipes, conduit, etc., leaving 1/8: maximum clearance.

.D Do not wet concrete masonry units before or during laying.

.E Locate corners accurately. Use full bed of mortar for first course. Bed face shells and cross and end web fully in mortar. Stagger joints in every course. Align joints plumb over each other in every other course.

.F Bond intersecting block walls in alternate courses. Do not break bond of corridor walls or other walls of exposed units where partitions intersect and if bonding would show through on intersect with prefabricated intersection masonry reinforcement in each course.

.G Take special care in erecting block walls to which other sections will be applying finishes or attaching equipment to ensure tolerances required of following sections can be met with reasonable construction procedures. (e.g. thin-set application of ceramic tile.)

.H Provide bullnose block at all exposed block corners.

.I Build block lintels, ensure that lintel jointing coincides with regular bond.

1.20 CONTROL JOINTS

.A Provide vertical through-wall control joints 25'-0" O.C. maximum (except as otherwise shown or specified) in continuous walls having no openings, intersections or columns. Locate control joints as directed by Consultant.

.B Locate control joints at high stress concentrations and at points of weakness such as at abrupt changes in work height, wall thickness changes such as at chases and at pilasters and maximum of 12'- 0" from corners. Construct joint as detailed.

1.21 REINFROCEMENT AND REINFORCING TIES

.A Reinforce all masonry walls with continuous masonry reinforcement in every second block course.

.B Provide extra reinforcement or reinforcing ties at openings so that first and second courses above and below openings are reinforced. Extend extra reinforcement 2’0” beyond opening in each direction.

.C Tie masonry elements to each other and to structural elements in accordance with referenced standards.

.D Masonry Reinforcement for Earthquake: CAN3-S304-M, refer to notes on Structural Engineers drawings.

1.22 MEMBRANE FLASHING

.A Install membrane flashing in accordance with manufacturer's written instructions, where indicated on drawings and in absence of any indication in locations as follows:

.1 First course above new grade line.

.B Apply primer to all substrate areas where membrane flashings are to be applied. Apply primer using lambs wool roller at rate 100 sq.ft. to 300 sq.ft./gallon depending on porosity of substrates. Allow primer to 'tack up' for approximately 30 minutes prior to application of membrane flashings. Primed surfaces not covered within 24 hours shall be completely reprimed.

.C Extend damp coursing and flashing through full thickness of walls, carrying material from outside to inside. Then install flashing, using same material as damp course, from outside through thickness of first wythe at same joint as damp course, up 8" at concrete block back-up and up 12" at cavity wall sheathing insulation back-up.

.D Wrap damp course/thru-wall flashing into inside corners and around outside corners, sealing seams and corners with adhesive/sealant.

.E Extend flashing through full thickness of walls, carrying material from outside to inside.

.F Lap all joints 6" and seal with adhesive.

.G Inspect flashings for punctures, tears, misaligned seams and the like, apply additional layer of flashing membrane, extending minimum of 6" around damaged area in all directions.

.H Co-ordinate with other trades to ensure continuity of air barrier.

1.23 BUILT-INS

.A Built-in items provided by other Sections, anchor bolts, sleeves, inserts, loose steel lintels, shelf angles, access panels, and other such items. Built-in items to present neat, rigid, true and plumb installation. Leave wall openings required for ducts, grilles, pipes and other items.

.B Fill voids between masonry and metal frames with masonry mortar.

1.24 REPOINTING OR TUCKPOINTING

.A Repoints defective joints as follows: cut back joints ½”, taking care not to damage units. Remove dust and loose materials by brushing or by water jet. If water jet is used, allow excess water to drain before repointing. Repoint with same mix as original. Pack mortar tightly in this layers, and tool joints or strike flush as required.

1.25 CLEANING

.A Keep work clean and free of mortar stains during laying. Allow mortar droppings which adhere to wall to dry out but not set. Then rub with small piece of masonry followed by

brushing to remove all traces. On completion of masonry, after mortar is thoroughly set and cured, and defective joints tucked and pointed, clean masonry thoroughly.

.B Remove mortar with wood paddles and scrapers before wetting. Saturate masonry with clean water and flush off loose mortar and dirt. Clean blockwork using water, scrubbing brushes and wood paddles only.

END OF SECTION

DIVISION 5
METALS

05030	Shop Applied Metal Coatings
05100	Structural Steel for the Structure
05200	Steel Joists
05300	Steel Roof Decking
05400	Cold Formed Metal Framing
05500	Metal Fabrications
05501	Anchor Bolts
05510	Steel Stairs and Railings
05515	Access Ladders
05810	Expansion Joint Assemblies

SECTION 05030
SHOP APPLIED METAL COATINGS

PART 1 – GENERAL 1

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1.2 REFERENCES 1
1.3 DEFINITIONS 1
1.4 PERFORMANCE REQUIREMENTS 2

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2.1 MANUFACTURERS AND PRODUCTS 3
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PART 3 – EXECUTION 4

3.1 PREPARATION 4
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SECTION 05030
SHOP APPLIED METAL COATINGS

PART 1 – GENERAL

1.1 SCOPE

.1 This Section covers the Work for surface preparation and shop painting (or post fabrication painting) of primer/finish coatings on:

.1 Structural Steel

.2 Miscellaneous Steel

.3 Other surfaces referenced to this section.

.2 This Section does not include those coatings, such as fluorocarbon coatings, that are applied to substrates before fabrication.

1.2 REFERENCES

.1 ASTM: American Society for Testing and Materials

.2 SSPC: Structural Steel Painting Council

1.3 DEFINITIONS

.1 General: Standard coating terms defined in ASTM D 16 apply to this Section.

.2 Types of Defects

.1 Physical: Conditions of the coating surface that will affect performance.

.2 Visual: Aberrations in the coating surface that do not affect performance but detract from a smooth, even surface.

.3 Reflectance: Using ASTM D 523 as the standard for measuring specular gloss:

.1 Flat refers to a lusterless or matte finish: 85° geometry = Less than 15 specular gloss reading.

.2 Eggshell refers to low-sheen finish: 60° geometry = Between 5 and 20 specular gloss reading.

.3 Satin refers to low-sheen finish: 60° geometry = Between 15 and 35 specular gloss reading.

.4 Semigloss refers to medium-sheen finish: 60° geometry = Between 30 and 65 specular gloss reading.

.5 Full gloss refers to high-sheen finish: 60° geometry = More than 65 specular gloss reading.

.4 Shop Painting: Painting of surfaces before delivery to construction site. This coating is usually applied after fabrication.

1.4 PERFORMANCE REQUIREMENTS

.1 General

.1 Owner's goal is to reduce the types of hazardous and potentially hazardous materials in Owner's facilities. This includes risk to employees and the environment for initial and maintenance exposures, and final disposal.

.2 Products used must be free of heavy metal compounds, including lead and chromates.

.2 This coating will perform as finish coat.

.1 Visual defects that can be seen from 5 metres under installed lighting conditions are not acceptable.

.3 Steel Coating

.1 Physical Properties

.1 Adhesion: ASTM D 4541, 375 psi minimum.

.2 Color Uniformity: ASTM D 2244 = 0.30 maximum acceptable color difference.

.3 Elongation of Attached Coating: ASTM D 522, Test Method B, 180° bend around 25 mm diameter mandrel = No cracking, 3.3 percent elongation.

.4 Gloss: ASTM D 523, 60° geometry = 30 to 65 specular gloss.

.5 Pencil Hardness: ASTM D 3363, scratch hardness = H (Berol Eagle Turquoise)

.2 Corrosion Resistance: Painted Specimens Subjected to Corrosive Environments: ASTM D 1654 = Failure rating number 8 minimum

.1 Exposure 1 (Salt Spray): ASTM B 117, 5 percent salt solution, room temperature, 500 hours continuous exposure

.2 Exposure 2 (Humidity): ASTM D 2247, 100 percent relative humidity, 38 deg C, 1000 hours continuous exposure

.3 Degree of Blistering: ASTM D 714 = Blister size No. 8, frequency "few" maximum

.3 Weathering: ASTM G 53, fluorescent UVA 313 bulb, cycle 16 hours light at 60 deg C and 8 hours condensation at 40 deg C = Failure rating number 7 minimum

.1 Color Uniformity: ASTM D 2244 = 0.30 maximum acceptable color difference

.2 Chalk Resistance: ASTM D 4214, Test Method A = No. 8 rating

.3 Gloss: ASTM D 523, 60° geometry = 50 percent of original specular gloss retained

PART 2 - PRODUCTS

2.1 MANUFACTURERS AND PRODUCTS

.1 Manufacturers: provide one of the following coatings:

.1 Refer to Specification Section 9900.

.2 Color: light gray form manufacturer's standard color selections.

2.2 SHOP COATING PROCEDURE

.1 Surface Preparation

.1 Clean surfaces to be coated. Remove deleterious materials, including rust, mill scale, spatter, slag, and flux deposits. Minimum surface preparation shall be according to Structural Steel Painting Council (SSPC) specifications.

.2 Profile: Cleaning process selected by Coater, including selection of blasting media, shall leave a maximum profile height of 50 μm (2.0 mils).

.3 Change or clean abrasive media before contaminants start to leave "powder" residue on the abrasive cleaned surface.

.2 Coating Application

.1 Ambient Conditions from Four Hours before Coating Application until Completion of Application: Steel surface temperature shall be 10 deg C minimum and at least 3 deg C above dewpoint.

.2 Just before Coating Application wipe surfaces to be coated to remove loose dust and other debris. Apply tape or masking film to surfaces with high-strength bolted slip-critical connections.

.3 Immediately After Surface Preparation: Apply coating according to manufacturer's instructions and at rate recommended by coating manufacturer to provide minimum Dry Film Thickness: 75 μm (3.0 mils), but not less than thickness recommended by coating manufacturer.

.4 Use coating application method that results in full coverage of joints, corners, edges, and exposed surfaces. Stripe coat (double coat) corners, crevices, bolts, welds, and sharp edges.

.3 Coating Curing or Drying

.1 Mark taped or masked location with an obvious fluorescent red ("day-glo") paint patch or waterproof sticker.

.2 Work with coating manufacturer's representative to optimize drying and curing conditions.

.3 Protect newly coated surfaces from dust and contaminants.

PART 3 – EXECUTION

3.1 PREPARATION

.1 Taped or Masked Locations: Remove tape or film to expose bare metal just before erection.

3.2 REPAIR

.1 When ambient temperature is 0°C and rising, unless otherwise required by coating manufacturer, and immediately after erection, clean field welds, bolted connections, and abraded coating areas according to SSPC SP-2 "Hand Tool Cleaning."

.2 Apply touch-up coating to exposed areas using same materials and color as used for shop coating. Apply coating by brush to provide a minimum dry film thickness of 75 μm (3.0 mils)

END OF SECTION

SECTION 05100 - STRUCTURAL STEEL FOR THE STRUCTURE

1 GENERAL

1.1 GENERAL REQUIREMENTS

.1 General Conditions, Supplementary Conditions and Division 01 apply to this Section.

.2 Conform to the National Building Code of Canada, the Construction Safety Act, CSA Standard S16-01 and applicable Provincial Building Code. All codes and standards shall be current editions with all revisions to date.

.3 Cooperate with other trades for satisfactory completion of the Work.

.4 Where structural steel members specified on the drawings are not available to the contractor, the structural steel contractor shall provide members having all section properties equal to or better than the specified members at no additional cost. Contact engineer for acceptance of any and all substitutions.

1.2 RELATED WORK SPECIFIED ELSEWHERE

.1 Contractor shall be responsible for coordinating this section with all related sections.

1.3 QUALITY ASSURANCE

.1 Any organization undertaking to weld under this contract shall be fully approved by the Canadian Welding Bureau under the requirements of CSA W47.1-03,, W55.3- (latest edition) and CSA W59- (latest edition).

` .2 Shop Drawings:

.1 Prepare and submit shop and erection drawings which conform to the requirement of the General Conditions and Section 01300, CSA S16-01, and as specified herein.

.2 Show the size, spacing and location of structural steel connections, attachments, reinforcing and anchorage. Include necessary plans, elevations and details. Indicate size and type of fastening. For welded connections, use welding symbols in compliance with AWS and indicate clearly net weld lengths.

.3 Submit typical details of connections and any special connections for review by the Consultant before preparation of shop drawings.

.4 Review of shop drawings by the Architect and Engineer will not absolve the Contractor from his responsibility of providing materials and equipment to complete and finish his work in accordance with the contract documents. Departures or differences from the referenced drawings shall be approved, in writing, by the Architect/ Consultant.

.5 The Subcontractor shall include in his delivery schedule a minimum of two (2) weeks for consultant review of shop drawings.

.6 All connections to be designed by a qualified engineer registered to practice in the province of construction.

.7 All shop drawings are to be signed and sealed by a qualified engineer registered to practice in the province of construction, who shall take responsibility for the design of all connections.

.8 Do not use contract documents as shop drawings or erection drawings. Contract documents used for this purpose will not be reviewed. Delays resulting from this procedure will be the responsibility of the contractor.

1.5 INSPECTION AND TESTING

.1 Qualified inspectors will be employed by the Owner for this Work. Inspection organization undertaking to inspect welding shall be qualified in accordance with the requirements of CSA W178.1- (latest edition) "Qualification Code for Welding Inspection Organizations" and approved by the Canadian Welding Bureau.

.2 Provide free access for inspectors to all places where Work is being done.

.3 Inspectors are to ensure that materials conform with the requirements of this Specification.

.4 Mill test reports, properly correlated to the materials, will be accepted in lieu of physical tests.

.5 Inspection shall include:

.1 Shop inspection of fabrication in the plant.

.2 Identification of material grades.

.3 Check of overall dimensions.

.4 Check of cambers.

.5 Check of workmanship regarding layout, punching and reaming of holes.

.6 Shop and field inspection of bolted connections.

.7 Shop and field inspection of welded joints.

.8 General inspection of field cutting and alternations.

.9 General inspection of shop priming and field touch-up.

.6 The installation and testing of bolts shall conform to the requirements CSA S16-01. Inspector shall check one representative connection in ten by torque testing every bolt, and shall check each bolt in every connection with a tap of a hammer for soundness. Inspectors shall enforce the requirements of the connection type.

.7 Inspector shall examine visually all welded joints for inclusions, porosity, lack of fusion, penetration, contour, under-cuts and cracks. Root passes shall be checked for penetration and cracks from the back of the joint. When directed by the Consultant, have one representative weld in ten and every weld in direct tension tested ultrasonically.

.8 Inspector shall make a full prompt written report to the Architect of all inspections and tests. Circulate reports to the Architect (2 copies), Engineers (1 copy), General Contractor (2 copies), Owner (1 copy) and Authorities having jurisdiction.

.9 Steel materials and workmanship not conforming to this Specification will be rejected. Remove and replace defective materials without unnecessary delay and without extra cost.

1.6 DESIGN

.1 Design connections in accordance with the Handbook of Steel Construction by the Canadian Institute of Steel Construction for loads shown or required.

.2 Conform to the National Building Code of Canada (latest edition) and applicable Provincial Building Codes and subsequent updates, CSA S16-01, local by-laws and regulations.

.3 Top of beam elevations given in relation to the underside of steel deck levels shall be:

A)	Beams support joists……..	underside of joist shoe.
B)	Beams not supporting joists……..	0.
C)	Other…….	as noted on plans/sections.

1.7 DELIVERY, STORAGE AND HANDLING

.1 Coordinate deliveries to comply with Construction Progress Schedule and arrange ahead for off-the-ground storage location. Do not load any area beyond the design limits.

.2 Adequately protects the steel against rust and damage during manufacturing, delivery and storage.

.3 Store material on planks on a dry area and protect from damage. Make good immediately any damage done, clean scratches and the like, touch-up with specified primer.

2 PRODUCTS

2.1 MATERIALS

.1 Structural Steel: New stock (not weathered or rusted); to conform to CAN/CSA-G40.20/G40.21- (latest edition), Grade 350W.

.2 Hollow Structural Sections: (HSS); New stock; to conform to CAN/CSA-G40.20/G40.21- (latest edition), Grade 350W, Class H, stress relieved.

.3 Provide high strength bolts in compliance with ASTM Standard A325 (latest edition) – High Strength Bolts for Structural Steel Joints, including suitable nuts and plain hardened washers.

.4 Provide welding electrodes in compliance with CSA W48-Series – Mild Steel Covered Arc Welding Electrodes. Welding materials shall conform to CSA W59- (latest edition).

.5 Structural Steel Primer: CAN/CGSB-1.40-M (latest edition), Structural Steel, Oil Alkyd Type or CAN/CGSB-140-M (latest edition): Red Lead, Iron Oxide, Oil Alkyd type and zinc rich paint to approved manufacturer's specifications containing 85% zinc in dry film for exterior exposed members. Shop coat and on-site touch-up shall be no less than 0.5 mils thickness.

.6 Touch-up Primer: CAN/CGSB-1.181- (latest edition), zinc rich organic primer, "Gild Zinc 100" by ICI Paints Canada Inc., or other approved manufacturer.

.7 Commercial galvanizing to conform to CSA Standard G164-M (latest edition).

.8 Welded studs shall be by an approved manufacturer such as TRW Nelson and shall conform to CSA Standard W59- (latest edition).

3 EXECUTION

3.1 PREPARATION RELATED TO OTHER TRADES

.1 As the work of other trades progresses, supply anchor bolts, adjustable lintel inserts, bearing plates, lintels and other members required to be built-in with the work of other trades.

.2 Give necessary instructions to other trades for setting bearing plates, anchor bolts and other members to be built-in with the work of other trades.

.3 Verify the locations and elevations of concrete foundations and anchor bolts for column bases before standing columns, or commencement of erection will be deemed to represent acceptance of the previous work and conditions.

3.2 FABRICATION

.1 Fabrication of structural members shall comply with CSA S16-01 and as specified below.

.2 Use only clean and straight material. If straightening or flattening is necessary, do it only by a process and in a manner that will not injure the material. Material having kinks or bends not called for on the drawings will be rejected.

.3 Shop or field connections shall be bolted with high strength bolts or welded. Connections shall be made with due regard for Architectural Drawings and appearance. **Do Not** interfere with clearance lines or architectural finishes.

.4 Minimum size of welds to be 5mm.

.5 Beam connections shall be adequate to resist the reactions produced by the framing or load conditions.

.6 Provide double angle header connections where practical. Otherwise use seat connections with top clip angles for lateral support.

.7 Header connections shall be used at all expansion joints for structural steel.

.8 Minimum length of double angle header connections shall not be less than half of the depth of the beams.

.9 Do not use one-sided or fish plate type connections.

.10 Provide top and bottom flange angle clips for all spandrel beams.

.11 Provide punched holes 11mm to 27mm in diameter for convenience of other trades in attaching wood or other materials to steel work, when so directed by the Architect.

Holes shall be so placed as not to cause any appreciable reduction in the strength of the member.

.12 Provide holes for pipes and ducts and the reinforcing for same as indicated on drawings. Cutting of holes in steel beams in the field will not be permitted, without the written approval of the Consultant.

.13 Provide separators at approximately 1200mm o.c. for double beams and channels as follows:

.1 Beams and channels 200mm or less in depth – one or two rows of pipe separators.

.2 Beams and channels over 200mm in depth – channel separators unless otherwise detailed on the drawings.

.14 Mill column bearing plates under column bearing.

.15 Structural steel members shall not be spliced unless approved by the structural engineer in writing.

.16 Provide 50mm clear space between structural steel at expansion joints.

.17 Provide adjustable galvanized steel anchors 40mm x 6mm on columns that abutt masonry for anchoring every 400mm in height.

.18 Provide adjustable galvanized steel anchors 40mm x 6mm on beams that abut masonry at 400mm on centre vertically and 2000mm on centre horizontally.

.19 Welding shall comply with CSA W59- (latest edition).

.20 Fabricator shall be approved by the Canadian Welding Bureau under the requirements of CSA W47.1-03.

3.3 SHOP PAINTING AND PROTECTION

.1 Clean steel by shot-blasting or power wire brushing to remove rust, mill scale, oil, dirt, and other foreign matter before commencing shop painting. The quality of cleanliness shall be of standard stated in SSPC-SP6 Commercial Blast Cleaning, or SSPC-SP3 Power Tool Cleaning, as may be required to satisfy final paint finish requirements.

.2 Clean welds by wire brushing and wash down with clean water, to remove the chemical residues left by the electrodes, prior to painting.

.3 All steel work shall receive one shop coat of exterior grade primer.

.4 Steel work shall be painted and shall remain under cover until the paint protection has dried.

.5 Give the parts which are inaccessible after assembly two coats of primer coat paint, of different colors, when members are noted to be painted.

.6 Provide sandblasting before finish painting for steel members at edge of openings as shown on drawings.

.7 Steel work shall be left installed in a clean state ready to receive applicable finishes.

.8 Where steel is to be covered with sprayed fireproofing, ensure that paint primer used is compatible with sprayed fireproofing.

.9 The following surfaces shall not be painted:

1. Surfaces and edges to be field welded, except joist surfaces to receive steel decking. If painted, remove paint for field welding for a distance of at least 50mm on all sides of the joint.
2. The contact surfaces of friction-type connections assembled by high strength bolts.
3. Portions of steel members which are to be encased in, or in contact with, concrete slabs cast-in-place.

.10 All exterior exposed structural steel shall be galvanized or painted with approved rust inhibitive paint.

3.4 ERECTION

.1 Make adequate provision for horizontal and vertical erection loads and for sufficient temporary braces to keep structural steel plumb and in true alignment until the completion of erection and installation of concrete work and roof decks which provide the necessary permanent bracing. Any failure to make proper and adequate provisions for erection stresses shall be entirely at the risk and responsibility of the Contractor.

.2 When temporary steel members are required for erection purposes, such members shall be provided, and removed when no longer required.

.3 Handle and store structural steel on the job site in such a manner that no damage shall be caused to the material, or the structure.

.4 Erect individual members of the structural steel to the following tolerances:

.1 Exterior columns, spandrel beams and angles, 1 to 1000.

.2 All other pieces 1 to 500.

.3 Adjustable Shelf Angles attached to steel frame 3mm plus or minus, with abutting ends of members at the same level. These elements shall be welded in place after final adjustment and galvanizing shall be touched-up with zinc rich paint.

.4 A variation of 1.5mm is permissible in the overall length of members with both ends milled. Members without milled ends which are to be framed to other steel parts of the structure may have a variation from the detail length not greater than 2.5mm for members 9000mm or less in length; and not greater than 3mm for members over 9000mm in length.

.5 Execute all field assembly and welding in accordance with the requirements for shop fabrication excepting such as manifestly apply to shop conditions only.

.6 Provide bearing plates and standard government wall anchors for beams bearing on masonry or concrete.

.7 Provide 150mm bearing for angle lintels and bolt or weld together upstanding legs. Maximum spacing of bolts or welds shall be 600mm.

.8 Paint field bolts, field welds and any abrasions or damage to the shop coat or primer, after erection.

.9 Provide C100 x 8 structural members for framing at perimeter of holes through metal decking where openings between 450mm and 1200mm in roof deck and between 300mm and 1200mm in floor deck measured across the flutes. Connect to main framing members.

3.5 ARCHITECTURALLY EXPOSED STEEL

.1 Where finished surfaces of steel are to be left exposed to view, fabricate as specified in AISC Specification for Architecturally Exposed Steel, including specified straightness.

.2 Continuously welds connection joints where exposed to view, and grind them smooth and flush with adjacent surfaces.

.3 Remove mill marks, identification and surface imperfections by grinding smooth and flush with adjacent surfaces.

.4 Clean, prime and protect all steel as specified in this Section. Apply one coat of primer compatible with finish specified in Section 099

END OF SECTION 05100

SECTION 05200 - STEEL JOISTS

1 GENERAL

1.1 GENERAL REQUIREMENTS

.1 General Conditions, Supplementary Conditions and Division 01 apply to this Section.

.2 Unless otherwise specified, conform to CSA Standard S16-01, Steel Structures for Building – Limit States Design and CSA S136-01, Cold Formed Steel Structural Members including all supplements as of the date of tender.

1.2 RELATED WORK SPECIFIED ELSEWHERE

.1 Contractor shall be responsible for coordinating this section with all related sections.

1.3 QUALITY ASSURANCE

.1 Execute the work of this Section only by personnel who have adequate plant, equipment and skill and are known to have been responsible for satisfactory work similar to that specified during a period of at least five years.

.2 Any organization undertaking to weld under this Contract shall be fully approved by the Canadian Welding Bureau under the requirements of CSA W47.1-03, W55.3 and W59, (latest editions).

1.4 SUBMITTALS

.1 Submit in accordance with the General Conditions and Section 01 30 00 Administrative Requirements.

.2 Shop Drawings:

.1 Submit structural design calculations and supporting engineering information concerning joists. Each design data document shall bear the seal of the design engineer responsible for its preparation.

.2 Prepare erection and detail drawings for open web steel joists for review by the Architect and Consultant.

.3 Show pertinent details including capacity, types, and sizes of joists, details of bridging and anchoring, chord extensions, and reinforcing where required.

.4 Do not use contract drawings as shop drawings or erection drawings. Contract drawings used for this purpose will not be reviewed. Delays resulting from this procedure will be the responsibility of the contractor.

1.5 INSPECTION AND TESTING

.1 Make copies of mill test reports (properly correlated to the materials) available to the Consultant upon request. Mill test reports will be accepted in lieu of mill inspection.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Coordinate deliveries to comply with Construction Progress Schedule and arrange ahead for off-the-ground storage location. Do not load any area beyond the design limits.

.2 Adequately protect steel against rust and damage during manufacturing, delivery and storage.

.3 Store material on planks in a dry area and protect from damage. Make good immediately any damage done, clean scratches and the like, touch-up with specified primer.

1.7 DESIGN

.1 Design joists by a qualified Engineer registered to practice in the province of construction to safely support the uniformly distributed loading shown, all concentrated loads carried by the joists, and in addition, snow accumulation loads as shown.

.2 Design joists for conditions such as non-uniform load, fixed or cantilevered ends or absence of adequate lateral support by the decking.

.3 Design joists for all loading conditions specified in the National Building Code and local building codes, in addition to the snow loads specified on plans.

.4 Specified loads are shown on plans.

.5 Areas shaded on the roof plan indicate extent of additional snow piling with peak specified loads noted. Roof joists shall be designed, manufactured and erected to support basic specified loads as well as additional snow loading.

.6 For water filled pipe sizes and locations, refer to mechanical drawings and sprinkler drawings. In the absence of detailed information, the weights of water filled pipes shall be assumed as follows:

100mm diameter pipes and smaller	ignore	
125mm diameter pipes	w =	0.35 kN/m
150mm diameter pipes	w =	0.47 kN/m
200mm diameter pipes	w =	0.75 kN/m

Add 0.45 kN point loading at the hanging points

Design joists for additional point loads P in kN due to pipe hangers as follows:

$$P = wL + 0.45 \text{ kN}$$

Where L is the hanger spacing in metres and w is the weight of the filled pipe in kN/m.

.7 All mechanical pipes 50mm in diameter and larger shall be hung from top chord of joists at panel points only.

.8 Design joists for net uplift due to wind using gross uplift in accordance with N.B.C. Supplement (latest edition).

.9 All joists are to be cambered for full dead load deflection.

.10 Live load deflection of roof joists when subjected to full total load shall not exceed 1/240 of the span for roof members, except where such members support a plaster ceiling or similar finish like drywall, the deflection due to live load shall not exceed 1/360 of the span. Live load deflection for floor joists shall be as specified on the structural drawings.

.11 T.J. denotes tie joists. Full size of bottom chords shall be framed into columns or beams. Top and bottom chords shall be designed and connected for horizontal loads resulting from a live load moment of negative 14 kN.m specified, or 10% of the specified dead + live vertical end reactions of the joists, (whichever is greater), in addition to the gravity and wind uplift loads specified.

.12 Minimum size of bottom chords for tie joists to be 2L 45x45x5

.13 In order to facilitate the passage of mechanical ducts and pipes through joists, the joist supplier shall locate the diagonals so that they line up from joist to joist.

.14 Steel joist supplier shall design, supply and erect joist bridging of sufficient size and spacing in accordance with the CSA S16-01, and if the assembly is to be fire rated, provide bridging as required by the applicable fire rated design.

.15 Ensure that all bridging is located so that it clears all equipment to be installed between the joists, such as lighting, ductwork, piping etc.

.16 All pipes must be hung from top chord of joists. If a load, (approved by the structural Consultant), is hung from a joist at a location other than the panel point, then a web diagonal shall be welded from the hanger location to the nearest panel point on the opposite chord.

2 PRODUCTS

2.1 MATERIALS

.1 Steel for open web steel joists shall be of quality suitable for the applicable welding processes and shall conform to CSA Standard G40.20/G40.21 (latest edition), General Requirements for Rolled or Welded Structural Quality Steel, and Structural Quality Steels, except that steel used in cold roll-formed components shall conform to the requirements for such steel as prescribed by CSA Standard S136-01, Cold Formed Steel Structural Members.

.2 Welding Electrodes: Conforms to CSA W48.1-M (latest edition) Mild Steel Covered Arc-Welding Electrodes.

.3 Primer: Refer to Structural Steel for Buildings, Section 05 12 23.

.4 Commercial galvanizing – CSA Standard G164-M (latest edition).

3 EXECUTION

3.1 WORKMANSHIP

.1 Conform to CSA Standard W55.3-(latest edition), Resistance Welding Qualification Code for Fabricators of Structural Members Used in Buildings.

.2 Conform to CSA Standard W59-(latest edition), Welded Steel Construction (Metal-Arch Welding).

.3 Connect component members of joists by arc or resistance welding, bolting or other methods approved by the Consultant.

.4 Provide bearings at ends of joists proportioned so that the allowable bearing pressure on the supporting material is not exceeded. On masonry or concrete, extend the end of the bearing a minimum of 100mm beyond the face of the support. On steel, extend the end of the bearing a minimum of 65mm beyond the face of the support.

3.2 PRIME COAT PAINTING AND GALVANIZING

.1 Clean joists by wire brushing or other effective means to remove loose mill scale, rust, oil, dirt and other foreign matter.

.2 Apply one coat of paint in the shop by dipping or spraying.

.3 Touch-up field welds and abrasions in the field.

.4 Where steel joists are covered with sprayed fireproofing, ensure that paint primer used is compatible with sprayed fireproofing.

3.3 ERECTION

.1 Erect, set accurately and in correct alignment, all joists level and true, and so secure them as to remain in place during the installation of the deck.

.2 Anchor joists supporting up to 9 square metres of area to steel supports at each end bearing by a minimum of two 5mm fillet welds, each 25 long, or other comparable means approved by the Consultant.

.3 Anchor joists supporting more than 9 square metres of area to steel supports of each end bearing by not less than two 5mm fillet welds, each 50 long, or other comparable mechanical means approved by the Consultant.

.4 Supply steel packing to elevate joists to the required bearing level or provide a special shoe at the joists.

.5 After erection is complete, remove accumulations of soil or other foreign matter, leaving the surfaces of joists suitable for receiving field painting.

.6 Erect joists in accordance with design.

3.4 INSTALLATION OF BRIDGING

.1 Before the application of any construction load, install bridging in accordance with Section 16.7 of CSA S16-01, and as required by ULC test design where applicable. Anchor each line of bridging to walls and other supporting structural members.

.2 Provide 1 row of horizontal bridging at the first bottom chord panel point at each end of all joists.

.3 Provide additional cross bridging as indicated on plans.

.4 Provide additional X-bridging between the outside perimeter beams/joists and the first row of joists, in all areas where perimeter members run parallel with the joists.

.5 Additional X-bridging is shown thus = = = = on plans.

.6 Minimum size of X-bridging to be L35x35x3 spaced at maximum 6’-8” on centre, unless noted otherwise on plan.

.7 Adjust bridging locations to allow for mechanical/electrical/architectural equipment to be installed between the joists. Contact engineer for advice before relocating bridging shown on contract documents and shop drawings.

3.5 FURRING EXTENSION RODS

.1 Provide furring extension rods for bottom chords of joists where required, suitable to support the weight of ceiling construction.

3.6 SPACING OF JOISTS

.1 All joists are to be equally spaced between tie joists unless specifically dimensioned on the structural drawings.

.2 Where tie joists do not exist, all joists are to be equally spaced in the area in which they are shown, unless specifically dimensioned on the structural drawings.

END OF SECTION 05200

SECTION 05300- STEEL ROOF DECKING

1 GENERAL

1.1 GENERAL REQUIREMENTS

.1 General Conditions, Supplementary Conditions and Division 01 apply to this Section.

1.2 RELATED WORK UNDER OTHER SECTIONS

.1 Contractor shall be responsible for coordinating this section with all related sections.

1.3 QUALITY ASSURANCE

.1 Execute the work of this Section only by personnel who have adequate plant, equipment and skill and are known to have been responsible for satisfactory work similar to that specified during a period of at least five (5) years.

.2 Welding shall meet specified requirements of CSA Standard W59- (latest edition), and shall be performed only by a fabricator fully certified to the conditions of CSA Standard W55.3- (latest edition), and W47.1-03.

1.4 SHOP DRAWINGS

.1 Submit in accordance with the General Conditions and Section 01 30 00 Administrative Requirements.

.2 Submit in accordance with the General Conditions.

.3 Shop Drawings:

.1 Prepare erection and detail drawings for review by the Architect and Consultant.

.2 Indicate the types of deck, their locations, design load, location of openings and their reinforcement, gauge of steel, surface protective coating, flashing and closure plates, locations of welds, anchorage plates and the like. Provide sufficient detail and sections indicating the deck's orientation to support members.

.3 Do not use contract drawings as shop drawings or erection drawings. Contract drawings used for this purpose will not be reviewed. Delays resulting from this procedure will be the responsibility of the contractor.

1.5 INSPECTION AND TESTING

.1 Make copies of mill test reports (properly correlated to the materials) available to the Consultant upon request. Mill test reports will be accepted in lieu of mill inspection.

1.6 DESIGN

.1 Determine structural properties and capacity of decking in accordance with CSA S136-01, Cold Formed Steel Structural Members.

.2 Areas shaded on roof plans indicate extent of additional snow piling. Roof deck shall be designed, manufactured and erected to support basic specified as well as additional snow loading.

.3 Under live load, the deck shall not have a deflection between consecutive supports, exceeding $1/360^{th}$ of the span for roof deck supporting plaster or other finished ceilings, such as drywall, $1/240^{th}$ of span of roof deck in other areas.

.4 Where deck has been designed to act as a diaphragm to resist lateral loads, as indicated on the structural drawings, provide transverse puddle welds, longitudinal puddle welds, and button punched side laps as indicated on the structural drawings.

.5 In areas where deck has not been specified to act as a diaphragm, provide the following minimum deck connections:

Attach to supporting steel with 20mm diameter fusion welds. (effective diameter to be minimum 13mm).

Transverse puddle welds shall be spaced at 300mm on centre maximum.

Side laps to be button punched at 600mm on centre maximum.

.6 Anchor deck to supporting framework to resist uplift forces stated in the National Building Code of Canada, and local building codes. Dead loads may be deducted from gross uplift forces in accordance with the National Building Code of Canada and local building codes.

.7 In cases where deck forms part of a fire rated assembly, ensure that the installation of the deck meets with the minimum requirements of such an assembly as specified in underwriters laboratories test design specification. Verify, before erection of deck, that work specified in other sections, as a part of

the entire assembly, will be installed to meet validating specification for ceiling-roof assembly.

.8 Span metal deck units continuous over at least three or more supports wherever possible. Increase thickness of metal to compensate for continuity wherever fewer than three supports may occur.

1.7 DELIVERY, STORAGE AND HANDLING

.1 Ship, store and install metal deck to prevent damage to the finish, denting, deformation and rusting, by both careful handling and physical protection. Replace deck that has suffered damage.

.2 Store deck in stacks raised clear of ground, with panels separated by wood blocking, covered with waterproof material leaving space for air circulation, and tilted to drain water.

.3 Secure units to framing with temporary fastenings, until they are permanently welded in place, to ensure against displacement from all causes.

.4 Secure loose bundles of deck in place.

.5 Deliver bearing plates and anchors supplied by this Section for installation by other Sections as directed by installer and to meet construction schedule.

2 PRODUCTS

2.1 MATERIALS

.1 Roof Deck: Metal deck shall have deck flutes at 150mm centres, and shall be formed from sheet steel conforming to the requirements of CSSBI 10M (latest edition) zinc coated structural quality sheet steel for roof deck, Grade ‘A’, with a minimum zinc coating designation of ZF075 Wiped Coat Finish, and a nominal base steel thickness as specified on the structural drawings.

.2 Zinc-Rich Paint: Conforming to CAN/CGSB-1.81-(latest edition).

3 EXECUTION

3.1 FABRICATION

.1 Include in Work of this Section sheet steel angles, curbs, cover plates, cell closures, fasteners, stiffeners and accessories, all as required. Fabricate sheet metal accessories of same material and finish as deck and in not less than 1.22mm thick material.

.2 Fabricate metal deck to meet specified requirements of CSA S136-01 and to support superimposed loading as shown on Structural Drawings.

.3 Form metal deck units to provide male and female interlocking side lap joints.

.4 Fabricate units to provide for joints between abutting panel ends with:

.1 50 overlap, swaged and sized to provide smooth joint.

.2 Ends squared and finished to ensure minimum space between panels.

.5 Provide for ribs to bear on beams parallel to flutes when tops of such beams are at same elevation as deck bearing.

.6 Incorporate reinforcing stiffeners for unsupported edges of metal deck.

.7 Holes in Deck:

.1 Incorporate holes in deck as required for services. Verify size and location of holes before commencing fabrication.

.2 For holes greater than 450mm in dimension across flutes, separate framing is included under Work of another Section.

.3 Steel deck contractor shall reinforce all openings in deck 450mm in size or smaller.

3.2 ERECTION

.1 Erect deck by its fabricator.

.2 Include hoisting and erection equipment in Work of this Section.

.3 Level and align deck units with panels parallel to each other and perpendicular to supports. Locate panel ends only over supports and to provide minimum 45mm bearing. Install steel packing to level units if necessary. Install cover plates to provide full extent of deck surface to support roofing over each area, including expansion joints and intersections of panels that span in different directions.

.4 Lap ends of panels no less than 50mm.

.5 Reinforce cell elements at top and bottom by a continuous web where they are cut longitudinally 50mm or more from a vertical web.

.6 Deck contractor shall supply and install closures and cover plates at edges of roof deck. Provide deck closures at all areas where deck edges are weak.

.7 Secure closures, plates and accessories by either sheet metal screws or welding.

.8 Install interior cell closures in flutes intersecting vertical surfaces exposed to view, at tops of interior walls and partitions extended to deck, at intersections of roof deck with exterior walls, and as otherwise indicated on drawings. Secure cell closures by welding, sheet metal screws or adhesive as suitable for material.

.9 Wedge the flutes of the steel roof deck under wood sleepers and metal curbs carrying roof top units.

.10 No mechanical or electrical equipment/accessories shall be hung from the steel deck.

.11 Hangers for suspension of ceiling are to be attached to the structural steel framing members. These may, however, be attached in between the framing members to the side of the deck flutes and by looping and tying around, but on no account should these hangers be punched through the bottom of the flutes.

3.3 ADJUSTMENT AND CLEANING

.1 Touch-up adjacent primed surfaces burned, scratched or otherwise damaged during erection with prime paint to match shop coat, when erection is completed.

.2 Paint over bare areas on galvanized surfaces and welds with zinc rich paint.

.3 Replace dented, punctured or weld-perforated deck where exposed to view.

END OF SECTION 05300

SECTION 05400
COLD FORMED METAL FRAMING

GENERAL

1.01 GENERAL REQUIREMENTS

.A General Conditions, Supplementary Conditions and Division 01 apply to this Section.

.B Unless otherwise specified conform to CSA S16, Steel Structures for Building - Limit States Design and CSA S136, Cold Formed Steel Structural Members together with all supplements as of the date of tender.

1.02 SUMMARY

.A Section includes:

.1 Load bearing formed steel stud wall framing.

.2 Masonry veneer anchoring system for steel stud back-up.

.3 Non-load bearing formed steel stud partition.

.4 Thru-wall flashing.

.B Related Sections:

.1 Section 04220 – Masonry

.2 Section 05120 – Structural Steel

.3 Section 05210 – Steel Joists

.4 Section 05300 – Metal Decking

.5 Section 06100 – Rough Carpentry

.6 Section 09260 – Gypsum Board Systems

1.03 REFERENCES

.A American Society for Testing and Materials (ASTM):

.1 ASTM A153 – Standard Specification for Zinc Coating (Hot-Dipped) on Iron and Steel Hardware.

.2 ASTM A568 – Standard Specification for Steel, Sheet, Carbon, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements for

.3 ASTM A653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by Hot-dip Process.

.4 ASTM C955 – Standard Specification for Load-Bearing (Transverse and Axial) Steel Studs, Runners (Track), and Bracing or Bridging for Screw Application of

Gypsum Board and Metal Plaster Bases

.B Canadian Institute of Steel Construction (CISC):

.1 CISI - Specification for the Design of Cold-Formed Steel Structural Members, in accordance with CSA S136.

.C Canadian Standards Association (CSA):

.1 CAN/CSA A370 – Connectors for Masonry, Includes all Updates

.2 CAN/CSA A371 – Masonry Construction for Buildings

.3 CAN/CSA G164 – Hot Dip Galvanizing of Irregularly Shaped Articles

.4 CSA S16 – Design of steel structures, Includes all Updates.

.5 CSA S136 – North American Specification for the Design of Cold Formed Steel Structural Members, Includes all Updates

.6 CSA S304.1 – Design of Masonry Structures

.D Canadian Welding Bureau:

.1 CSA W47.1 - Certification of companies for fusion welding of structure, Includes all Updates.

.2 CSA W55.3 – Certification of companies for resistance welding of steel and aluminum

.3 CSA W59 - Welded steel construction (Metal Arc Welding), Includes all Updates.

.4 CSA W117.2 – Safety in Welding, Cutting and Allied Processes

.E The Society for Protective Coatings (SSPC):

.1 SSPC Paint 20 – Zinc-Rich Coating (Type I – Inorganic and Type II – Organic), Includes all Revisions.

1.04 SUBMITTALS

.A Section 01300 - Submittals: Procedures for Submittals.

.B Submit Shop Drawings and Calculations within twenty-one (21) Working Days of award of Contract.

.C Submit copy of Contractor's Shop Drawing Review form at end of this Section within twenty-one (21) Working Days of award of Contract.

.D Shop Drawings:

.1 Prepare and submit shop and erection drawings, stamped signed and dated by the

Professional Engineer responsible for the design, and which conform to the requirements of the CSA S16, and as specified herein.

.2 Calculations indicating loading, stresses and framing connections shall be prepared, signed and sealed under the direct supervision of a Professional Engineer licensed in province of the Place of Work.Cold-formed metal framing system must have shop drawings prepared by qualified draftsmen, checked by and bearing the seal of a Professional Engineer registered to design structures and practice in the place of Work.

.3 Show the size, spacing and location of connections, attachments, reinforcing and anchorage. Include necessary plans, elevations and details. Indicate size and type of fastening. For welded connections use welding symbols in compliance with AWS and indicate clearly net weld lengths.

.4 Submit typical details of connections, and any special connections for approval, before preparation of shop drawings.

.5 Review of shop drawings by the Consultant and Structural Engineer will not absolve the Contractor from his responsibility of providing materials and equipment to complete and finish work of this Section in accordance with the architectural and structural drawings. Departures or differenced from the referenced drawings shall be approved in writing by the Consultant.

1.05 QUALITY ASSURANCE

.A Conform to requirements of CSA S16, steel structures for buildings, and CSA S136, cold formed steel structural members.

.B Work to be executed by firm thoroughly conversant with laws, by-laws and regulations which govern, and capable of workmanship of best grade of modern shop and field practice known to recognized manufacturer's specializing in this Work.

.C Work shall be executed by workmen especially trained and experienced in this type of work. Have a full time, senior, qualified representative at the site to direct the Work.

.D Install system to provide for movement of components without damage, failure of joint seals, undue stress on fasteners, or other detrimental effects when subject to seasonal or cyclic day/night temperature ranges.

.E Install system to accommodate construction tolerances, deflection of building structural members, and clearances of intended openings.

1.06 STORAGE, DELIVERY, HANDLING AND PROTECTION

.A Co-ordinate deliveries to comply with construction schedule and arrange ahead for strategic off the ground, under cover storage locations. Do not load any area beyond the design limits.

.B Adequately protect and crate all components against damage, dirt, disfigurement and weather during delivery and storage. Damaged materials shall not be used and shall be replaced by approved material.

.C Cover and protect the work of other Sections in the area of Work from damage. Make good all damage to the satisfaction of the Consultant.

.D Protect the installed work of this Section and on completion the Work shall be examined and damage shall be remedied to the complete satisfaction of the Consultant.

PRODUCTS

1.07 FRAMING MATERIALS

.A To conform to the requirements of CSA S136.

.B Studs: ASTM C955 sheet steel formed to channel shape, of gauge, size, and having minimum section properties shown on Drawings.

.C Runner: ASTM C955, formed steel channel shape; same width as studs, tight fit; solid web; gage as indicated on Drawings, but no less than gage of stud.

1.08 ACCESSORIES

.A Plates, Gussets, Clips: Formed sheet steel, thickness determined for conditions encountered; same finish as framing members.

1.09 VENEER ANCHORING SYSTEM

.A Veneer Connector: HDG-3 Connector by Bailey Metal Products Limited, or BL-607 Connector by Bloc-Lok Limited or other approved by Consultant, conforming to CSA A370, CSA A371 and CSA S304.1.

.B V-Wire Tie: ESSW stainless steel wire tie by Bailey Metal Products Limited or Flex-O-Lok stainless steel wire tie by Bloc-Lok Limited or other approved by Consultant. Supply to Section 04200 for installation by mason.

1.10 FASTENINGS

.A Self-drilling, Self-tapping Screws, Bolts, Nuts and Washers: ASTM, hot-dip galvanized to 1.25 ounce per square foot.

.1 Hilti, 12-24 x 7/8 HWH #311615 Kwik-cote or other approved by Consultant .

.B Anchorage Devices: Power driven, power actuated, drilled expansion bolts, or screws with sleeves, as application indicates.

.C Welding: CSA S16, CSA S136 and CSA W59.

1.11 THRU-WALL FLASHING

.A 40 mils thick glass fibre reinforced SBS modified bitumen thru-wall flashing, 'Blueskin TWF' by Bakor Inc.

.B Thru-Wall Membrane Flashing Primer:

.1 Synthetic rubber, solvent base, trowel consistency type primer, 'Blueskin Primer' by Bakor Inc., or polymer emulsion type, 'Blueskin Aquatac' by Bakor Inc., as recommended by manufacturer to suit conditions.

.C Thru-Wall Flashing Adhesive:

.1 As recommended by the manufacturer to suit the application.

1.12 FABRICATION

.A Fit and assemble work in shop where possible. Execute work according to details and reviewed shop drawings.

.B Take measurements at the building for work which is to fit or be connected to steel, concrete framing or masonry, before commencing fabrication.

.C Where shop fabrication is not possible, make trial assembly in shop.

.D Do all welding in accordance with requirements of CSA W59, CSA W55.3 and CSA-W117.2. Grind welds smooth and flush with surface of parent metal, where exposed to view and where specifically indicated on drawings. Welds shall be continuous seam welds unless specified otherwise. Maintain sharp arrises.

.E Fit joints and intersecting members accurately in true planes, square, plumb, straight with tight joints and intersections.

.F Provide adequate reinforcing, fastenings, anchors, accessories required for fabrication and erection of work of this Section. Such items occurring on or in an exterior wall or slab shall be hot-dip galvanized. Make thread dimensions such that nuts and bolts will fit without rethreading or chasing threads.

.G Fabricate, drill and tap members to accommodate attachments, anchorage and work of other Sections where located and directed by them.

.H Exposed steel surfaces shall be smooth and free from imperfections such as warping, buckling, weld marks, burrs, rust and scale.

.I Gauges and sizes of metal shall be adequate for various conditions.

.J Make exposed metal fastenings and accessories of same material, texture, colour and finish as base metal on which they occur unless otherwise shown or specified. Keep exposed fastenings to an absolute minimum evenly spaced and neatly laid out. Make fastenings of permanent type unless otherwise indicated.

.K Priming:

.1 Thoroughly clean steel free of rust, scale and weld spatter by power wire brushing. Remove oil and grease with solvent and clean cloths, apply shop coat of primer to all surfaces except areas requiring field welding. Apply by brush, working paint well into surfaces, interstices and cavities.

.2 Prime field welded areas after erection and touch up shop coat where damaged and barred by erection and handling.

.3 Prime steel with two full coats of zinc rich paint in strict accordance with paint manufacturer's directions.

1.13 FINISHES

.A Galvanizing:

.1 All uncoated steel specified to be galvanized shall be galvanized after fabrication by the hot dip process according to CAN/CSA G164. Coating 2 oz./sq.ft. Galvanize after all welding is complete. Welding of galvanized material will not be permitted. Specially treated conforming to SSPC standards ready to receive prime paint finish.

.B Primer: For touch-up for galvanized surfaces.

.1 Zinc Rich Primer: conforming to SSPC Paint 20.

EXECUTION

1.14 GENERAL

.A Verify at the site that the work to receive the work of this section is free of irregularities detrimental to the installation and performance of the Work and that it is located correctly and at proper levels before delivery and installation.

1.15 EXAMINATION

.A Verify that building framing components are ready to receive work.

.B Beginning of installation means acceptance of existing conditions.

1.16 ERECTION OF STUDS

.A Install components to manufacturer's instructions.

.B Align floor and ceiling runners, locate to wall or partition layout. Secure in place with screws or welding at maximum 24 inches on centre. Co-ordinate installation of sealant with floor and ceiling track.

.C Place studs as indicated on Drawings and not more than 2 inches from abutting walls and at each side of openings. Connect studs to tracks using clips and ties, screws, or welding.

.D Construct corners using minimum three studs. Double studs at door, window jambs, and wall openings.

.E Erect studs one piece full length. Splicing of studs is not permitted.

.F Erect load bearing studs, brace, and reinforce to develop full strength to meet design requirements.

.G See Drawings for height of partition framing.

.H Co-ordinate placement of insulation in multiple stud spaces made inaccessible after erection.

.I Install intermediate studs above and below openings to match wall stud spacing.

.J Provide deflection allowance in stud track, directly below horizontal building framing for non-load bearing framing.

.K Attach cross studs or furring channels to studs for attachment of fixtures anchored to walls. Install framing between studs for attachment of mechanical and electrical items, and to prevent stud rotation.

.L Install Veneer Connectors at 16" o/c vertically and stud spacing horizontally. Supply V-Wire Ties to Section 04220 for installation by mason.

.M Touch up field welds and damaged galvanized surfaces with primer.

1.17 THRU-WALL FLASHING

.A Install thru-wall flashing in accordance with manufacturer's written instructions.

.B Apply primer to all substrate areas where thru-wall flashings are to be applied. Apply primer using lambs wool roller at rate 100 sq.ft. to 300 sq.ft./gallon depending on porosity of substrates. Allow primer to 'tack up' for approximately 30 minutes prior to application of thru-wall flashings. Primed surfaces not covered within 24 hours shall be completely reprimed.

.C Extend thru-wall flashing through under width of studs in exterior walls and under width of all interior stud walls.

.D Lap all joints 6" and seal with adhesive.

.E Inspect flashings for punctures, tears, misaligned seams and the like, apply additional layer of flashing membrane, extending minimum of 6" around damaged area in all directions.

END OF SECTION

SECTION 05500
METAL FABRICATIONS

GENERAL

1.01 GENERAL REQUIREMENTS

.A General Conditions, Supplementary Conditions and Division 01 apply to this Section.

1.02 SUMMARY

.A Section includes:

.1 Shop fabricated ferrous material items, galvanized and prime painted.

.2 See schedule at end of this section.

.a Provide as scheduled or as shown on Drawings.

.b Include anchorages and attachments necessary for installation.

.c Schedule lists basic items and systems. Include related and systems necessary to complete the Work.

.B Related Sections:

.1 Section 03300 – Cast-In-Place Concrete

.2 Section 04220 – Masonry

.3 Section 05120 – Structural Steel

.4 Section 07544 –PVC Fully Adhered Single Ply Roofing System

.5 Section 09900 – Painting

.6 Read carefully all other Sections and review drawings to determine extent of metal work supplied and installed, or installed by others.

1.03 REFERENCES

.A American Society for Testing and Materials (ASTM)

.1 ASTM A53 – Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

.2 ASTM A307 – Standard Specification for Carbon Steel Bolts, Studs and Threaded Rod 60 & #x2009; 000 PSI Tensile Strength

.3 ASTM A325M – Standard Specification for Structural Bolts, Steel, Heat Treated 830 MPa Minimum Tensile Strength (Metric)

.4 ASTM A500 – Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes

.5 ASTM A526 – Standard Specification for Steel Sheet, Zinc-Coated (Galvanized by the Hot-Dip Process, Commercial Quality

.6 ASTM A653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by Hot-dip Process.

.7 ASTM G164 – Standard Test Method for Determination of Surface Lubrication on Flexible Webs

.B Canadian Institute of Steel Construction (CISC):

.1 CISI - Specification for the Design of Cold-Formed Steel Structural Members, in accordance with CSA S136.

.C Canadian Standards Association (CSA):

.1 CSA G40.20/G40.21 – General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel

.2 CAN/CSA G164 – Hot-Dip Galvanizing of Irregularly Shaped Articles

.3 CSA S16 – Design of steel structures, Includes all Updates.

.4 CSA S136 – North American Specification for the Design of Cold Formed Steel Structural Members, Includes all Updates

.D Canadian Welding Bureau:

.1 CSA W47.1 - Certification of companies for fusion welding of structure, Includes all Updates.

.2 CSA W55.3 – Certification of companies for resistance welding of steel and aluminum

.3 CSA W59 - Welded steel construction (Metal Arc Welding), Includes all Updates.

.4 CSA W117.2 – Safety in Welding, Cutting and Allied Processes

.E Steel Structures Painting Council (SSPC):

.1 SSPC Paint 20 – Zinc-Rich Coating (Type I – Inorganic and Type II – Organic), Includes all Revisions.

.F National Building Code.

.G Provincial Building Codes (where applicable).

1.04 SUBMITTALS

.A Section 01300 – Submittals: Procedures for Submittals.

.B Submit Shop Drawings with twenty-one (21) Working Days of award of Contract.

.C Submit copy of Contractor's Shop Drawing Review form at end of the Section within twenty-one (21) Working Days of Award of Contract.

.D Shop Drawings:

.1 Make thorough examination of drawings and details, determine the intent, extent, and materials, and be fully cognizant of requirements when preparing the shop drawings.

.2 Submit shop drawings in accordance with General Conditions. Show and describe in detail all work of this Section including large scale detail of members and materials, of connection and interfacing with work of other Sections, jointing details, and of anchorage devices, dimensions, gauges, thicknesses, description of materials, metal finishing, as well as other pertinent data and information.

.3 Shop drawings shall bear the seal of an Engineer registered to practice in the place of Work, employed by the miscellaneous metal fabricator.

.4 Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories.

.5 Include erection Drawings, elevations, and details where applicable.

.6 Indicate welded connections using standard CSA S16 welding symbols. Indicate net weld lengths.

.7 Prepare Shop Drawings under the supervision of a licensed Structural Professional Engineer.

1.05 QUALITY ASSURANCE

.A Conform to requirements of CSA S16, steel structures for buildings, and CSA S136, cold formed steel structural members.

.B Work to be executed by firm thoroughly conversant with laws, by-laws and regulations which govern, and capable of workmanship of best grade of modern shop and field practice known to recognized manufacturer's specializing in this work.

.C Work shall be executed by workmen especially trained and experienced in this type of Work. Have a full time, senior qualified representative at the site to direct the work.

1.06 STORAGE, DELIVERY, HANDLING AND PROTECTION

.A Co-ordinate deliveries to comply with construction schedule and arrange ahead for strategic off the ground, under cover storage locations. Do not load any area beyond the design limits.

.B Adequately protect and crate all components against damage, dirt, disfigurement and weather during delivery and storage. Damaged materials shall not be used and shall be replaced by approved material.

.C Cover and protect the work of other Sections in the area of Work from damage. Make good all damage to the satisfaction of the Consultant.

.D Protect the installed work of this Section and on completion the Work shall be examined and damage shall be remedied to the complete satisfaction of the Consultant.

PRODUCTS

1.07 MATERIALS

.A Steel Plates and Shapes: CSA G40.20 and G40.21.

.B Bolts, Nuts, and Washers: ASTM A325 and ASTM A307.

.C Cold Rolled Steel: CSA G40.20/G40.21, matte finish.

.D Cold Rolled Sheet: CSA G40.20/G40.21

.E Galvanized Steel Sheets:

.1 Structural: ASTM A653, G90.

.2 Galvanized Sheet Steel: ASTM A653, Class C.

.F Steel Tubing: ASTM A500, Grade B.

.G Steel Piping: ASTM A53.

.H Welding Materials: CSA W59, CSA W55.3 and CSA W117.2.

.I Galvanized Sheet Steel (Commercial Quality): Galvanized coating G90 (Z275) in accordance with ASTM A526, minimized spangle, stretch levelled or temper rolled. Specially treated conforming to SSPC standards ready to receive prime paint finish.

.J Galvanizing: All uncoated steel specified to be galvanized shall be galvanized after fabrication by the hot dip process according to CAN/CSA G164. Coating 2 oz./sq.ft. Galvanize after all welding is complete. Welding of galvanized material will not be permitted. Specially treated conforming to SSPC standards ready to receive prime paint finish.

.K Metal Filler: Polyester based, as required to suit conditions.

.L Paint primer: In compliance with CISC-1.73. Shop coat and on site touch-up shall be no less than 2 mil thickness, colour gray.

.M Zinc Rich Primer: conforming to SSPC Paint 20.

1.08 FABRICATION

.A Fit and assemble work in shop. Execute work according to details and reviewed shop drawings.

.B Take measurements at the building for work which is to fit or be connected to steel, concrete framing or masonry, before commencing fabrication.

.C Where shop fabrication is not possible, make trial assemble in shop.

.D Do all welding in accordance with requirements of CSA W59, CSA W55.3 and CSA W117.2. Grind welds smooth and flush with surface of parent metal, where exposed to view and where specifically indicated on drawings. Welds shall be continuous seam welds unless specified otherwise. Maintain sharp arrises.

.E Fit joints and intersecting members accurately in true planes, square, plumb, straight with tight joints and intersections.

.F Provide adequate reinforcing, fastenings, anchors, accessories required for fabrication and erection of work of this Section. Such items occurring on or in an exterior wall or slab shall be hot-dip galvanized. Make thread dimensions such that nuts and bolts will fit without rethreading or chasing threads.

.G Fabricate, drill and tap members to accommodate attachments, anchorage and work of other Sections where located and directed by them.

.H Exposed steel surfaces shall be smooth and free from imperfections such as warping, buckling, weld marks, burrs, rust and scale.

.I Gauges and sizes of metal shall be adequate for various conditions.

.J Make exposed metal fastenings and accessories of same material, texture, colour and finish as base metal on which they occur unless otherwise shown or specified. Keep exposed fastenings to an absolute minimum evenly spaced and neatly laid out. Make fastenings of permanent type unless otherwise indicated.

.K Priming:

.1 Thoroughly clean steel, free of rust, dirt, scale and weld spatter by power wire brushing. Remove oil and grease with solvent and clean cloths, apply shop coat of primer to all surfaces except areas requiring field welding. Apply by brush, working paint well into surfaces, interstices and cavities.

.2 Prime field welded areas after erection and touch up shop coat where damaged and barred by erection and handling.

.3 Prime steel with two full coats of zinc rich paint in strict accordance with paint manufacturer’s directions.

EXECUTION

1.09 EXAMINATION

.A Verify at site that the Work to receive the work of this Section is free of irregularities detrimental to the installation and performance of the Work and that it is located correctly and at proper levels before delivery and installation.

.B Obtain Owner's Construction Manager's approval prior to site cutting or making adjustments not scheduled.

.C Clean and strip site primed steel items to bare metal where site welding is scheduled.

.D Make provision for erection loads with temporary bracing. Keep work in alignment.

.E Supply items required to be cast into concrete or embedded in masonry with setting templates, to appropriate Sections. Use grout specified in Section 03300 for setting metal fabrications.

1.10 PREPARATION

.A Assemble and erect work plumb, true, square, straight, level and accurate to sizes detailed, to reviewed shop drawings, free from distortion and defects detrimental to appearance and performance.

.B Insulate metals where necessary to prevent corrosion due to contact between dissimilar metals and between metals and masonry, concrete or plaster. Use bituminous paint or butyl tape.

.C Supply adequate instructions, templates, and if necessary, supervise installation of the fastenings or accessories requiring to be built-in by other Sections of the work.

1.11 SCHEDULE

.A General:

.1 Supply and install all miscellaneous metal work indicated on drawings and not included in the work of other Sections in addition to items listed below. Where items are required to be built into masonry, concrete or other work, supply such items to respective Sections with all anchors and accessories for building in.

.2 The following schedule is included for convenience only and may not be complete. It is the Contractor's responsibility to examine all Contract Documents to determine the full extent of Work required under this Section.

.3 Supply and install metal work listed below unless specifically designated to be supplied only. Each item shall be as shown on drawings and as detailed on reviewed shop drawings.

.B Loose Bearing Plates, Embedded Plates, and Lintels: Fabricate to sizes and configuration indicated on Drawings; prime paint finish except for items embedded in concrete or masonry and items requiring field welding.

.C Miscellaneous Framing and Supports: Furnish steel framing and supports not required to support structural steel, steel joints, or metal deck. Co-ordinate with Section 05120. Fabricate welded construction in as large units as possible. Drill and tap for hardware and other items. Include anchors required for building into work of other Sections/

.1 Interior: Prime paint finish, gray.

.2 Exterior: Galvanized.

.D Rough Hardware: Custom fabricated bolts, plates, anchors, hanger, dowels, and other miscellaneous steel and iron shapes required for framing, supporting, and anchoring other construction. Galvanized unless indicated otherwise.

.E Edge of Roof Curbs and Upstands: Provide bent metal roof curbs and upstands as detailed. Reinforce curbs as required with stiffeners within curbs at maximum 2'-0" O.C. Hot-dip galvanized.

.F Expansion Joint Curbs on Roof: Provide bent metal expansion joint roof curbs as detailed. Reinforce curbs as required with stiffeners within curbs at maximum 2'-0" O.C. Hot-dip galvanize after fabrication.

.G Aluminum Wall Ladder (Roof Parapet): Co-ordinate wall ladders (size, type and installation) with Section 07722 - Roof Hatches.

.1 Side Rails: 45 mm x 76 mm flat bar aluminum.

.2 Rungs: 32 mm, 12 inches O.C, anodized aluminum.

.3 Wall bracket: 5 mm x50 mm anodized aluminum wall bracket U channel.

.4 Provide safety grab bars and safety cap as indicated on drawings.

.5 Provide 600 mm x 600 mm x 50 mm concrete paver with non-slip finish and 557 mm x 557 mm x 25 mm of rigid insulation as indicated on drawings.

.6 Aluminum wall ladder, sized to match above, by Precision Stair Corp., distributed by Parzze & Assoc. Inc. Contact Myron ParZei, telephone 905-629-9898 or other as approved by Consultant.

.H Steel Wall Ladder (Roof Hatch): Co-ordinate steel wall ladders (size, type and installation) with Section 07722 - Roof Hatches.

.1 Side Rails: 3/8 x 3-1/2 inch flat bar steel.

.2 Rungs: 3/4 x 3/4 inch solid steel tubes, 12 inches O.C.

.3 Attach with steel mounting brackets.

.4 Prime paint finish.

.5 Cage: Hoops of 1/4 x 2 inch bars with 3/16 x 1-1/2 inch vertical bars.

.6 Where roof to roof exterior ladders are required, provide galvanized steel grating platform above upper roof as indicated on drawings. Steel grating platforms shall be capable of supporting up to 150 lbs./sq.ft.

.7 Substitutions: Aluminum wall ladder and cage, sized to match above, by Precision Stair Corp., distributed by Parzze & Assoc. Inc. Contact Myron ParZei, telephone 905-629-9898.

.I Frames for Overhead Doors:

.1 Supply and install 1/4” thick steel frame around openings at heads and jambs to suit wall thickness and return on either side of wall face as detailed on drawings. Provide extensions on interior side at head to accommodate track and operators to suit doors specified.

.2 Co-ordinate installation with work of other Sections. Provide proper anchors for solid installation.

.3 Finish: Hot-dip galvanized after fabrication, ready for painting by Section 09900.

.J Fender Guards:

.1 Provide 1/4" thick x 36" high "Z" shaped bent steel plate fender guard at overhead door tracks as indicated on drawings.

.2 Coordinate installation with work of other Sections. Provide proper anchors for solid installation.

.3 Finish: Prime paint after fabrication, ready for painting by Section 09900.

.K Weatherstripping Guards:

.1 Provide 3/16” thick x 48” high “Z” shaped bent steel plate fender guard at weathering stripping at overhead doors.

.2 Coordinate installation with work of other Sections. Provide proper anchors for solid installation.

.3 Finish: Prime paint after fabrication, ready for painting by Section 09900.

.L Steel Plate at Overhead Doors:

.1 Supply 12" x 12" x 1/4" thick steel plate at overhead doors.

.2 Co-ordinate installation with work of other Sections. Provide proper anchors for solid installation.

.3 Finish: Prime paint after fabrication, ready for painting by Section 09900.

.M Steel Pipe Railings: Fabricate to dimensions indicated on Drawings. Make smooth mitred corners; finish; exterior: hot dipped galvanized; interior - primed.

.1 Set and secure railings to other construction as indicated.

.2 Handrails and Top Rails: Design point load 200 lbs, downward or horizontal, and uniform load of 50 lb/lin ft applied simultaneously in both vertical and horizontal directions. Concentrated and uniform loads need not be assumed to act concurrently.

.3 Intermediate Rails: Uniform load of 25 lbs/sq ft of gross area of railing system, including open area.

.N Handrail Brackets: Cast iron with not less than 3 inches projection from wall surface to centre line of handrail. Finish as indicated below:

.1 Exterior: Hot dipped galvanized.

.2 Interior: Prime paint finish.

.O Heavy Duty Bird Screen and Metal Frame: **(at metal roof over)**

.1 Provide heavy duty 1"x1" heavy duty bird screen complete with steel frame to suit application and as detailed on drawings.

.2 Hot-dip galvanized after fabrication.

END OF SECTION

SECTION 05501
ANCHOR BOLTS

PART 1 – GENERAL 1

1.1 SCOPE 1
1.2 DESCRIPTION: 1

PART 2 - PRODUCTS 1

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2.3 DESIGN: 2
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PART 3 – EXECUTION 3

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3.2 CAST-IN-PLACE ANCHOR BOLTS: 3
3.3 ADHESIVE ANCHOR BOLTS: 3
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SECTION 05501
ANCHOR BOLTS

PART 1 – GENERAL

1.1 SCOPE

.1 This Section shall be read in conjunction with Section 05500 – Metal Fabrications which shall apply to and govern the work of this Section.

.2 Work under this section of the Contract Specifications shall be performed in conjunction with Section 06610 – fibre-reinforced plastic stairs, handrail & grating.

1.2 DESCRIPTION:

.1 This section specifies anchor bolts complete with washers and nuts. Anchor bolts shall be Type 316 stainless steel.

PART 2 - PRODUCTS

2.1 GENERAL:

.1 Anchor bolt holes in equipment support frames shall not exceed the bolt diameters by more than 25 percent, up to a limiting maximum over sizing of 6 mm. Minimum anchor bolt diameter shall be 12 mm. Anchor bolts for equipment mounting and vibration isolation systems shall be provided as required.

.2 Tapered washers shall be provided where mating surface is not square with the nut.

.3 Expansion, wedge, or adhesive anchors set in holes drilled in the concrete after the concrete is placed will not be permitted in substitution for anchor bolts except where otherwise specified. Upset threads are not acceptable.

2.2 MATERIALS:

.1 Anchor bolt materials shall be as specified in Table A.

Table A Anchor Bolt Materials

Material	Specification
Stainless steel bolts, nuts, washers	ASTM A320, Type 316
Expansion anchors	HILTI-BOLT, or equal
Wedge anchors	ITT or equal.
Adhesive anchors	HILTI-Expoxy Bond or equal

2.3 DESIGN:

.1 Anchor bolts for equipment frames and foundations shall be designed in accordance with the project seismic zone requirements.

2.4 PRODUCT DATA:

.1 The following information shall be provided in accordance with Section 01330 for all bolt systems not cast-in-place:

.1 Data indicating load capacities.

.2 Chemical resistance.

.3 Temperature limitations.

.4 Installation instructions.

.5 Evaluation report for expansion and wedge type anchors.

PART 3 – EXECUTION

3.1 GENERAL:

.1 Fieldwork, including cutting and threading, shall not be permitted on galvanized items. Dissimilar metals shall be protected from galvanic corrosion by means of pressure tapes, coatings or isolators. Grouting of anchor bolts with non-shrink or epoxy grouts as required.

3.2 CAST-IN-PLACE ANCHOR BOLTS:

.1 Anchor bolts to be embedded in concrete shall be placed accurately and held in correct position while the concrete is placed or, if specified, recesses or blockouts shall be formed in the concrete and the metalwork shall be grouted in place in accordance with Section 03300. The surfaces of metalwork in contact with concrete shall be thoroughly cleaned.

.2 After anchor bolts have been embedded, their threads shall be protected by grease and the nuts screwed on.

3.3 ADHESIVE ANCHOR BOLTS:

.1 Use of adhesive or capsule anchors shall be subject to the following conditions:

.1 Use shall be limited to locations where exposure, on an intermittent or continuous basis, to acid concentrations higher than 10 percent, to chlorine gas, or to machine or diesel oils, is extremely unlikely.

.2 Use shall be limited to applications where exposure to fire or exposure to concrete or rod temperature above 120 degrees F is extremely unlikely. Overhead applications (such as pipe supports) because of the above concerns, shall be disallowed.

.3 Approval from the Region for specific application and from supplier of equipment to be anchored, if applicable.

.4 Anchor shall be threaded or deformed full length of embedment and shall be free of rust, scale, grease, and oils.

.5 Embedment depth shall be as per manufacturer's recommendations. Adhesive capsules of different diameters may be used to obtain proper volume for the embedment, but no more than two capsules per anchor may be used. When installing different diameter capsules in the same hole, the larger diameter capsule shall be installed first. No extension or protrusion of the capsule from the hole is acceptable.

.6 All installation recommendations by the anchor system manufacturer shall be followed carefully.

.7 Holes shall have rough surfaces.

.8 Holes shall be cleaned with compressed air and be free of dust or water prior to installation.

.9 Anchor shall be left undisturbed and unloaded for the full adhesive curing period.

.10 Concrete temperature (not air temperature) shall be compatible with curing requirements of adhesives. Anchors shall not be placed in concrete below minus 4 degrees C.

3.4 EXPANSION ANCHORS:

.1 The Contractor shall supply the Owner with independent current evaluation reports for the particular brand of expansion anchors to be used.

END OF SECTION

SECTION 05510
STEEL STAIRS AND RAILINGS

GENERAL

1.01 GENERAL REQUIREMENTS

.A General Conditions, Supplementary Conditions and Division 01 apply to this Section.

1.02 SUMMARY

.A Section includes:

.1 Concrete Filled Metal Pan Stairs

.2 Railings and Handrails

.B Related Sections:

.1 Section 03300 – Cast-In-Place Concrete

.2 Section 04200 – Masonry

.3 Section 05500 – Miscellaneous Metals

.4 Section 09900 - Painting

1.03 REFERENCES

.A American Society for Testing and Materials (ASTM)

.1 ASTM A53 – Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

.2 ASTM C939 – Standard Test Method for Flow of Grout for Preplaced-Aggregate Concrete (Flow Cone Method)

.3 ASTM C1107 - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)

.B Canadian Institute of Steel Construction (CISC):

.1 CISI - Specification for the Design of Cold-Formed Steel Structural Members, in accordance with CSA S136.

.C Canadian General Standards Board

.1 CAN/CGSB 51.32 – Sheathing, Membrane, Breather Type

.D Canadian Standards Association (CSA):

.1 CSA G40.20/G40.21 – General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel

.2 CAN/CSA G164 – Hot Dip Galvanizing of Irregularly Shaped Articles

.3 CSA S16 – Design of steel structures, Includes all Updates.

.4 CSA S136 – North American Specification for the Design of Cold Formed Steel Structural Members, Includes all Updates

.E Canadian Welding Bureau:

.1 CSA W47.1 - Certification of companies for fusion welding of structure, Includes all Updates.

.2 CSA W55.3 – Certification of companies for resistance welding of steel and aluminum

.3 CSA W59 - Welded steel construction (Metal Arc Welding), Includes all Updates.

.4 CSA W117.2 – Safety in Welding, Cutting and Allied Processes

.F National Association of Architectural Metal Manufacturers (NAAMM)

.1 NAAMM AMP 510 – Metal Stair Manual

.2 NAAMM MBG 531 – Metal Bar Grating Manual

.3 NAAMM MBG 532 – Heavy Duty Metal Bar Grating Manual

.G Society for Protective Coatings (SSPC):

.1 SSPC Paint 20 – Zinc-Rich Coating (Type I – Inorganic and Type II – Organic), Includes all Revisions.

1.04 SUBMITTALS

.A Section 01300 – Submittals: Procedures for Submittals.

.B Submit Shop Drawings with twenty-one (21) Working Days of award of Contract.

.C Submit copy of Contractor's Shop Drawing Review form at end of this Section within twenty-one (21) Working Days of award of Contract.

.D Shop Drawings:

.1 Submit shop drawings showing and describing in detail profiles, members, type and details of fastening and anchorage, gauges and metal finishing and all other pertinent data.

.2 Shop drawings shall bear the seal and signature of a Professional Engineer registered to design structures in the place of the Work.

.3 Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories.

.4 Include erection Drawings, elevations, and details where applicable.

.5 Indicate welded connections using standard CSA S16 welding symbols. Indicate net weld lengths.

1.05 QUALITY ASSURANCE

.A Conform to requirements of CSA S16, Steel Structures for Buildings and CSA S136, Cold Formed Steel Structural Members.

.B Work of this Section shall be executed by firm having minimum five (5) years continuous experience in similar fabrications, thoroughly conversant with laws, by-laws, regulations which govern and capable of workmanship of best grade of modern shop and field practice.

.C Detail and fabricate steel stairs and railings to Metal Stairs Manual, NAAMM AMP 510.

PRODUCTS

1.06 MATERIALS

.A Structural Steel Sections, Steel Plates and Checker Plate:

.1 Conforms to CSA-G40.20/G40.21, Grade 350W.

.B Hollow Structural Sections:

.1 Conforms to CSA G40.20/G40.21, Grade 350W, Class H.

.C Sheet Steel (Structural Quality):

.1 Conforms to ASTM A570/A570M-92.

.D Sheet Steel (Commercial Quality):

.1 Conforms to ASTM A366/A366M-91, stretcher levelled or temper rolled.

.E Steel Grating:

.1 Thicknesses as required to support loading and conforming to Metal Bar Grating Manuals, NAAMM MBG 531 and 532, type as approved by Consultant, by Borden Metal Products (Canada) Limited, or by Dominion Bridge Company Limited, or by Robertson Building Systems, or by Armtec Inc., or by Fisher & Ludlow, Division of Harris Steel Ltd.

.2 Provide manufacturer's standard and saddle clip type fasteners for grating.

.F Steel Pipe: Hot-dip galvanized, zinc coated, welded and seamless type steel pipe conforming to ASTM A53.

.G Welding Materials:

.1 Conforms to CSA W59.

.H Paint primer: in compliance with CISC-1.73. Shop coat and on site touch-up shall be no less than 2 mil thickness.

.I Zinc-Rich Paint:

.1 Ready mixed, zinc rich primer conforming to SSPC Paint 20. ‘Sealtight Galvafroid Zinc-Rich Coating' by W.R. Meadows of Canada Limited, or 'Zinc Clad No.7 Organic Zinc Rich Primer' by Sherwin Williams Company of Canada Ltd.

.J Non-Shrink Grout:

.1 Premixed, high strength, maximum bearing, impact resistant, non-shrink metallic aggregate grout having minimum 76 Mpa 28 day compressive strength and conforms to ASTM C939 and ASTM C1107, 'Embeco Premixed Grout' by Master Builders Technologies Ltd., or 'Tartan Grout Iron' by Webster & Sons Ltd., or 'Ferrogrout 939' by Sika Canada Inc.

.K Bituminous Paint:

.1 Conforms to CAN/GSB-1 108-M. Type 2.

.L Building Paper:

.1 Conforms to CAN/CGSB 51.32.

.M Butyl Tape:

.1 Extruded, high grade, macro-polyisobutylene tape of thickness, width and shore hardness to suit conditions.

.N Galvanizing:

.1 All uncoated steel specified to be galvanized shall be galvanized after fabrication by the hot-dip process according to CAN/CSA-G164, with minimum coating of 2 oz./sq/ft. galvanize after all welding is complete. Welding of galvanized material will not be permitted. Specially treat by phosphate conversion process conforming to SSPC Paint 20 a ready to receive prime paint finish.

1.07 FABRICATION AND MANUFACTURE

.A Design Requirements:

.1 Fabricate steel stairs to safely support a load of 100 pounds per square foot evenly distributed over treads and landings with maximum deflection of L/240. Fabricate railings to conform to the Ontario Building Code, latest edition, in particular Division B, Part 4, Sub-section 4.1.5.

.B General:

.1 Fabricate steel stairs and railings to details indicated on Drawings and to Metal

Stairs Manual, NAAMM AMP 510.

.2 Fabricate to reviewed shop drawings and in general to details indicated on drawings and specified herein. Where possible, fit and shop assemble and deliver to site in largest practicable sections.

.3 Fabricated work shall be complete with components required for anchoring.

.4 Fit joints and intersecting members accurately with hairline joints in least conspicuous locations and manner. Make work in true plane with adequate fastenings.

.C Welding:

.1 Except where bolted connections are indicated, make stairs of welded construction conforming to requirements of CSA W59.

.2 Grind exposed welds smooth. Machine materials and straighten in such a way that no disfigurement will show in finished work.

.D Fastenings and Connections:

.1 Weld connections where possible. Where not possible bolt or otherwise secure in approved manner. Where approved, install exposed fastenings of same materials, colour and finish as base metal on which they occur.

.2 Countersink screws unless noted otherwise and reinforce where necessary.

.3 Use shop and field connections detailed. Where not detailed, connections shall comply with CSA S16.

1.08 COMPONENTS

.A Concrete Filled Metal Pan Stairs:

.1 Risers, Treads, Landings: 12 gauge steel pan where indicated on drawings, reinforced as required. Form metal pan tread with metal nosing and key at risers for concrete fill. Fasten open riser stair treads to stringers with concealed brackets.

.2 Stringers: Steel stringer channel unless otherwise noted, with 14 gauge formed fascia.

.3 Provide non-slip inserts on all stair treads.

.4 Balusters and Handrails: Provide balustrades, railings and handrails as indicated on drawings, complete with brackets and anchoring devices.

.5 Framing: Structural steel framing, angles, channels, trimmers, posts and columns, channel bearings, support angles and clip angle connections to floor slabs and walls.

.6 Finish: After shop fabrication, thoroughly de-scale steelwork, remove roughness and irregularities by grinding, clean with wire brush, remove oil and grease from surface of steel and give one coat of primer. Give steelwork one coat of primer in shop working well into crevices and interstices.

.B Railings and Handrails:

.1 Provide floor and wall mounted railings and handrails as indicated on drawings, complete with brackets, anchoring devices and removable sections.

.2 Finish: After shop fabrication, thoroughly de-scale steelwork, remove roughness and irregularities by grinding, clear with wire brush, remove oil and grease form surface of steel and give one coat of primer. Give steelwork one coat of primer in shop working well into crevices and interstices. Leave ready for finish painting by Section 09900. Hot dip galvanized exterior steel railings and handrails.

.C Finishes:

.1 Thoroughly descale steelwork, remove roughness and irregularities by grinding, clean with wire brush, remove oil and grease from surface of steel.

.2 Provide hot dip galvanized finish for exterior components and where indicated, for interior components with zinc coating weight of 2 oz./sq.ft.

.3 Except where zinc rich paint or galvanized finish is called for give steelwork one coat of primer, applied in shop, working well into crevices and interstices.

EXECUTION

1.09 INSTALLATION

.A Furnish, set and secure framing brackets, hangers, anchors, inserts or similar supports for proper erection of stairs before masonry and concrete is places. Provide temporary supports and bracing required to position stairs and railings.

.B Do all coring, drilling and fitting necessary to attach work of this Section to adjoining work.

.C Continuous weld connections between handrails and balusters and in lengths of handrails.

.D Secure wall brackets to wall at 4'-0" O.C. maximum with through-bolts and plate where these can be concealed, otherwise use bolts and expansion shields to achieve maximum rigidity of rail. Wood plugs for fixing to walls will not be permitted. Use metal anchoring devices.

.E Grout bases of posts, balusters or newels occurring in concrete using non-shrink grout in accordance with manufacturer's instructions. Finish smooth, level and flush with surrounding finished surface.

.F Isolate where necessary to prevent electrolysis due to dissimilar metal-to-metal contact or metal-to-masonry and concrete. Use 2 coats of bituminous paint, butyl tape, building paper or other approved means.

.G Grind off surplus welding materials and provide sharp profiles and arrises.

.H Build and erect work plumb, true, square, straight, level and accurate, to sizes detailed, to reviewed shop drawings, free from distortion or defects detrimental to appearance and performance.

.I Touch up with matching primer, or zinc rich paint for galvanized components, field welds, damaged and abraided surfaces, and surfaces not previously primed. Leave ready for finish painting by Section 09900.

END OF SECTION

SECTION 05515
ACCESS LADDERS

PART 1 – GENERAL 1

1.1 SCOPE 1
1.2 WORK INCLUDED: 1
1.3 QUALITY ASSURANCE: 1
1.4 SUBMITTALS: 1

PART 2 - PRODUCTS 1

2.1 MATERIALS: 1

PART 3 - EXECUTION 2

3.1 FABRICATION: 2
3.2 INSTALLATION: 2

SECTION 05515
ACCESS LADDERS

PART 1 – GENERAL

1.1 SCOPE

.1 This Section of the Specifications shall be read in conjunction with Section 05500 – Metal Fabrication, which shall apply to and govern the work of this Section.

.2 Work under this section of the Contract Specifications shall be performed in conjunction with Section 06610 – fibre-reinforced plastic stairs, handrail & grating.

1.2 WORK INCLUDED:

.1 Supply and install all Type 316L or 304 stainless steel or aluminum access ladders as detailed on the Drawings and as specified herein.

.2 Provide fall arrest systems and/or safety cages and landings as specified.

.3 Comply with all pertinent requirements of Section 05500 – Metal Fabrications.

1.3 QUALITY ASSURANCE:

.1 Comply with the requirements of the Industrial Safety Branch, Ministry of Labour.

.2 Comply with CSA Z259.2-M1979 “Fall Arresting Devices, Personnel Lowering Devices and Lifelines”.

1.4 SUBMITTALS:

.1 Submit fabrication drawings to the Engineer for review prior to fabrication in accordance with Section 01330.

PART 2 - PRODUCTS

2.1 MATERIALS:

.1 Side rails: 50 mm x 12 mm Type 316L or 304 stainless steel or aluminum bars, drilled to receive ladder rungs.

.2 Rungs: 25 mm x 20 mm serrated Type 316L or 304 stainless steel or aluminum bars, which penetrate the vertical rails and are plug-welded on the outside of the rail.

.3 Safety cages: 6 mm x 40 mm Type 316L or 304 stainless steel or aluminum hoops spaced at 600 mm o/c, connected by 6 mm x 40 mm Type 316L or 304 stainless steel or aluminum slats as detailed on the Drawings.

.4 Fall Arrest System: Model 3152 Safety Slide Rail complete with 2 safety belts and clips (Model 3156) by MSU Mississauga Limited or approved equal.

.5 Safety handle extensions: Model 3102 Safety 'T' Handle as supplied by MSU Mississauga Limited or approved equal.

.6 Grab bars: 48.3 m O.D., Type 316L or 304 stainless steel or aluminum tube, minimum wall thickness 3.7 mm, as detailed on the Drawings.

PART 3 - EXECUTION

3.1 FABRICATION:

.1 Accurately cut, form and machine ladder components to the details shown on the Drawings.

.2 Base all dimensioning required on accurate field measurements. Responsibility for field measurement is the Fabricator's.

3.2 INSTALLATION:

.1 Install ladders where indicated on the Drawings. Ladders longer than 4300 mm between landings, shall be provided with either safety cages extending from the upper landing to within 2100 mm of the bottom landing, or a fall arrest system.

.2 Ladder rungs shall extend 1200 mm above the floor surface. Ladders not projecting above the floor surface shall be equipped with a pair of wall-mounted grab bars. If no wall is present, equip the ladder with a safety handle extension.

END OF SECTION

SECTION 05810
EXPANSION JOINT ASSEMBLIES

PART 1 GENERAL

1.01 GENERAL REQUIREMENTS

.A General Conditions, Supplementary Conditions and Division 01 apply to this Section.

1.02 SUMMARY

.A Section includes:

.1 Expansion joint assemblies

.B Related Sections:

.1 Section 03300 – Cast-In-Place Concrete

.2 Section 03400 – Architectural Precast Concrete

.3 Section 04200 – Masonry

.4 Section 05400 – Cold Formed Metal Framing

.5 Section 07270 – Fire Stopping and Smoke Seals

.6 Section 07421 – Insulated Metal Wall Panel System

.7 Section 07900 – Joint Sealants

.8 Section 09260 – Gypsum Board Systems

1.03 REFERENCES

.A American Society for Testing and Materials (ASTM)

.1 ASTM C518 – Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus

.2 ASTM C711 – Standard Test Method for Low-Temperature Flexibility and Tenacity of One-Part, Elastomeric, Solvent-Release Type Sealants

.3 ASTM D3574 – Standard Test methods for Cellular Materials – Slab, Bonded, and Molded Urethane Foams

.4 ASTM E96 – Standard Test Methods for Water Vapor Transmission of Materials

.5 ASTM E283 – Standard Test method for Determining Rate of Air Leakage Through Exterior Windows, Curtain Walls and Doors Under Specified Pressure Differences Across the Specimen

.6 ASTM E330 – Standard Test Method for Structural Performance of Exterior Windows, Skylights and Curtain Walls by Uniform Static Air Pressure Difference

.7 ASTM E331 – Standard Test Method for Water Penetration of Exterior Windows, Skylights and Curtain Walls by Uniform Static Air Pressure Difference

.8 ASTM G26 – Standard Practice for Xenon-Arc Exposure of Plastics Intended for Outdoor Applications

1.04 SUBMITTALS

.A Section 01300 – Submittals: Procedures for Submittals.

.B Certification - Exterior Wall Expansion Joints:

.1 Type 1:

.a Submittal will include certification from manufacturer that the expanding foam impregnation will not at any time bleed, stain, or otherwise contaminate the substrates so as to adversely effect future adhesion of sealants in the joint area.

.b Submittal must include written certification from manufacturers of silicone and impregnated foam that the silicone and impregnation have been tested and are compatible and that the silicone has good adhesion to the expanding foam backing.

.2 Type 2:

.a Manufacturer to certify that the material has been tested and meets the values in the table below and has been performance tested according to the listed performance tests and exhibits results listed below:

Property	Value	Test Method
Base Material Impregnated Expanding Foam Laminations Closed-Cell Foam Lamination	 Open-cell, high density, polyurethane foam, impregnated with Water-Based, Stabilized Acrylics Crosslinked Ethylene Vinyl Acetate (EVA)	N/A
Colour	Grey	N/A
Tensile Strength	21 psi minimum (145 kPa)	ASTM D3574
Elongation - Ultimate	150% minimum	ASTM D3574
Compression Set (70°C, 50% RH after 72 hrs)	3% maximum	ASTM D3574
Thermal Conductivity	0.34 BTU in/hr ft^2 °F (0.05 W/M °C)	ASTM C518
Water Vapour Transmission	0.011 perms	ASTM E96
Temperature Range High Permanent Low Permanent	 185°F (85°C) -40°F (-40°C)	ASTM C711

Performance Tests	Results	Test Method
Weatherometer	Xenon Arc Weatherometer 2000 hrs - No visible deteriorations	ASTM G26
Weatherometer test repeated after Intentional Damage to Primary Liquid Sealant Face	Xenon Arc Weatherometer 2000 hrs - No visible deteriorations	ASTM G26
Rate of Air Leakage Through Curtain Walls	Passed	ASTM E283
Water Penetration of Curtain Walls by Uniform Air Pressure Difference	Tested Up to 20.88 PSF - Passed	ASTM E331
Structural Performance of Curtain Walls by Uniform Air Pressure Difference (Gust Loads)	+62.66 PSF, -56.39 PSF - Passed	ASTM E330

1.05 QUALITY ASSURANCE

.A Manufacturer's Instructions: In addition to requirements of these specifications, comply with manufacturer's instructions and recommendations for all phases of Work, including preparation of substrate, apply materials and protection of installed units.

1.06 DELIVERY, STORAGE AND HANDLING

.A Deliver materials as factory packaged, sealed and labelled. Handle and protect as necessary to prevent damage or deterioration during shipment, handling and storage.

.B Follow any special instructions by manufacturer or manufacturer's representative.

1.07 PROJECT CONDITIONS

.A Substrate Condition: Proceed with work only when substrate condition and preparation work is complete and in condition to receive sealant system.

.B Weather Conditions:

.1 Perform work only when existing and forecasted weather conditions are within the guidelines established by the manufacturer of the sealant system.

.2 Do not proceed with installation of expansion joint when joint to be sealed is damp, wet, or frozen, or when temperatures are below or above the manufacturer's recommended limitations for installation.

PART 2 PRODUCTS

2.01 MATERIALS

.A Exterior Wall Expansion Joints:

.1 Type 1: Silicone, pre-coated, preformed, precompressed, self-expanding, sealant system. 'Seismic Colourseal' by Emseal Joint Systems, Ltd., as distributed by DRE Industries Inc., contact Marla Cosburn, 416-233-1603 or other as approved by Consultant.

.2 Type 2: Water-based, stabilized, polymer-modified acrylic impregnated expanding foam sealant with internal laminations of closed cell (EVA) foam, 'Backerseal (Greyflex)' by Emseal Joint Systems, Ltd., as distributed by DRE Industries Inc., contact Marla Cosburn, 416-233-1603 or other as approved by Consultant.

2.02 FABRICATION

.A General:

.1 Fabricate components in longest practicable lengths.

.2 Prefabricate corners and other intersection pieces.

.3 Select width of assemblies to suit expansion joint size.

.B Exterior Wall Expansion Joints:

.1 Type 1:

.a Seal shall combine factory-applied, 15 Shore-A hardness, low-modulus silicone, and a backing of acrylic-impregnated expanding foam into a unified binary sealant system.

.b Expanding foam to be open-cell polyurethane foam, impregnated with a water-based, non-drying, polymer-modified acrylic. Impregnation density of uncompressed foam to be at least 8.4 and must not exceed 9.1 lbs/cu.ft. Impregnated foam laminations to have tested stability over temperature range from -40°C t 120°C, according to ASTM C711.

.c Product to have lateral, differential deflection, shear, and torsional movement capability of +50% and -50% (total 100%), of mean temperature joint size.

.d Silicone external colour facing to be factory-applied to the foam while it is partially pre-compressed to a width greater than maximum joint extension and cured before final compression. Coating width to be a minimum of two (2) times the designed or field measured, joint gap width. When compressed to final supplied dimension, a bellows with distinct and uniform folds to handle movement must be created in the silicone coating.

.e Seal must be supplied pre-compressed to less than the joint size, packaged in shrink-wrapped lengths (sticks), with a self-adhesive on one face. Depth of seal as recommended by manufacturer.

.2 Type 2:

.a Material to be supplied in sticks or reels, pre-compressed to less than joint size at mean temperature for ease of installation. Reel material will contain a nylon mesh (to reduce stretching), embedded into a pressure-sensitive adhesive on one (1) side of the material. Stick material to contain a pressure-sensitive adhesive on one (1) face.

2.03 FINISHES AND COLOURS

.A Exterior Wall Expansion Joints:

.1 Type 1: Silicone coating shall be match colour of adjacent building material. Allow for four (4) colours.

.2 Silicone Sealant at Type 1 exterior wall expansion joint colour shall match colour of silicone coating on expansion joint. Liquid silicone for corner beads to be supplied by the sealant manufacturer from the same colour batch as was used to form the silicone bellows.

PART 3 EXECUTION

3.01 INSPECTION

.A Examine surfaces and adjacent areas where products will be installed and verify that surfaces are ready to receive Work. All known detrimental conditions shall be reported immediately in writing. Do not proceed until unsatisfactory conditions have been corrected.

.B Joint surfaces to receive seal shall be sound, smooth, straight, parallel, clean, dry and free of all visible contaminants. Applications of non-visible coatings or contaminants to surfaces of joint interface area prior to installation of seal shall be controlled by the Consultant, in consultation with the expansion joint manufacturer.

.C The joint configuration and the joint surfaces shall be as detailed in the drawings and in accordance with the contract documents and in compliance with requirements in the current material available from the manufacturer.

.D Beginning of installation means installer accepts condition of existing surfaces and substrate.

3.02 INSTALLATION

.A Install expansion joint assemblies in accordance with manufacturer's written instructions, in longest practicable lengths, plumb, square, level and free of distortion.

.B Provide all items required for complete installation of expansion joint assemblies.

.C Joint sealer/expansion material to be installed in strict accordance with the manufacturer's written instructions.

.D Exterior Wall Expansion Joints:

.1 Type 1:

.a End to end joins of consecutive lengths of material to be joined by mitering across the direction of expansion of the material (sizes 2-3/4” can be butted, as opposed to mitered together), and jointed faces to be lightly 'buttered' with liquid silicone. To obtain identical colour sealant, use liquid silicone sealant supplied by manufacturer from same colour batch as was used to form the bellows.

.b Sealing against the substrate to be achieved through a combination of the pressure-sensitive adhesive impregnation, and the back-pressure of

the expanding foam, as well as through the addition in the field of a corner bead of silicone tooled between the preformed silicone bellows and the substrate.

.2 Type 2:

.a Material to be installed recessed from substrate faces and to receive a field-applied coating of low-modulus liquid sealant, not to exceed 1/4" thick. Refer to Section 07900, Joint Sealers, for low-modulus sealant.

3.03 CLEANING AND PROTECTION

.A Remove all waste materials from site. Leave work in a condition satisfactory to the Consultant.

END OF SECTION

DIVISION 6
WOOD AND PLASTICS

06100	Rough Carpentry
06200	Finish Carpentry
06610	Fibre-Reinforced Plastic Stairs, Handrail & Grating

SECTION 06100
ROUGH CARPENTRY

GENERAL

1.01 GENERAL REQUIREMENTS

.A General Conditions, Supplementary Conditions and Division 01 apply to this Section.

1.02 SUMMARY

.A Section includes:

.1 Wood furring for wall finishes.

.2 Blocking, cants and nailers for roofing system and related metal flashings.

.3 Preservative and fire resistive treatment.

.4 Concealed blocking behind wall mounted items.

.5 Wood blocking.

.6 Plywood.

.B Related Sections:

.1 Section 01000 – General Requirements

.2 Section 03300 – Cast-In-Place Concrete

1.03 REFERENCES

.A American Society for Testing and Materials (ASTM)

.1 ASTM A307 – Standard Specification for Carbon Steel Bolts, Studs and Threaded Rod 60 & #x2009; 000 PSI Tensile Strength

.B American Wood-Preservers' Association (AWPA - latest edition).

.1 AWPA T1 – Use Category System: Processing and Treatment Standard

.C Canadian Standards Association (CSA):

.1 CSA B111 – Wire Nails, Spikes and Staples

.2 CAN/CSA G164 – Hot Dip Galvanizing of Irregularly Shaped Articles

.3 CSA O80 Series - Wood Preservation, Includes all Updates.

.4 CSA O121 – Douglas Fir Plywood

.5 CSA O141 – Softwood Lumber

.6 CSA O151 – Canadian Softwood Plywood

.D Standards Council of Canada / Underwriters Laboratories of Canada (CAN/ULC)

.1 CAN/ULC-S102 – Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies

.E National Lumber Grades Authority NLGA

.1 NLGA Standard Grading Rules for Canadian Lumber

.F National Building Code.

.G Provincial Building Codes (where applicable).

1.04 SUBMITTALS

.A Section 01300 - Submittals: Procedures for submittals.

.B Letter of Conformance: Submit one (1) copy of the Letter of Conformance form at the end of this Section within twenty-one (21) Working Days of award of Contract.

.C Letter of Certification:

.1 Preservatives Treatment: For type specified, include certification by treating plant stating chemicals and process used, net amount of preservative retained and conformance with CSA O80 Series.

.2 For water-borne preservatives, include statement that moisture content of treated materials was reduced to a maximum of 15% for plywood prior to shipment to Project site.

.3 Fire Retardant Treatment:

.a For type specified, include certification by treating plant stating chemicals and process used, net amount of retardant retained and conformance with AWPA T1.

.b Include statement that moisture content of treated materials was 15% or less.

.c Submit Letter of Certification within twenty-one (21) Working Days of award of Contract.

1.05 SOURCE QUALITY CONTROL

.A Lumber Identification: By grade stamp of an agency certified by Canadian Lumber Standards Accreditation Board.

.B Plywood Identification: By grade mark in accordance with applicable CSA standards.

1.06 DELIVERY, STORAGE AND HANDLING

.A Co-ordinate deliveries to comply with construction schedule and arrange ahead for off-the-ground, under cover storage location. Do not load any area beyond the design limits.

.B Materials shall be carefully checked, unloaded, stored and handled to prevent damage to edges, ends and surfaces. Protect materials with suitable non-staining waterproof coverings.

.C Keep materials dry. Stack materials off ground a minimum of 12 inches or if on concrete slab-on-grade a minimum of 1-1/2 inches, fully protected from weather.

PRODUCTS

1.07 LUMBER MATERIALS

.A Lumber:

.1 Except as indicated or stated otherwise, lumber to be softwood, S4S, moisture content 19% or less, in accordance with the following standards:

.a CSA O141 - “Softwood Lumber”.

.b NLGA - “Standard Grading Rules for Canadian Lumber” (latest supplement).

.B Framing and Board Lumber:

.1 Treatable Species: No. 2 and better – S4S, Dry, 19%

.C Furring, Blocking, Nailing Strips, ground Rough Bucks, Curbs Fascia Backing and Sleepers:

.1 Board Sizes: “Standard” grade to NLGA, Paragraph 114c.

.2 Dimension Sizes: “Standard” grade to NLGA, Paragraph 122c.

1.08 PANEL MATERIALS

.A Interior Plywood: Douglas Fir Plywood (DFP): To CSA O121. Exterior Grade.

.B Canadian Softwood Plywood (CSP): To CSA O151.

.C Non-Structural Panel Products:

.1 COFI Performance Rated Panels: For concealed applications, provide panel products meeting performance requirements indicated on Drawings.

.2 Provide panels with tongue and groove edges where indicated on Drawings for compliance with U.L. assembly.

.D Thickness:

.1 Backing for Electrical and telephone Equipment: ¾" thickness.

.2 Other Locations: Shall be ¾" thick unless indicated otherwise on drawings.

1.09 ACCESSORIES

.A Fasteners: Provide manufacturer's recommended power tools for each type of fastener.

.1 Screws: Stainless steel, square drive head to ASTM standard.

.2 Nails, Spikes and Staples: To CSA B111.

.3 Nails, Spikes and Staples: Galvanized for exterior locations, high humidity areas, and treated wood; plain finish for other interior locations; size and type to suit application, unless otherwise noted. Galvanizing shall be to CAN/CSA G164.

.4 Use only stainless steel or hot dip galvanized steel for pressure-treated lumber.

.5 Bolts, Nuts, Washers, Lag Screws, and Wood Screws: ASTM A307, Medium carbon steel; size and type to suit application; galvanized for exterior locations, high humidity areas, and treated wood; plain finish for other interior locations, of size and type to suit application, unless otherwise noted. Galvanizing shall be to CAN/CSA G164.

.6 Toggle Bolt Fasteners: For anchorage of non-structural items to hollow masonry.

.7 Expansion Shield Fasteners: For anchorage of non-structural items to solid masonry and concrete.

.8 Powder or Pneumatically Activated Fasteners: For anchorage of non-structural items to steel.

.9 Provide manufacturers recommended power tools for each type of fastener.

.B Fasteners for structural wood members to masonry:

.1 Hilti HY-150 MAX adhesive anchors, size and length as indicated on Drawings.

.C Fasteners for Furring to Masonry

.1 Tapcon masonry anchors, by ITW Buildex. 1/4" diameter x 2-3/4" with Phillips flat head.

.2 Kwik-Con II fastener, by Hilti. 1/4" diameter x 2-3/4", with Phillips flat head.

1.10 WOOD TREATMENT

.A Preservative Treatment – Pressure Application:

.1 New Lumber Outside the Building Envelope or Exposed to Weather or Standing

Water:

.a Vacuum-pressure treat those items in accordance with CSA-O80.2 "Preservative Treatment of Lumber, Timer, Bridge Ties, and Mine Ties by Pressure Processes", commodity standard using NW-100, ACQ-Type C, alkaline copper quaternary compounds (ACQ-C) preservative to obtain a minimum net retention of 6.4 kg/m3 (0.40 pcf) by assay.

.2 New Lumber, Not exposed to Weather or Direct Wetting:

.a Vacuum-pressure treat those items in accordance with CSA-O80.2 "Pressure Treatment of Lumber, Timber, Bridge Ties, and Mine Ties by Pressure Processes" commodity standard using alkaline copper quaternary compound (ACQ-C) preservative to obtain a minimum net retention of 6.4 kg/m3 (0.40 pcf) by assay.

.3 New Plywood, Not Exposed to Weather or Direct Venting

.a Vacuum-pressure treat those items in accordance with CSA-O80.9 "Plywood - Preservative Treatment by Pressure Processes" commodity standard using alkaline copper quaternary compound (ACQ-C) preservative to obtain a minimum net retention of 4.0 kg/m3 (0.25 pcf) by assay.

.4 All lumber and plywood to be re-dried following treatment with waterborne preservatives, to an average moisture content of 19%.

.5 Third party inspection of products treated with preservative by vacuum-pressure will be carried out by an accredited inspection agency of the Canadian Standards Association [i.e. Canadian Softwood Inspections (CSI) or Timer Products Inspection (TP)].

.B Preservative Treatment – Field Application:

.1 Field treat with Copper Naphthenate (green), minimum 2.35% as copper metal preservative to the following:

.a All cut ends and surfaces, bolt holes and machined areas of ACQ-C treated wood products.

.C Fire Retardant Plywood (sheathing, rough carpentry):

.1 Fire retardant treatment: 'Dricon' by Trent Timber Treating Ltd.

.2 All plywood shall be a Douglas Fir Exterior Grade, and have ink brands on one face or end of plywood sheet.

.3 Pressure treat plywood with fire retardant chemical, according to CSA O80.27, and pink in colour for on-site recognition.

.4 Each piece of treated material shall bear the UL FR-S classification or shall bear actual flamespread and smoke developed ratings indicating compliance with an extended 30 minute tunnel test in accordance with CAN/ULC-S102M.

.5 Follow-up inspection and labelling shall be provided by ULC and material shall be certified to have following:

.a Flame spread rating 25 or less.

.b Fuel contribution 25 or less.

.c Smoke development 25 or less.

.6 After treatment, all lumber shall be dried to an average moisture content of 19% or less.

.7 Plywood shall be kiln dried to 15% after pressure impregnation.

.8 All treated material shall meet interior Type A requirements in AWPA T1 for lumber and plywood.

.9 Fire retardant chemicals used for treatment shall be free of halogens, sulphates, ammonium phosphates and formaldehyde.

.10 Treatment material shall provide protection against termites, fungal decay and shall be registered for use as a wood preservative.

.D Wood Requiring Treatment:

.1 Lumber, Preservative Treated:

.a Where fire retardant treatment is not required.

.b Nailers, blocking, stripping, and similar items in conjunction with roofing, flashing, and other construction.

.c Sills, blocking, furring, stripping, and similar items in contact with masonry or concrete.

.2 Interior Plywood, Fire Retardant Treated:

.a Plywood used as finish material, walls, ceilings, wainscots and bases in fire-rated corridors and other areas, as indicated on drawings.

.b Plywood backing for electrical and telephone equipment.

EXECUTION

1.11 EXAMINATION

.A Examine areas to receive rough carpentry work and verify following:

.1 That installation of building components to receive rough carpentry work is complete.

.2 That surfaces are satisfactory to receive work.

.3 That spacing, direction and details of supports are correct to accommodate installation of blocking, backing, stripping, furring and nailing strips.

1.12 SITE TREATMENT OF WOOD MATERIALS

.A Field treat any ACQ-C Pressure Treated surfaces exposed by cutting, trimming or boring with liberal application of Copper Naphthenate (2.35%) preservative before installation.

.B Apply two (2) liberal coats by brush or dip to completely saturate cuts, holes or injuries to pressure treated wood. Allow preservative to cure prior to placing members.

.C Material to be field treated is as follows:

.1 Wood cants, fascia backing, curbs, nailers, sleepers on roof deck, and deck boards.

.2 Wood furring for exterior cladding.

1.13 INSTALLATION

.A Comply with the requirements of the local Building Code (latest edition), Part 9, supplemented by the following paragraphs.

.B Install miscellaneous blocking, nailing strips, framing, and sheathing as detailed on Drawings, or as required. Co-ordinate to allow proper attachment of work of other Sections.

.1 Secure wood blocking, cants, nailers, in place using fasteners specified. Use only recommended power tools for placement of fasteners.

.2 Recess heads of fasteners below surface of wood members.

.C Install members true to line, levels and elevations, square and plumb.

.D Secure in place with appropriate fasteners. Use fasteners of correct size that will not penetrate members where opposite side will be exposed to view or require finishing. Do not split wood with fasteners; set panel products to allow expansion at joints.

.E Do not splice structural members between supports.

.F Firestop concealed spaces with wood blocking (horizontally and vertically per drawings) not less than 2 inches thick where space is not blocked by other framing members.

.G Construct members of continuous pieces of longest possible lengths.

.H Install spanning members with “crown-edge” up.

.I Select exposed framing for appearance. Install lumber and panel materials so that grade-marks and other defacing marks are concealed or are removed by sanding where materials are left exposed.

.J Employ qualified personnel to apply wood preservatives in accordance with manufacturer's written instructions.

.K Furring on Masonry: Attach wood furring strips with specified Masonry Fasteners at 12" O.C. and liquid nail adhesive.

END OF SECTION

SECTION 06200
FINISH CARPENTRY

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SECTION 06200
FINISH CARPENTRY

PART 1 – GENERAL

1.1 SCOPE

.1 Labour, Products equipment and services necessary for the cabinetry and miscellaneous finish carpentry Work in accordance with the Contract Documents.

1.2 REFERENCES

.1 ANSI A208.1, Particleboard.

.2 ANSI A208.2, Medium Density Fibreboard for Interior Use.

.3 ANSI/NEMA LD 3, High-Pressure Decorative Laminates.

.4 ASTM F1667, Driven Fasteners: Nails, Spikes and Staples.

.5 Architectural Woodwork Manufacturers Association of Canada (AWMAC).

.6 Architectural Woodwork Standards (AWS) - Quality Standards for Architectural Woodwork.

.7 CAN/CSA O141, Softwood Lumber.

.8 CSA O151-M, Canadian Softwood Plywood.

.9 National Hardwood Lumber Association (NHLA) Rules for the Measurement and Inspection of Hardwood and Cypress.

.10 National Lumber Grades Authority (NLGA) Standard Grading Rules for Canadian Lumber.

1.3 SUBMITTALS

.1 Shop drawings: Submit shop drawings of finish carpentry Work in accordance with Section 01330 indicating materials, thicknesses, sizes, finishes, wood species, grades, profiles, connection attachments, shop jointing, field jointing, reinforcing, anchorage, fastener types and sizes, location of exposed fastenings, mechanical and electrical service routes, service outlets, cutout locations, and sizes. Include erection drawings, plans, elevations, sections, and details as applicable.

.2 Samples: Submit samples of the following in accordance with the requirements of Section 01330:

.1 Two representative pieces of each type of wood to receive a stained or natural finish.

.2 Two representative pieces of each type of wood finished as specified.

.3 Two of each colour, pattern, gloss, and texture of plastic laminate, in manufacturer's standard tag size.

.4 Two samples of laminated plastic joints, edging, cutouts and postformed profiles.

.5 Two samples of melamine surfaced board, edging and postformed profiles.

.6 Two of each countertop, in 100 x 75 x 19 mm samples.

.7 One of each item of finish carpentry hardware.

1.4 QUALITY ASSURANCE

.1 Execute Work of this Section by member of AWMAC, with min. 5 years' experience in finish carpentry Work of comparable complexity and scope. Submit proof of experience upon Consultant's request.

.2 Fabricate finish carpentry Work in accordance with AWS Quality Standards, Premium Quality materials and installation unless otherwise indicated. Perform Work in accordance with the definition of Good Workmanship as defined in the AWS Quality Standards.

.3 Remove and replace finish carpentry Work which does not conform to the AWS Quality standards or as amended by these Specifications.

1.5 DELIVERY, STORAGE, AND HANDLING

.1 Deliver, store, and handle finish carpentry in accordance with the AWS Quality Standards. Control the temperature and humidity in accordance with the AWS recommendations, before, during, and after finish carpentry delivery, and also during storage and installation.

.2 Cover finished plastic laminated work with heavy kraft paper or put in cartons during shipment. Protect installed surfaces by approved means. Do not remove until immediately before final inspection.

1.6 EXTENDED WARRANTY

.1 Submit an extended warranty for plastic laminate work of this Section in accordance with General Conditions, except that warranty period is extended to 2 years from date of Substantial Performance of the Work.

.2 Warrant against defects in material and workmanship including but not limited to opening of joints, cracking, shrinkage, warpage, and delamination of plastic laminate.

.3 Coverage: Complete replacement including affected adjacent Work.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 General:

.1 Materials used for Work of this Section are to include, but not be limited to the following criteria:

.1 Regionally sourced materials.

.2 Certified wood.

.3 Low VOC content limits.

.2 Adhesives - Urea-formaldehyde-free glues.

.3 All dimensional lumber and plywood to be FSC certified.

.4 All composite wood and/or agrifibre products (including core materials) and adhesives used to fabricate laminated assemblies used in building must not contain added urea-formaldehyde.

.5 Material to be sourced regionally from within 800 km of jobsite wherever possible.

.6 Concealed framing lumber: Eastern Spruce, Balsam Fir, or Jack Pine, to CAN/CSA O141, NLGA, and AWS Custom Grade, S4S, average moisture content 7% +/- 2% at installation.

.7 Hardwood lumber: Maple to NHLA and AWS Premium Grade, S4S, average moisture content 7% +/- 2% at installation.

.8 Softwood plywood: CSA O151-M; 19 mm unless indicated otherwise, (G2S).

.9 Plastic laminate: Provide plastic laminates conforming to ANSI/NEMA LD 3 as follows:

.1 Flatwork face sheet: 1.2 mm thick, heavy wear resistance.

.2 Vertical interior face sheets: 0.8 mm thick.

.3 Postformed face sheet: 0.8 mm thick.

.10 Backing sheet: thickness to match face sheet, high pressure laminate, manufactured by same manufacturer as face sheet.

.11 Plastic laminate: As manufactured by Arborite, Formica, Forbo, Nevamar, Pionite, Wilsonart and Octopus Products Ltd, and Abet Laminati.

.12 Colours: Consultant to select from structural unless indicated on drawings.

.2 Melamine Surfaced Particleboard: ANSI A208.1, Grade M2, contains 100% post-industrial wood fibres, no urea-formaldehyde. Edging to be done in minimum 0.5 mm thin PVC to match melamine colour. 'Nu Green Particleboard' by Uniboard Canada Inc. or approved alternative, having the following minimum criteria:

.1 Density: 635 kg/m3.

.2 Modulus of rupture: 14.5 N/mm2.

.3 Modulus of elasticity: 2, 250 N/mm2.

.4 Internal bond: 0.45 N/mm2.

.5 Hardness: 2,225 N.

.6 Linear expansion: < 35%.

.7 Formaldehyde emissions: 0.00-0.01 ppm.

.8 Melamine facing: 'Panval Melamine' by Uniboard Canada Inc. or approved alternative. Colours as follows:

.1 Interior millwork surfaces: White.

.2 Exterior millwork surfaces: Colour and pattern as selected by Consultant.

.3 Medium Density Fibreboard (MDF), core or panel: ANSI A208.2; SCS and EPP certified, no-added formaldehyde, moisture resistant MDF panels engineered for interior high moisture areas, 'Medex' by SierraPine or approved alternative by Flakeboard Company Limited; meeting the following minimum criteria:

.1 Density: 769 kg/m3.

.2 Internal bond: 1.38 N/mm2.

.3 Modulus of rupture: 41.34 N/mm2.

.4 Modulus of elasticity: 4134 N/mm2.

.5 Moisture content: 4-6%.

.4 Particle board core: ANSI A208.1, no-added formaldehyde, FSC certified particleboard containing recycled content, ‘Purekor Platinum Particleboard’ by Panel Source or approved alternative by SierraPine; meeting the following minimum criteria:

.1 Density: 720 kg/m3.

.2 Internal bond: 0.76 N/mm2.

.3 Modulus of rupture: 25.4 N/mm2.

.4 Modulus of elasticity: 2861 N/mm2.

.5 Stainless Steel counter (SS-1): 14 gauge; Col XL Suede by Excelsior Metal.

.6 Laminating adhesive: CSA O112 Series, water resistant type, low VOC content, selected by laminate manufacturer for intended end use.

.7 Draw bolts and splines: Type as recommended by fabricator.

.8 Nails and staples: Conforming to ASTM F1667; Size and type to suit application, galvanized for exterior work, interior humid areas and for treated lumber; plain finish elsewhere.

.9 Bolts, nuts, washers, blind fasteners, lags and screws: Size and type to suit application. Stapling is not acceptable.

.10 Adhesive and bituminous mastic: Selected by the millwork fabricator with low VOC content.

.11 Miscellaneous metals: In accordance with Section 05500.

.12 Glass and glazing materials: In accordance with Section 08800.

.13 Finishing: In accordance with Section 09900.

2.2 HARDWARE

.1 The following hardware is the minimum quality standard for the work of this Section. Alternatives may be considered provided they are approved by Consultant prior to ordering of products.

.2 Drawer slides: Full extension, 8400 Series by Knape & Vogt or approved alternative by Blum, Accuride or Hafele.

.3 Pilasters: Clear anodized aluminum recessed shelf standards with 12 mm divisions, Model 233 by Knape & Vogt or approved alternative by Blum, Accuride or Hafele.

.4 Clips: Bright zinc plated, adjustable height shelf supports, Model 256 by Knape & Vogt or approved alternative by Blum, Accuride or Hafele.

.5 Cabinet hinges: Heavy duty, concealed 110 degree, clip, self closing, Model 75M3550 by Blum or approved alternative by Knape & Vogt, Accuride or Hafele.

.6 Drawer and cabinet pulls: 136 mm in length, metal pulls with brushed nickel finish, 871128NBV by Richelieu or approved alternative by Knape & Vogt or Hafele.

.7 Magnetic catches: Model 918 by Knape & Vogt or approved alternative by Blum, Richlieu or Hafele.

.8 Locks: Cam locks/deadbolt locks complete with lock core by Hafele or approved alternative by Knape & Vogt, Blum or Accuride, type to suit application and installation. All locks in same unit keyed alike unless indicated otherwise.

.9 Closet rail: 27 mm diameter wardrobe rail stainless steel finish ‘Model 660 Round Tubing' and tubing flange ‘Model 735' by Knape & Vogt or approved alternative by Richelieu, Accuride or Hafele.

.10 Cable grommets: 44 - 60 mm, colour to match counter finishes, as manufactured by Hafele or approved alternative by Richelieu or Accuride.

.11 Door and drawer bumper: Self adhesive, plastic, door and drawer bumper as manufactured by Richelieu or approved alternative by Hafele.

2.3 PLASTIC LAMINATE WORK

.1 Perform plastic laminate Work in accordance with AWS Quality Standards and ANSI/NEMA LD 3.

.2 Ensure adjacent parts of continuous laminate work match in colour and pattern.

.3 Laminate plastic laminates to core materials in accordance with manufacturer's instructions.

.4 Fabricate core surfaces and profiles with continuous support and bond over entire surface to receive plastic laminate.

.5 Apply plastic laminate backing sheets to balance shrinkage stresses induced by plastic laminate face sheets.

.6 Minimize joints in plastic laminate Work; do not install joints in plastic laminate Work in less than 2400 mm o.c. Locate joints minimum 610 mm from cut-outs. Offset core and plastic laminate facing joints.

.7 Form shaped profiles and bends as indicated, using postformed grade laminate to laminate manufacturer's instructions.

.8 Use straight self-edging laminate strip to match adjacent colour, finish, gloss, and pattern to cover exposed edge of core material. Chamfer exposed edges uniformly at approximately 20 degrees. Do not mitre laminate edges.

.9 Apply laminated plastic liner sheet to interior of cabinetry and where indicated.

2.4 FABRICATION

.1 Be responsible for methods of construction and for ensuring that materials are rigidly and securely attached and will not be loosened by the work of other sections.

.2 Coordinate locations of concealed supports and blocking with other parts of Work. Provide cutouts for outlet boxes and other fixtures.

.3 Fabricate work in a manner which will permit expansion and contraction of the materials without visible open joints. Conceal joints and connections in wherever possible.

.4 Set nails and countersink screws, apply wood filler to indentations, sand smooth and leave ready to receive finish.

.5 Mitre exposed corners, no end grain shall be visible in completed installation.

.6 Finish millwork in accordance with Section 09 91 00. Finished millwork shall be free from bruises, blemishes, mineral marks, knots, shakes and other defects and shall be selected for uniformity of colour, grain and texture.

.7 Shelving to cabinetwork to be adjustable unless otherwise noted.

.8 Recess shelf standards, unless noted otherwise. Stagger recessed shelf standards on opposite sides of divider.

.9 Do not exceed maximum 760 mm unsupported span for 19 mm thick shelving. House fixed shelving into gables and divisions.

.10 Shop assemble finish carpentry to accommodate delivery and handling and to ensure passage through building openings.

.11 Shop install cabinet hardware for doors, shelves and drawers. Recess shelf standards unless noted otherwise.

.12 MDF Baseboard: Fabricate base from MDF 100 mm high x 16 mm thick, finished in accordance with Section 09 91 00.

.13 Window sills:

.1 Provide all plastic laminate window sills and aprons where indicated and as detailed.

.2 Construct sills and aprons of plastic laminate on 20 plywood.

.3 Conceal all fixings.

.4 Include all plastic laminate on the exposed edge of sill.

.5 Provide all solid continuous blocking and shims required for installation.

.6 Colour of plastic laminate window sill to select foam spray gauge or as indicated otherwise on drawing.

PART 3 - EXECUTION

3.1 EXAMINATION

.1 Verify condition and dimensions of previously installed Work upon which this Section depends. Report defects to Engineer. Commencement of Work means acceptance of existing conditions.

3.2 INSTALLATION

.1 Install Work in accordance with AWS Quality Standards and tolerances for Architectural Woodwork. Set and secure finish carpentry in place, rigid, plumb, square, and level.

.2 Scribe and cut as required, fit to abutting walls, and surfaces, fit properly into recesses and to accommodate columns, fixtures, outlets, or other projecting, intersecting or penetrating objects leaving a 0.8 mm gap maximum.

.3 Coordinate cutouts for plumbing fixtures, inserts, appliances, outlet boxes, and other fixtures, in finish carpentry. Round internal corners of cut-outs and seal exposed cores.

.4 Form joints to conceal shrinkage.

.5 Install draw bolts and splines in laminated plastic counter top joints at maximum spacing 450 mm o.c., and 75 mm from edge. Make joints flush, hairline butt joints.

.6 Install finishing hardware accurately and securely in accordance with manufacturer's directions, adjust and clean.

.7 Install prefinished millwork at locations shown on drawings. Position accurately, level, plumb straight.

.8 Apply bituminous coating over wood framing members in contact with masonry or cementitious construction.

.9 Melamine panels: Assemble melamine millwork using dowelled/wafered-and-glue construction. Installed melamine panels shall not show any exposed fasteners on finished/exposed surfaces.

.10 Install window sills level, plumb and even in locations as indicated and ensure that sills are securely fastened.

.11 Stainless steel counter: Laminate stainless steel sheet to exterior grade plywood with acceptable laminating adhesive as outlined above for plastic laminate. Follow stainless steel requirements as indicated in Section 05 50 00.

.12 Fastening:

.1 Coordinate wall securement, anchorage, and blocking for finish carpentry items.

.2 Position items of finished carpentry work accurately, level, plumb, true and fasten or anchor securely.

.3 Design and select fasteners to suit size and nature of components being joined. Use proprietary devices as recommended by manufacturer.

.4 Provide heavy duty fixture attachments for wall mounted cabinets.

.5 Set finishing nails to receive filler. Where screws are used to secure members, countersink screw in round cleanly cut hole and plug with wood plug to match material being secured.

.13 Remove and replace damaged, marked, or stained finish carpentry.

END OF SECTION

SECTION 06610
FIBRE-REINFORCED PLASTIC STAIRS, HANDRAIL & GRATING

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SECTION 06610
FIBRE-REINFORCED PLASTIC STAIRS, HANDRAIL & GRATING

PART 1 – GENERAL

1.1 SCOPE

.1 This Section covers the Work for fibreglass stairs, handrail systems, and grating in compliance with the National Building Code and OSHA.

.2 Work under this section of the Contract Specifications shall be performed in conjunction with Section 05500 – Metal Fabrications.

1.2 REFERENCES:

.1 The publications listed below (latest revision applicable) form a part of this specification to the extent referenced herein.

.2 American Society for Testing and Materials (ASTM) test methods:

.1 ASTM D-638-Tensile Properties of Plastics

.2 ASTM D-790-Flexural Properties of Unreinforced and Reinforced Plastics

.3 ASTM D-2344-Apparent Interlaminar Shear Strength of Parallel Fiber Composites byShort Beam Method

.4 ASTM D-495-High Voltage, Low-Current, Dry Arc Resistance of Solid Electrical Insulation

.5 ASTM D-696-Coefficient of Linear Thermal Expansion for Plastics

.6 ASTM E-84-Surface Burning Characteristics of Building Materials

1.3 SUBMITTALS

.1 Furnish shop drawings clearly showing material sizes, types, styles, part or catalog 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.

.2 Submit the manufacturer’s published literature including structural design data, structural properties data, corrosion resistance tables, certificates of compliance, and test reports as applicable.

.3 Submit design calculations signed and sealed by a Professional Engineer registered in Ontario for all custom-designed structural members and connections including concrete anchors for ladders and intermediate platforms.

.4 Submit sample pieces as requested.

1.4 MANUFACTURERS

.1 Equal to Fibergrate Composite Structures Inc.

PART 2 – PRODUCTS

2.1 STAIRS

.1 General

.1 Handrails and railings, ladders, gratings, stair systems, vanity counter supports and anchorage and other metal fabrication items to be installed in spaces comprising the Beaufort Pumping Station, with the exception of the reservoir access room, shall be of aluminum, 304 stainless steel or fibre-reinforced plastic (FRP) as indicated on Contract Drawings.

.2 Handrails and railings, ladders, gratings, stair systems, vanity counter supports and anchorage and other metal fabrication items to be installed in the reservoir access room within the Beaufort Pumping Station shall be of 316L stainless steel or fibre- reinforced plastic (FRP) as indicated on Contract Drawings.

.3 Handrails and railings, ladders, gratings, stair systems, vanity counter supports and anchorage and other metal fabrication items to be installed in spaces comprising the Beaufort Reservoir shall be of 316L stainless steel or fibre- reinforced plastic (FRP) as indicated on Contract Drawings.

.2 Structural Shapes

.1 Manufactured by the pultrusion process with a glass content minimum of 45%, maximum of 55% by weight. The structural shapes shall be composed of fiberglass 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 Fiberglass reinforcement shall be a combination of continuous roving, continuous strand mat, and surfacing veil in sufficient quantities as needed by the application and/or physical properties required.

.3 Resins shall be fire retardant isophthalic polyester or VEFR, fire retardant vinyl ester with chemical formulation 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, free of voids and without dry spots, cracks, crazes or

unreinforced areas. All glass fibers shall be well covered with resin to protect against their exposure due to wear or weathering.

.5 All pultruded structural shapes shall be further protected from ultraviolet (UV) attack with 1) integral UV inhibitors in the resin and 2) a synthetic surfacing veil to produce a resin rich surface.

.6 All FRP products shall have a tested flame spread rating of 25 or less per ASTM E-84 Tunnel Test.

.7 Pultruded structural shapes are to have the minimum longitudinal mechanical properties listed below:

.1	Tensile Strength	ASTM D-638	206 MPa
.2	Tensile Modulus	ASTM D-638	17.2 GPa
.3	Flexural Strength	ASTM D-790	206 MPa
.4	Flexural Modulus	ASTM D-790	12.4 GPa
.5	Flexural Modulus (Full Section)		19.3 GPa
.6	Short Beam Shear (Transverse)		ASTM D-2344 31 MPa
.7	Shear Modulus (Transverse)		3.1 GPa
.8	Coefficient of Thermal Expansion cm/cm/°C		ASTM D-696 8.0 x 10-6
.9	Flame Spread	ASTM E-84	25 or less

2.2 STAIR TREADS

.1 Manufacture:

.1 Stair treads shall be of a one piece molded construction and shall have a 38 mm x 152mm rectangular mesh pattern providing unidirectional strength in the tread span direction. Treads shall be reinforced with continuous rovings in each direction. The top layer of reinforcement shall be no more than 3 mm below the top surface of the tread so as to provide maximum stiffness and prevent resin chipping of unreinforced surfaces. Percentage of glass (by weight) shall not exceed 35% so as to achieve maximum corrosion resistance, and as required to maintain structural requirements. After molding, no dry glass fibers shall be visible on any surface of bearing bars or cross bars. All bars shall be smooth and uniform with no evidence of fiber orientation irregularities, interlaminar voids, porosity, resin rich or resin starved areas.

.2 Non-slip surfacing: Stair treads shall be manufactured with a concave, meniscus profile on the top of each bar providing maximum slip resistance and with a 38 mm solid, molded nosing coated with angular quartz grit, integrally molded into the top surface of the nosing area only.

.3 Fire rating: Tested flame spread rating of 25 or less to ASTM E 84.

.4 Resin system: Corrosion and UV resistant

.5 Thickness: 38 mm with a tolerance of plus or minus 1.5 mm

.6 Mesh Configuration: 38 mm x 152 mm rectangular mesh pattern with double cross bars on 152 mm centers

.7 Load/Deflection: To manufacturer's published recommended loading with deflection not to exceed the following:

.8 Concentrated load of 225 kg placed at the centerline of a 914 mm tread span with a maximum deflection not to exceed 8 mm

.2 Fabrication:

.1 Measurements: To the dimensional requirements and tolerances shown on the Drawings. The Contractor shall provide and/or verify measurements in field for work fabricated to conform to field conditions as required by stair tread 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: All shop fabricated stair tread cuts shall be coated with vinyl ester resin to provide maximum corrosion resistance. All field fabricated stair tread cuts shall be coated similarly by the contractor in accordance with the manufacturer's instructions.

.3 Hardware: Type 316 stainless steel hold-down clips shall be provided and spaced as recommended by the manufacturer. A minimum of four hold-down clips shall be required for each tread.

2.3 FRP HANDRAILING

.1 Materials

.1 All FRP posts, rails and structural shapes manufactured by the pultrusion process as follows:

.1 Top and bottom rails: 44.4 mm x 3.2 mm wall square tube.

.2 Posts: 53.9 mm x 4.8 mm wall square tube.

.3 Kickplate: 100 mm high x 12 mm wide with two reinforcing ribs.

.2 Design railings to withstand minimum horizontal and vertical loads as required to meet requirements of authorities having jurisdiction. In no instance shall load design of railings be less than 2.2 kN/m horizontally and 1.5 kN/m vertically.

.3 All rails, posts, and kick plates are to be integrally pigmented yellow.

.4 All fasteners used in the railing system are to be 316 SS. Rivets to be 18-8 SS.

.2 Handrail Fabrication

.1 Fabricate the handrail post-rail connection such that the rails are unbroken and continuous through the post without the use of packs or splices. Install the bottom rail through the post at a prepared hole made to fit the outside dimensions of the rail. Fit the top rail into a machined, U-shaped pocket formed into top of the post such that the rail is located at the center of the post. Round all exposed post corners to eliminate sharp edges. Join the rails to the posts using a combination of bonding and riveting at a maximum post spacing of 1.8 m adjusted as required to provide uniform spacing on any straight run.

.2 Provide floor or wall-mounted post supports generally as shown on the Drawings, reinforced to a height of 250 mm.

.3 When required, splice rails using a 250 mm length of 38.1 mm x 3.2 mm FRP square tube bonded and riveted into place using epoxy adhesive and 18-8 stainless steel rivets.

.4 Do not used PVC or CPVC connectors

.5 Seal all shop fabrication cuts with a vinyl ester resin to provide maximum corrosion resistance and provide complete instructions for coating field cuts.

2.4 FRP GRATING

.1 Manufacture:

.1 One-piece moulded construction with tops and bottoms of bearing bars and cross bars in the same plane and a rectangular mesh pattern to provide bi-directional strength. Reinforce grating with continuous rovings of equal number of layers in each direction. Place the top layer of reinforcement no more than 3 mm below the top surface of the grating to provide maximum stiffness and prevent resin chipping of unreinforced surfaces. Ensure a

maximum of 45% of glass by weight to maximize corrosion resistance and as required to satisfy structural requirements.

.2 Ensure no dry glass fibers are visible on any surface of the bearing or cross bars and that the bars are smooth and uniform with no evidence of fiber orientation irregularities, inter-laminar voids, porosity, resin rich or resin starved areas.

.3 Color: Dark Gray

.4 Depth: 38 mm or 50 mm to suit spans as shown on the Drawings with a tolerance of plus or minus 1.5 mm

.5 Mesh Configuration: 25.4 mm x 50 mm with a tolerance of plus or minus 1.5 mm mesh centerline to centerline.

.6 Grating bar intersections: filleted to a minimum radius of 1.5 mm to reduce local stress concentrations and the possibility of resin cracking.

.7 Panel Sizes:

.1 As shown on the Drawings

.2 Or where not shown, maximum 1220 mm x 1828 mm with load bars parallel to the 1220 mm direction.

.8 FRP embedment angles to size as required and configuration as shown on the Drawings

.9 Size FRP structural members where indicated on the Drawings and as required to support all applied loads

.10 All stainless steel hold-down bolted-clips and hinges for access openings

.2 Grating Fabrication:

.1 Measurements: Base grating fabrication on field measurements verified by the Contractor.

.2 Make grating sections readily removable unless indicated otherwise.

.3 Seal all shop fabrication cuts with a vinyl ester resin to provide maximum corrosion resistance and provide complete instructions for coating field cuts.

.4 Hardware: Provide all necessary 316 stainless steel hold-down clips, fasteners and hinges for all grating and where specifically noted on the Drawings.

.3 Performance Requirements:

.1 Minimum concentrated vertical load of 100 kg applied at mid-span.

.2 Minimum uniform live load of 4.8 kPA.

PART 3 - EXECUTION

3.1 INSTALLATION

.1 In accordance with the manufacturer's instructions.

.2 True to line and level.

.3 All stainless steel hardware and drill-in anchors.

END OF SECTION

DIVISION 7
THERMAL AND MOISTURE PROTECTION

07120	Bituminous Waterproofing
07121	Chemical Waterproofing
07130	Sheet Waterproofing
07131	Cold-Fluid Applied Waterproofing
07132	Self-Adhering Sheet Waterproofing
07195	Air Barrier Membrane
07210	Building Insulation
07216	Sprayed Polyurethane Foam Insulation
07256	Sprayed Mineral Fibre Fireproofing
07270	Firestopping and Smoke Seals
07412	Standing Seam Sheet Metal Roofing
07421	Insulated Metal Wall Panel System
07544	PVC Single Ply Fully Adhered Roofing System
07620	Sheet Metal Flashing and Trim
07722	Roof Hatches and Accessories
07900	Joint Sealants

SECTION 07120
BITUMINOUS WATERPROOFING

GENERAL

1.01 GENERAL REQUIREMENTS

.A General Conditions, Supplementary Conditions and Division 01 apply to this Section.

1.02 SUMMARY

.A Section includes:

.1 Bituminous waterproofing.

.B Related Sections:

.1 Section 03300 – Cast-In-Place Concrete

1.03 SUBMITTALS

.A Section 01300 – Submittals: Procedure for Submittals

1.04 QUALITY ASSURANCE

.A The Contractor executing Work of this Section shall have a minimum of five (5) years continuous Canadian experience in successful application of chemical waterproofing work of type specified. Submit proof of experience to Consultant.

1.05 SITE CONDITIONS

.A Environmental Requirements: Perform Work only when existing and forecasted weather conditions are within the limits established by the manufacturer of the materials and products used. Maintain warranty requirements.

1.06 WARRANTY

.A Provide warranty signed jointly by Contractor, installer and manufacturer, agreeing to replace or repair defective materials and workmanship for warranty period of two years. Include significant leakage of water, abnormal aging or deterioration of materials, and other failures of chemical waterproofing to perform as required.

1.07 DELIVERY, HANDLING, PROTECTION AND STORAGE

.A Co-ordinate deliveries to comply with construction schedule and arrange ahead for strategic off the ground, dry, enclosed storage area.

.B Material shall be carefully checked, unloaded, stored and handled to prevent damage. Protect materials with suitable waterproof coverings.

.C Deliver and store waterproofing materials in the manufacturer’s original containers and wrappers with seals intact.

.D Do not permit materials to freeze. Store materials at temperatures above 10°C.

PRODUCTS

1.08 BITUMINOUS WATERPROOFING

.A Manufacturer List: Products of following manufacturers are acceptable subject to conformance to requirements of Drawings, Schedules and Specifications:

.1 Bakor Inc.; www.bakor.com

.B Substitution Limitations: Comparable Products from other manufacturers not listed herein will be accepted provided they meet requirements of this Specification after full review by Consultant.

.C Extent of Waterproofing:

.1 On exterior vertical face and full width of top of footings to walls bordering basements.

.2 Over entire area of base levelling slabs, turned up minimum of 50 mm (2") above slab at vertical surfaces; around pipes and drains extending through slabs; atop interior footings against which base levelling slab abuts; at changes in levels of such slabs and lapped over horizontal waterproofing to ensure watertight membrane.

.3 In angle between toe footing and outside face of basement walls to which surface waterproofing is applied.

.D Waterproofing Membrane for Temperature Below 4 deg C (40 deg F):

.1 Asphalt Dampproof Primer: Primer conforming to CGSB 37-GP-9Ma, “910-01 Penetrating Asphalt Primer” by Bakor Inc.

.2 Premium Grade Fibrated Asphalt Coating: Asphalt emulsion, “710-11 Premium Grade Foundation Coating” by Bakor Inc.

.E Waterproofing Membrane for Temperature Above 4 deg C (40 deg F):

.1 Asphalt Emulsion Primer: “700-01 Asphalt Emulsion Dampproofing” by Bakor Inc., diluted 20% with clean water.

.2 Asphalt Emulsion Dampproof Coating: “700-01 Asphalt Emulsion Dampproofing” by Bakor Inc.

.F Reinforcing Fabric: Open weave glass fabric yarn saturated with synthetic resins, “990-06 Yellow Jacket” by Bakor Inc.

.G Protection Board: Polypropylene extruded flexible twin-wall 2 mm thick protection board with a compressive strength of 0.45 kg/cm2, “990-31 Polypropylene Protection Board” by Bakor Inc.

.H Protection Board Adhesive: A synthetic rubber base compound having following characteristics:

.1 Compatible with waterproofing membrane and substrate.

.2 Chemical Resistance: Alkalis, mild acid and salt solutions.

.3 Acceptable Product: “230-21 Adhesive” by Bakor Inc.

EXECUTION

1.09 EXAMINATION

.A Before commencing work, ensure environmental and site conditions are suitable for installation of waterproofing membrane.

.B Ensure substrate is clean and dry, free from surface water, ice, snow or frost, dust, dirt, oil, grease, curing compounds or any other foreign matter detrimental to adhesion of waterproofing membrane.

.C Evaluation and Assessment: Commencement of work implies acceptance of previously completed work.

1.10 INSTALLATION

.A Install all productions in accordance with manufacturers written instructions and to the approval of the Consultant.

.B Waterproofing Membrane System:

.1 Apply a coat of primer as recommended at rate as recommended and allow to cure until touch dry.

.2 Apply first bedding coat of waterproofing membrane at a minimum rate of 1.0 l/m^2 (200 sq ft/gal) and embed fabric reinforcement immediately eliminating air pockets, wrinkles, buckles or fishmouths. Ensure full adhesion and allow to dry.

.3 Apply successive plies of membrane reinforcement in further bedding coats in same manner. Offset joints at least 25 mm (1”) from joints of preceding ply of membrane reinforcement.

.4 At corners, angles and at junctions of waterproofing on foundation walls with footings, reinforce membrane with 2 additional coats of waterproofing membrane and 2 plies of fabric reinforcement extending at least 100 mm (4”) each side of junction.

.5 Apply seal coat of waterproofing membrane over entire surface at rate of 1.0 l/m^2 (200 sq ft/gal) and permit to cure thoroughly.

.C Protection Board:

.1 Install protection boards over waterproofing membrane to prevent damage from materials used in backfilling.

.2 Apply protection board adhesive in 13 mm (1/2") wide strips spaced at 450 mm (18") oc to cured waterproofing membrane. Immediately embed protection board and press into adhesive to ensure full contact.

.3 Do not backfill until adhesive has cured and dried. Do not use excessive levels of adhesive.

.D SITE QUALITY CONTROL

.1 Non-Conforming Work: Replace damaged work which cannot be satisfactorily repaired, restored or cleaned, to satisfaction of Consultant at no cost to Owner.

.E CLEANING

.1 Promptly as work proceeds and on completion, clean up and remove from the premises rubbish and surplus materials resulting from foregoing work.

END OF SECTION

SECTION 07121
CHEMICAL WATERPROOFING

GENERAL

1.01 GENERAL REQUIREMENTS

.A General Conditions, Supplementary Conditions and Division 01 apply to this Section.

1.02 SUMMARY

.A Section includes:

.1 Chemical waterproofing.

.B Related Sections:

.1 Section 03300 – Cast-In-Place Concrete

1.03 SUBMITTALS

.A Section 01300 – Submittals: Procedure for Submittals

1.04 QUALITY ASSURANCE

.A The Contractor executing Work of this Section shall have a minimum of five (5) years continuous Canadian experience in successful application of chemical waterproofing work of type specified. Submit proof of experience to Consultant.

1.05 SITE CONDITIONS

.A Environmental Requirements: Perform Work only when existing and forecasted weather conditions are within the limits established by the manufacturer of the materials and products used. Maintain warranty requirements.

1.06 WARRANTY

.A Provide warranty signed jointly by Contractor, installer and manufacturer, agreeing to replace or repair defective materials and workmanship for warranty period of two years. Include significant leakage of water, abnormal aging or deterioration of materials, and other failures of chemical waterproofing to perform as required.

1.07 DELIVERY, HANDLING, PROTECTION AND STORAGE

.A Co-ordinate deliveries to comply with construction schedule and arrange ahead for strategic off the ground, dry, enclosed storage area.

.B Material shall be carefully checked, unloaded, stored and handled to prevent damage. Protect materials with suitable waterproof coverings.

.C Deliver and store waterproofing materials in the manufacturer’s original containers and wrappers with seals intact.

.D Do not permit materials to freeze. Store materials at temperatures above 10°C.

PRODUCTS

1.08 CHEMICAL WATERPROOFING

.A Waterproofing System: Permaquik by Tremco. or Vandex Super by Vandex as distributed by Stoncor, or other as approved by Consultant, consisting of the following:

.1 Waterproofing: Permaquik Super 200 or Vandex Super

.2 Mortar: Permaquik 300 or Vandex Premix

.3 Plugging material: Permaquik 900/800 or Vandex

.4 Pure/Vax Quick Binder

.5 Water: Potable.

EXECUTION

1.09 EXAMINATION

.A Quality of concrete substrate: Clean, free of structural defects, with wood-float type finish and sharply formed expansion joints.

.B Examine areas to be waterproofed and report conditions which would adversely

1.10 PREPARATION

.A Prepare concrete surfaces to achieve open capillary (fine sandpaper) texture by one of the following methods:

.1 Wet sandblasting.

.2 High pressure water blasting.

1.11 INSTALLATION

.A Install all productions in accordance with manufacturers written instructions and to the approval of the Consultant.

END OF SECTION

SECTION 07130
SHEET WATERPROOFING

1 GENERAL 1

1.1 SECTION INCLUDES 1
1.2 RELATED SECTIONS 1
1.3 REFERENCES 1
1.4 QUALITY ASSURANCE 2
1.5 PRE-CONSTRUCTION MEETING 2
1.6 SUBMITTALS 2
1.7 DELIVERY, STORAGE, AND HANDLING 3
1.8 ENVIRONMENTAL REQUIREMENTS 3

2 PRODUCTS 3

2.1 MATERIALS 3
2.2 ACCESSORIES 4

3 EXECUTION 4

3.1 EXAMINATION 4
3.2 SURFACE PREPARATION 5
3.3 INSTALLATION 5
3.4 PROTECTION 6

SECTION 07130
SHEET WATERPROOFING

1 GENERAL

1.1 SECTION INCLUDES

.1 Surface preparation.

.2 Installation of a blindside sheet membrane.

1.2 RELATED SECTIONS

.1 Section 03300 – Cast-in-Place Concrete.

.2 Section 7132 – Self-Adhering Sheet Waterproofing.

.3 Section 02315 – Temporary Protection Systems.

1.3 REFERENCES

.1 ACI 302.1R.17 – Guide for Concrete Floor and Slab Construction.

.2 ASTM C836 - Standard Specification for High Solids Content, Cold Liquid-Applied Elastomeric Waterproofing Membrane for Use with Separate Wearing Course.

.3 ASTM D412-06: Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers - Tension.

.4 ASTM D882: Standard Test Method for Tensile Properties of Thin Plastic Sheeting.

.5 ASTM D903: Standard Test Method for Peel or Stripping Strength of Adhesive Bonds.

.6 ASTM D1970-01 - Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection.

.7 ASTM D5385-93: Standard Test Method for Hydrostatic Pressure Resistance of Waterproofing Membranes.

.8 ASTM E96 (Method B): Standard Test Methods for Water Vapor Transmission of Materials.

.9 ASTM E154: Standard Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover.

.10 ASTM F2130: Standard Test Method for Measuring Repellency, Retention, and Penetration of Liquid Pesticide Formulation Through Protective Clothing Materials.

.11 GSA-PBS 07115: General Services Administration, Public Building Service - Guide Specification for Elastomeric Waterproofing.

.12 Texas A&M Method Resistance to Penetration by Termites.

1.4 QUALITY ASSURANCE

.1 Contractor will provide the proper equipment, manpower, and supervision at the jobsite to install the membrane in compliance with the project plans and specifications.

.2 Installation must be carried out by an experienced contractor with an adequate number of skilled personnel, experienced in the application of the blindside membrane applications.

.3 Maintain a record of the batch numbers of all materials supplied for this project.

1.5 PRE-CONSTRUCTION MEETING

.1 Convene one, week prior to commencing work of this section, in accordance with Section 1.4 - Quality Assurance, meeting with manufacturer’s technical representative, General Contractor and Site Engineer to review the installation procedures.

1.6 SUBMITTALS

.1 Comply with Section 01330 - Submittal Procedures.

.2 Submit manufacturer's product data and application instructions.

1.7 DELIVERY, STORAGE, AND HANDLING

.1 Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying product name and manufacturer.

.2 Store materials in a clean, dry area in accordance with manufacturer's instructions.

.3 Store adhesive at temperatures of 4.4°C (40° F) and above to facilitate handling.

.4 Do not store at temperatures above 32°C (90° F) for extended periods.

.5 Protect materials during handling and application to prevent damage or contamination.

1.8 ENVIRONMENTAL REQUIREMENTS

.1 Product not intended for uses subject to abuse or permanent exposure to the elements.

.2 Apply membrane when conditions are dry and rain is not imminent.

.3 Ensure concrete is poured within 60 days of membrane application.

2 PRODUCTS

2.1 MATERIALS

.1 Blindside Waterproofing Membrane: 73 mil (1.85mm) thick, composite sheet membrane
comprised of an elastomeric membrane bonded to a seven-ply plasmatic matrix and a non-woven geotextile fabric.

.1 Performance Based Spec: Blindside waterproofing membrane shall have the following properties as determined by laboratory testing:

.1 Membrane Thickness: 1.85 mm (73 mil)
.2 Low Temperature Flexibility, ASTM D1970: Pass
.3 Resistance to Hydrostatic Head, ASTM D5385-93: 70 m (230')
.4 Elongation, ASTM D412-06: >400%
.5 Tensile Strength (film), ASTM D882: 63.4 MPa (9,200 psi)
.6 Crack Cycling, ASTM C836: Pass
.7 Puncture Resistance, ASTM E154: >934 N (>210 lb)
.8 Peel Adhesion to Concrete, ASTM D903: 1,754 N/m (10 lb/in)
.9 Moisture Vapor Transmission, ASTM E96 (Method B): 0.0011 perms
.10 Resistance to Penetration by Termites, Texas A&M Method, Percentage of Penetration: 0.0%
.11 Resistance to Penetration by Pesticides, ASTM F2130, Percentage of Penetration: 0.0%
.12 Resistance to Fungi in Soil, GSA-PBS 07115 – 16 weeks: No Effect

.2 Proprietary Based Spec:
.1 PRECON Blindside/Underslab Waterproofing Membrane by W. R. MEADOWS.

2.2 ACCESSORIES

.1 Rolled Matrix Drainage System.

.2 Liquid Membrane for Fastener Details.

.3 Liquid Membrane for Overlap Detail.

.4 Detail Fabric for Terminations.

.5 Detail Tape Adhesive.

3 EXECUTION

3.1 EXAMINATION

.1 Examine surfaces to receive membrane. Notify architect if surfaces are not acceptable. Do not begin surface preparation or installation until unacceptable conditions have been corrected.

3.2 SURFACE PREPARATION

.1 Inspect all surfaces for any conditions detrimental to the proper completion of the work.

.2 Ensures surfaces are structurally sound.

.3 Remove debris or any other foreign material that could damage the membrane.

3.3 INSTALLATION

.1 Vertical Application
- .1 Mechanically fasten membrane across the top lagging at 12” (300 mm) on centre, 12 mm (½”) from the top, with fasteners approved by the manufacturer.
- .2 Ensure the fabric side of the membrane is facing the interior side of the form to receive the concrete.
- .3 Apply two-component liquid membrane over the areas where the fasteners have been attached and carry over the top edge.
- .4 Remove release paper on 150 mm (6”) selvedge edge and overlap edges of additional sheet. Roll press into place.
- .5 For end-to-end overlap, overlap membrane 152.4 mm (6”).
- .6 Apply liquid detail membrane in this area to be lapped and roll press membrane into this liquid detail membrane.
- .7 Apply liquid detail membrane at terminations of membrane, 310 mm (12”) wide centered over the termination.
- .8 Embed detail fabric into this wet liquid detail membrane centered over the termination, 152.4 mm (6”) on each side of lap edge, and roll press into place.
- .9 Apply additional liquid detail membrane on all terminations of detail fabric.
- .10 Inspect membrane prior to pouring of concrete for any punctures or damage.
- .11 Repair damaged areas as directed by the manufacturer.

.2 Horizontal Application
- .1 Prepare subgrade prior to membrane application according to ACI 302.1R.17.
- .2 Ensure the fabric side of the membrane is facing up.
- .3 Remove release paper on 150 mm (6”) selvedge edge and overlap edges of additional sheet. Roll press into place.
- .4 For end-to-end overlap, overlap membrane 152.4 mm (6”).

.5 Apply liquid detail membrane in this area to be lapped and roll press membrane into this liquid detail membrane.

.6 Apply liquid detail membrane at terminations of membrane, 310 mm (12”) wide centered over the termination.

.7 Embed detail fabric into this wet liquid detail membrane centered over the termination, 152.4 mm (6”) on each side of lap edge, and roll press into place.

.8 Apply additional liquid detail membrane on all terminations of detail fabric.

.9 Inspect membrane prior to pouring of concrete for any punctures or damage.

.10 Repair damaged areas as directed by the manufacturer.

3.4 PROTECTION

.1 Ensure membrane is not damaged prior to concrete pour.

.2 Ensure concrete is poured within 60 days of membrane application.

END OF SECTION

SECTION 07131
COLD FLUID-APPLIED WATERPROOFING

1. GENERAL 1

1.1 SECTION INCLUDES 1
1.2 RELATED SECTIONS 1
1.3 REFERENCES 1
1.4 SUBMITTALS 1
1.5 QUALITY ASSURANCE 2
1.6 MOCK-UPS 2
1.7 DELIVERY, STORAGE, AND HANDLING 2
1.8 ENVIRONMENTAL REQUIREMENTS 3

2. PRODUCTS 3

2.2 MATERIALS 3
2.3 ACCESSORIES 3

3 EXECUTION 4

3.1 EXAMINATION 4
3.2 SURFACE PREPARATION 4
3.3 APPLICATION 5
3.4 PROTECTION 6

SECTION 07131
COLD FLUID-APPLIED WATERPROOFING

1. GENERAL

1.1 SECTION INCLUDES

.1 Surface preparation.

.2 Application of single-component, cold-applied, liquid waterproofing membrane.

1.2 RELATED SECTIONS

.1 Section 03300 – Cast-in-Place Concrete.

.2 Section 07132 – Self-Adhering Sheet Waterproofing.

1.3 REFERENCES

.1 ASTM C836 - Standard Specification for High Solids Content, Cold Liquid-Applied Elastomeric Waterproofing Membrane for Use with Separate Wearing Course.

.2 ASTM C661 - Standard Test Method for Indentation Hardness of Elastomeric-Type Sealants by Means of a Durometer.

.3 ASTM D816 - Standard Test Methods for Rubber Cements.

.4 ASTM D1644 - Standard Test Methods for Nonvolatile Content of Varnishes.

.5 ASTM D2370 - Standard Test Method for Tensile Properties of Organic Coatings.

.6 ASTM D2697 - Standard Test Method for Volume Nonvolatile Matter in Clear or Pigmented Coatings.

.7 ASTM E96 - Standard Test Methods for Water Vapor Transmission of Materials.

1.4 SUBMITTALS

.1 Comply with Section 01330 - Submittal Procedures.

.2 Submit manufacturer's product data and application instructions.

1.5 QUALITY ASSURANCE

.1 Installer Qualifications:
  .1 Use an experienced installer and adequate number of skilled personnel who are thoroughly trained and experienced in the application of fluid applied waterproofing membranes.

.2 Obtain waterproofing materials from a single manufacturer regularly engaged in manufacturing the product.

.3 Provide products which comply with all state and local regulations controlling use of volatile organic compounds (VOCs).

1.6 MOCK-UPS

.1 Prior to installation of waterproofing membrane, apply waterproofing membrane to $10m^2$ ($107 ft^{2)}$ of deck or wall to demonstrate surface preparation, crack and joint treatment, corner treatment, thickness, and to demonstrate tie-ins with adjoining construction, and other termination conditions, as well as qualities of materials and execution.

.2 Cooperate and coordinate with the owner's inspection and testing agency. Do not cover any installed waterproofing membrane unless it has been inspected, tested and approved.

1.7 DELIVERY, STORAGE, AND HANDLING

.1 Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying product name and manufacturer.

.2 Store materials in a clean, dry area in accordance with manufacturer's instructions.

.3 Store at temperatures between 4° - 21°C (40° - 70°F).

.4 Protect materials during handling and application to prevent damage or contamination.

1.8 ENVIRONMENTAL REQUIREMENTS

.1 Product not intended for uses subject to abuse or permanent exposure to the elements.

.2 Do not apply membrane when air, material, or surface temperatures are expected to fall below -1^{o} C (30^{o} F) within four hours of completed application.

.3 Do not apply membrane if rainfall is forecast or imminent within 12 hours.

.4 Do not apply waterproofing membrane to any surfaces containing frost.

.5 Consult manufacturer for applications to green concrete.

2. PRODUCTS

2.2 MATERIALS

.1 Waterproofing Membrane: single-component, cold-applied, solvent-free, non-shrink, liquid waterproofing membrane.
- .1 Performance Based Spec: Waterproofing membrane shall have the following properties as determined by laboratory testing:
  - .1 Solids content:
    - .1 By weight, ASTM D1644: 98%.
    - .2 By volume, ASTM D2697: 98%.
  - .2 Tensile Strength, ASTM D2370: 0.48 MPa (70 psi).
  - .3 Elongation, ASTM D2370: 440%.
  - .4 Water Vapor Transmission, ASTM E96 (Method B): 0.07 perms.
  - .5 Shore 00 Hardness, ASTM C661: 55.
  - .6 Low Temperature Flexibility, ASTM D816: -28.9°C (-20°F) pass ¼ (6.4mm) mandrel.

2.3 ACCESSORIES

.1 Joint Tape: 150 mm (6”) wide reinforcing fabric for corners, crack, and joint treatment.

.2 Reinforced Joint Tape for outside corners subject to backfill.

.3 Detailing Membrane: BEM

.4 Concrete Repair Materials: 5 and 20 Concrete Repair Mortars.

.5 Waterproofing Protection Course: PERMINATOR or PROTECTION COURSE.

.6 Rolled Matrix Drainage System

3 EXECUTION

3.1 EXAMINATION

.1 Examine surfaces to receive membrane. Notify architect if surfaces are not acceptable. Do not begin surface preparation or application until unacceptable conditions have been corrected.

3.2 SURFACE PREPARATION

.1 Protect adjacent surfaces not designated to receive waterproofing.

.2 Clean and prepare surfaces to receive waterproofing in accordance with manufacturer's instructions.

.3 Do not apply waterproofing to surfaces unacceptable to manufacturer.

.4 Clean concrete surfaces so they are free of all coatings, dirt, oil, paints and any other contaminants.

.5 Patch all holes and voids and smooth out any surface misalignments.

.6 Remove and patch all concrete form ties.

.7 Treatment of Existing Cracks and All Non-Structural Joints

.1 Identify and install detailing membrane in all cracks and all non-structural joints.

.2 Apply a 30 wet mil coat of the fluid applied membrane ensuring that there is a minimum of 75 mm (3”) of membrane extending onto the wall in all directions.

.3 Embed the non-woven reinforcing fabric over the entire area of this membrane and work in using trowel.

.4 Completely cover the glass mesh with a second coat of the fluid applied membrane at 30 wet mils while the first coat is still wet, again extending 75 mm (3") onto the wall in all directions.

.8 Treatment of Inside & Outside Corners

.1 Install detailing membrane to create a minimum 18 mm (¾") fillet in all inside corners.

.2 Apply a 30 wet mil coat of the fluid applied membrane ensuring that there is a minimum of 75 mm (3") (75 mm) of membrane extending onto the wall in all directions.

.3 Embed the non-woven reinforcing fabric over the entire area of this membrane and work in using trowel.

.4 Completely cover the glass mesh with a second coat of fluid applied membrane at 30 wet mils while the first coat is still wet, again extending 3" onto the wall in all directions.

.5 On outside corners subject to backfilling, install reinforced joint tape in lieu of fabric joint tape following the same procedure.

3.3 APPLICATION

.1 Apply waterproofing membrane system in accordance with manufacturer's instructions.

.2 Gently mix membrane prior to application.

.3 Apply membrane by trowel, flat-blade squeegee, or roller, at a minimum coverage rate of 2.3 m^2/3.78 L (25 $ft.^2$/U.S. gal), providing a thickness of 60 wet mils.

.4 If a two-coat application is required, apply second coat as soon as possible with no more than eight hours between coats providing a minimum total thickness of 60 wet mils.

.5 Frequently inspect surface area to ensure proper adhesion and consistent thickness is achieved.

.6 Work material into any fluted rib forming indentations.

.7 Provide minimum cured membrane thickness of 1mm (60 mils) dry.

3.4 PROTECTION

.1 Protect membrane with application of waterproofing protection course, drainage board, or other approved material.

.2 Backfill immediately using care to avoid damaging waterproofing membrane system.

END OF SECTION

SECTION 07132
SELF-ADHERING SHEET WATERPROOFING

1 GENERAL 1

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SECTION 07132
SELF-ADHERING SHEET WATERPROOFING

1 GENERAL

1.1 SECTION INCLUDES

.1 Surface preparation.

.2 Application of rolled, self-adhering waterproofing membrane system.

1.2 RELATED SECTIONS

.1 Section 03300 - Cast-in-Place Concrete.

1.3 REFERENCES

.1 American Railway Engineering & Maintenance of Way Association (AREMA) Specification Chapter 29 - Waterproofing.

.2 ASTM D146 - Standard Test Methods for Sampling and Testing Bitumen-Saturated Felts and Fabrics Used in Roofing and Waterproofing.

.3 ASTM D412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers- Tension.

.4 ASTM D570 - Standard Test Method for Water Absorption of Plastics.

.5 ASTM D903 - Standard Test Method for Peel or Stripping Strength of Adhesive Bonds.

.6 ASTM D1876 – Standard Test Method for Peel Resistance of Adhesives. (T-Peel Test).

.7 ASTM D1970 - Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection.

.8 ASTM E96 (Method B) - Standard Test Methods for Water Vapor Transmission of Materials.

.9 ASTM E154 - Standard Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover.

1.4 SUBMITTALS

.1 Comply with Section 01330 - Submittal Procedures.

.2 Submit manufacturer's product data and application instructions.

1.5 DELIVERY, STORAGE, AND HANDLING

.1 Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying product name and manufacturer.

.2 Store materials in a clean dry area in accordance with manufacturer's instructions.

.3 Store adhesives and primers at temperatures of 5^{o}C (40^{o}F) and above to facilitate handling.

.4 Store membrane cartons on pallets.

.5 Do not store at temperatures above 32^{o}C (90^{o}F) for extended periods.

.6 Keep away from sparks and flames.

.7 Completely cover when stored outside. Protect from rain.

.8 Protect materials during handling and application to prevent damage or contamination.

.9 Avoid use of products which contain tars, solvents, pitches, polysulfide polymers, or PVC materials that may come into contact with waterproofing membrane system.

1.6 ENVIRONMENTAL REQUIREMENTS

.1 Product not intended for uses subject to abuse or permanent exposure to the elements.

.2 Protect rolls from direct sunlight until ready for use

.3 Do not apply membrane when air or surface temperatures are below 4°C (40°F).

.4 Do not apply to frozen concrete.

2 PRODUCTS

2.1 MATERIALS

.1 Rolled, Self-Adhering Waterproofing Membrane: Polymeric waterproofing membrane protected by release paper on cross-laminated polyethylene carrier film with exposed polymeric membrane strips on both sides protected by pull-off release strips.

.1 Performance Based Specification: Waterproofing membrane shall have the following characteristics:

.1 Compliance: AREMA Specification Chapter 29 - Waterproofing.

.2 Thickness:

.1 Carrier Film: 4 mils.

.2 Polymeric Membrane: 56 mils.

.3 Tensile Strength, ASTM D412, Die C:

.1 Carrier Film: 40.71 MPa (5,900 psi) minimum.

.2 Polymeric Membrane: 3.23 MPa (460 psi) minimum.

.4 Elongation, ASTM D412, Die C: Polymeric Membrane: 971 % minimum.

.5 Peel Adhesion, ASTM D903: 2068 N/m (11.8 lbf/in).

.6 Lap Adhesion, ASTM D1876: 1508 N/m (8.62 lbf/in)

.7 Water Vapor Permeability, ASTM E96, Method B: 0.036 perms.

.8 Water Absorption, ASTM D570: 0.1 percent, 72 hours maximum.

.9 Resistance to Hydrostatic Head: Equivalent to 70.3 m (230.9 feet) of water.

.10 Puncture Resistance, ASTM E154: 214.6 N (48.2 lbf).

.11 Exposure to Fungi, Soil Test: Pass, 16 weeks.

.12 Color:

.1 Carrier Film: White.

.2 Polymeric Membrane: Black.

2.3 ACCESSORIES

.1 Surface Conditioner:
.1 Temperatures Above 4°C (40°F): Water Base Primer.
.2 Temperatures Above -18°C (0°F): VOC Compliant Solvent Base Primer or Standard Solvent Base Primer.

.2 Flashing and Fillets: LIQUID MEMBRANE.

.3 Pointing Mastic: POINTING MASTIC.

.4 Termination Bar: TERMINATION BAR.

.5 Corner Tape: DETAIL STRIP.

.6 Waterproofing Protection Course: PROTECTION COURSE

.7 Rolled Matrix Drainage System: Rolled Matrix Drainage System.

3 EXECUTION

3.1 EXAMINATION

.1 Examine surfaces to receive self-adhering membrane. Notify Architect if surfaces are not acceptable. Do not begin surface preparation or application until unacceptable conditions have been corrected.

3.2 SURFACE PREPARATION

.1 Protect adjacent surfaces not designated to receive waterproofing.

.2 Clean and prepare surfaces to receive waterproofing in accordance with manufacturer's instructions.

.3 Do not apply waterproofing to surfaces unacceptable to manufacturer.

.4 Concrete surfaces must be clean, smooth and free of standing water.

.5 Patch all holes and voids and smooth out any surface misalignments.

.6 Apply surface conditioner to surfaces that will be covered within one working day according to manufacturer's recommended coverage rates.

.7 Install corner tape on all inside and outside corners, including the footing.

.8 Apply a 229 mm (9") strip of self-adhering membrane over construction, control and expansion joints and over cracks greater than 1.59 mm (1/16") wide.

.9 Seal all terminations with pointing mastic.

3.3 APPLICATION

.1 Horizontal Application

- .1 Apply waterproofing membrane system in accordance with manufacturer's instructions.
- .2 Ensure accessory materials are compatible with membrane and approved by membrane manufacturer.
- .3 Remove release paper on edge, then position the membrane.
- .4 Pull balance of release paper off, running the roll from low to high points, so all laps will shed water.
- .5 Immediately hand-rub the membrane firmly to the surface, removing any bubbles or wrinkles, then pressure roll the complete surface to assure positive adhesion.
- .6 Stagger end laps and overlap all seams at least 63.5 mm (2 ½").
- .7 Seal all terminations with pointing mastic.
- .8 Inspect membrane before covering and repair as necessary. Cover tears and inadequate overlaps with membrane. Seal edges of patches with pointing mastic.
- .9 Perform flood testing of horizontal applications, as required. Mark leaks and repair when membrane dries.

.2 Vertical Application

- .1 Apply waterproofing membrane system in accordance with manufacturer's instructions.
- .2 Ensure accessory materials are compatible with membrane and approved by membrane manufacturer.
- .3 Remove release paper on edge and position the membrane.
- .4 Pull balance of release paper off, running the roll vertically over the top of the corner tape at the footing.
- .5 Immediately hand-rub the membrane firmly to the surface, removing any bubbles or wrinkles, then pressure roll the complete surface to assure positive adhesion.

.6 Overlap all seams and stagger end laps at least 63.5 mm (2 ½").

.7 Seal all terminations with pointing mastic.

.8 Inspect membrane before covering and repair as necessary. Cover tears and inadequate overlaps with membrane. Seal edges of patches with pointing mastic.

3.4 PROTECTION

.1 Protect membrane on vertical and horizontal applications with immediate application of waterproofing protection course, rolled matrix drainage board.

.2 Backfill immediately using care to avoid damaging waterproofing membrane system.

END OF SECTION

SECTION 07195
AIR BARRIER MEMBRANE

GENERAL

1.01 GENERAL REQUIREMENTS

.A General Conditions, Supplementary Conditions and Division 01 apply to this Section.

1.02 SUMMARY

.A Section includes:

.1 Sheet membrane air barrier

.2 Joint treatment

.B Related Sections:

.1 Section 03300 – Cast-In-Place

.2 Section 03400 – Architectural Precast Concrete

.3 Section 04200 – Masonry

.4 Section 05400 – Cold Formed Metal Framing

.5 Section 07210 – Building Insulation

.6 Section 07544 –PVC Fully Adhered Single Ply Roofing System

.7 Section 09260 – Gypsum Wallboard System

1.03 SUBMITTALS

.A Section 01300 – Submittals: Procedure for Submittals

1.04 QUALITY ASSURANCE

.A The Contractor executing Work of this Section shall have a minimum of five (5) years continuous Canadian experience in successful application of air barrier membrane work of type specified. Submit proof of experience to Consultant.

1.05 SITE CONDITIONS

.A Environmental Requirements: Perform Work only when existing and forecasted weather conditions are within the limits established by the manufacturer of the materials and products used. Maintain warranty requirements.

.B Soil Conditions: Contact manufacturer of sheet member prior to installation when acids, alkali or slats are present in the soil.

1.06 WARRANTY

.A Provide warranty signed jointly by Contractor, installer and manufacturer, agreeing to replace or repair defective materials and workmanship for warranty period of two years. Include removal and replacement of other work which conceals air barrier membrane.

1.07 DELIVERY, HANDLING, PROTECTION AND STORAGE

.A Co-ordinate deliveries to comply with construction schedule and arrange ahead for strategic off the ground, dry, enclosed storage area. Do not load any area beyond the design limits.

.B Material shall be carefully checked, unloaded, stored and handled to prevent damage. Protect materials with suitable waterproof coverings.

.C Deliver and store air barrier membrane materials in the manufacturer's original containers and wrappers with seals intact.

.D Store solvent based materials in safe areas well away from open flames or excessive heat.

.E Do not permit materials to freeze. Store materials at temperatures above 10°C.

PRODUCTS

1.08 AIR BARRIER SYSTEMS

.A Sheet membrane Air Barrier shall be one of the following:

.1 Blueskin SA, Self-Adhesive Air Barrier Sheet Membrane, by Bakor.

.a with Blueskin Primer, Primer for Self-Adhesive Membranes, by Bakor.

.2 Air Shield, Self-Adhesive Air/Vapour Barrier membrane, by W.R. Meadows.

.a with Mel-Prime, Primer for Self-Adhesive Membranes, by W.R. Meadows.

EXECUTION

1.09 EXAMINATION

.A Verify that previously executed Work and surfaces are satisfactory for installation or application, or both and that performance of subsequent Work will not be adversely affected.

.B Commencement of Work will constitute acceptance of site conditions and previously executed Work as satisfactory.

1.10 PREPARATION

.A Comply with manufacturer's instructions for installation of sheet material.

.B All surfaces must be sound, dry, clean and free of oil, grease, dirt or other contaminates.

1.11 INSTALLATION

.A Joint and Protrusions Treatment:

.1 Joints between panels of exterior sheathing board up to ¼" wide shall be filled with a trowel application of liquid membrane.

.2 Joints between dissimilar materials and all joints over ¼" wide shall be sealed with a strip of sheet membrane air barrier, adhered to substrate.

.3 Ensure continuity of air barrier membrane by working air barrier membrane over all exterior sheathing board fasteners and around all masonry ties and anchors and other items.

.B Sheet Membrane application:

.1 Prime areas to receive sheet membrane air barrier strips. Apply primer with lamb's wool roller at a rate of 100 to 300 sq.ft./gal. (depending on surface porosity.) Allow primer to tack-up for approximately 30 minutes prior to application of sheet membrane.

.2 Apply sheet membrane strips to all connections of exterior grade sheathing board to steel or concrete and all door and window frames using strips of air barrier membrane lapped a minimum of 3" on to substrates and centred over joint.

.3 Roll self-adhered membrane with hard steel or polypropylene hand roller to ensure full contact.

.4 Connect to all window and door connections by mechanically fastening through a metal bar or provide a properly designed sealant joint.

.5 Ensure all preparatory work is complete prior to application of membrane.

END OF SECTION

SECTION 07210
BUILDING INSULATION

GENERAL

1.01 GENERAL REQUIREMENTS

.A General Conditions, Supplementary Conditions and Division 01 apply to this Section.

1.02 SUMMARY

.A Section includes:

.1 Read other Sections for extent of insulation and vapour barrier specified under those Sections. Do all other insulation and vapour barriers indicated, specified or required to complete insulation and vapour barrier of building.

.B Related Sections:

.1 Section 03300 – Cast-In-Place Concrete

.2 Section 03400 – Architectural Precast Concrete

.3 Section 04200 – Masonry

.4 Section 05400 – Cold Formed Metal Framing

.5 Section 07195 – Air Barrier Membrane

.6 Section 07270 – Fire stopping and Smoke seals

.7 Section 07544 –PVC Fully Adhered Single Ply Roofing System

.8 Section 07900 – Joint Sealants

.9 Section 09260 –Gypsum Board Systems.

.10 Division 15 and 16 – Mechanical and Electrical Insulation

1.03 REFERENCES

.A American Society for Testing and Materials (ASTM)

.1 ASTM C954 – Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs form 0.033in (0.84mm) to 0.112 in. (2.84mm) in Thickness

.B Canadian Standards Association (CSA):

.1 CSA G40.20/G40.21 – General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel

.C Standards Council of Canada / Underwriters Laboratories of Canada (CAN/ULC)

.1 CAN/ULC S701 – Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering

.2 CAN/ULC S702 – Standard for Thermal Insulation Mineral Fibre for Buildings, Including all updates and amendments

1.04 SUBMITTALS

.A Section 01300 – Submittals: Procedure for Submittals

1.05 DELIVERY, HANDLING, PROTECTION AND STORAGE

.A Co-ordinate deliveries to comply with construction schedule and arrange ahead for strategic off the ground, dry, enclosed storage area. Do not load any area beyond the design limits.

.B Material shall be delivered to the job carefully checked, unloaded, stored and handled to prevent damage. Protect materials with suitable waterproof coverings.

.C Material shall be delivered to the job and stored in the manufacturer's original packages/containers with manufacturer's labels intact and clearly visible.

.D Store materials in dry, watertight areas and protect to prevent damage by other trades.

PRODUCTS

1.06 MATERIALS

.A Loose Insulation:

.1 Loose glass fibre or mineral wool insulation shall conform to CAN/ULC S702, Type II.

.B Foamed-In-Place Insulation:

.C Two component polyurethane froth/spray kit, UL Class I (flame spread of 25 or less), 'Froth Pak 25FS' by Insta-Foam Products Inc., or approved equal.

.D Insulation Support System:

.1 As recommended by the insulation manufacturer to suit each condition.

.E Underslab Insulation and Exterior Below Grade Insulation:

.1 Rigid Extruded expanded polystyrene, conforming to CAN/ULC S-701, Type IV, 'Styrofoam SM' by Dow Chemical or 'Celfort 300' by Owens Corning Canada.

.F High Density Underslab Insulation:

.1 Rigid Extruded expanded polystyrene, conforming to CAN/ULC S-701, Type IV, 'Styrofoam HI-40' by Dow Chemical or 'Foamular 400' by Owens Corning Canada.

.G Insulation Adhesive:

.1 As recommended by manufacturer of insulation materials.

EXECUTION

1.07 EXAMINATION

.A Verify that previously executed Work and surfaces are satisfactory for installation or application, or both and that performance of subsequent Work will not be adversely affected.

.B Commencement of Work will constitute acceptance of site conditions and previously executed Work as satisfactory.

1.08 PREPARATION

.A All materials and methods used in application shall be in strict accordance with the printed instructions of the manufacturer.

.B Remove stains, defective work or materials when directed by the Consultant and replace with approved work and materials at no cost to the Owner.

.C Clean all surfaces of dust, dirt and projecting surfaces prior to the application of insulation.

.D Do not install insulation when ambient air and surface temperatures are below 40°F or more that 100°F. The temperature shall be maintained in the building during and after installation as necessary by the above requirement and as directed for curing of the adhesive. Obtain approval prior to proceeding with application of adhesive and insulation.

.E Cut insulation to fit around pipes, ducts, openings, corners and all protruding obstructions occurring on the surface to be insulated and seal with adhesive.

1.09 INSTALLATION

.A Install insulation to maintain continuity of thermal protection to building elements and spaces.

.B Install vapour barrier stripping overlapping adjacent surfaces, including self-joints, a minimum of 2" and seal with specified tape. Applications to form a complete vapour seal.

.C Install loose insulation in locations and thicknesses shown. Seal joints to prevent the transfer of moisture.

.D Install below grade insulation with tight joints and to extent shown to prevent transfer of cold through insulation to structure.

.E Install high density under slab insulation in locations and thicknesses shown.

.F Cavity wall Insulation:

.1 Co-ordinate installation with Section 04200, 05400 and 07216, for installation of masonry veneer anchors and thru-wall flashings.

.G Apply foamed-in-place insulation at exterior walls, around penetrations, at deck flutes, at top of walls and where indicated or as required to maintain vapour barrier. Apply foamed-in-place insulation with suitable equipment in accordance with the manufacturer's written instructions. Fill all joints completely, leaving no voids or gaps and trim excess material.

END OF SECTION

SECTION 07216
SPRAYED POLYURETHANE FOAM INSULATION

GENERAL

1.01 GENERAL REQUIREMENTS

.A General Conditions, Supplementary Conditions and Division 01 apply to this Section.

1.02 SUMMARY

.A Section includes:

.1 Spray application of polyurethane foam to provide insulation, air barrier and vapour retarder in cavity of exterior walls with masonry back-up.

.B Related Sections:

.1 Section 03300 – Cast-In-Place Concrete

.2 Section 04200 – Masonry

.3 Section 05120 – Structural Steel

.4 Section 07544 – PVC Fully Adhered Single Ply Roofing System

1.03 REFERENCES

.A American Society for Testing and Materials (ASTM)

.B Canadian Standards Association (CSA)

.C Canadian General Standards Board (CGSB)

.D Standards Council of Canada / Underwriters Laboratories of Canada (CAN/ULC)

.1 CAN/ULC S705.1 – Standard for Thermal Insulation – Spray Applied Rigid Polyurethane Foam Medium Density – Material – Specification, Includes all Updates and Amendments.

.2 CAN/ULC S705.2 – Standard for Thermal Insulation – Spray Applied Rigid Polyurethane Foam Medium Density – Application, Includes all Updates and Amendments.

1.04 SUBMITTALS

.A Section 01300 - Submittals: Procedures for Submittals.

1.05 QUALITY ASSURANCE

.A Qualification of Applicator: Shall have a minimum of five (5) years continuous Canadian Experience in successful installations and shall be licensed under the BASF Canada Quality and Training Program-Raising Performance to New Heights and certified by Morrison Hershfield. Provide proof to Consultant.

1.06 DELIVERY, STORAGE, HANDLING AND PROTECTION

.A Co-ordinate deliveries to comply with construction schedule and arrange ahead for the ground under cover storage location.

.B Store materials as recommended by manufacturer's written instructions in original, undamaged containers with manufacturer's seals and labels intact. During cold weather, store raw materials in heated storage.

.C Protect adjacent surfaces and equipment from damage by overspray.

1.07 SEQUENCING AND SCHEDULING

.A Co-ordinate the work of this Section with installation of associated work specified under other sections.

PRODUCTS

1.08 MATERIALS GENERAL

.A All materials shall be products of established manufacturers and shall conform to C.S.A., CGSB, ASTM and all local authorities having jurisdiction including all divisions to date.

1.09 INSULATION

.A Spray polyurethane foam; Walltite ECO by BASF Canada or Johns Manville, or other as approved by Consultant conforming to CAN/ULC-S705.1 and CCMC 13408-L.

.1 Thickness as indicated on drawings.

.B Product to utilize Zero ODS (Ozone Depleting Agent) blowing agent, contain 5% by mass recycled content, contain renewable content and be certified by EcoLogo.

.C Primers: In accordance with manufacturer's recommendations if required for surface conditions.

1.10 EQUIPMENT

.A Use equipment as recommended in CAN/ULC-S705.1 and by foam manufacturer for type of application.

EXECUTION

1.11 EXAMINATION

.A Verify that surfaces and conditions are suitable to accept work required of this Section.

.B Report in writing, defects in surfaces or conditions which may adversely affect the performance of products installed under this Section to the Contractor, prior to commencement of work.

.C Do not commence work until defects have been corrected.

1.12 PREPARATION

.A Mask and cover adjacent areas to protect from overspray.

.B Apply primers for special conditions as required by foam manufacturer.

.C Clean work area prior to commencing spray operations.

.D Co-ordinate with masonry contractor that the required transition membranes, thru-wall flashing and the like are all in place prior to application of foam.

1.13 APPLICATION

.A Apply insulation to clean surfaces in accordance with CAN/ULC S705.2 installation standard and manufacturer's written instructions. Use primer where recommended by foam manufacturer.

.B Thickness of insulation will be 2.5" with a maximum tolerance from required thickness of +1/4" and -0.0".

END OF SECTION

SECTION 07256
SPRAYED MINERAL FIBRE FIREPROOFING

GENERAL

1.01 GENERAL REQUIREMENTS

.A General Conditions, Supplementary Conditions and Division 01 apply to this Section.

1.02 SUMMARY

.A Section includes:

.1 Spray application of mineral fibre fireproofing as indicated on drawings where fire rating is required.

.B Related Sections:

.1 Section 05120 – Structural Steel

.2 Section 05210 – Steel Joists

.3 Section 07412 – Preformed Metal Roofing

.4 Section 07421 – Insulated Metal Wall Panel System

1.03 REFERENCES

.A American Society for Testing and Materials (ASTM)

.1 ASTM E84 – Standard Test Method for Surface Burning Characteristics of Building Materials.

.2 ASTM E119 - Standard Test Method for Fire Tests of Building Construction and Materials.

.3 ASTM E136 - Standard Test Method for Behaviour of Materials in a Vertical Tube Furnace at 750°C.

.4 ASTM E605 - Standard Test Method for Thickness and Density of Sprayed Fire-Resistive Materials (SFRM) Applied to Structural Members.

.5 ASTM E736 - Standard Test Method for Cohesion/Adhesion of Sprayed Fire-Resistive Materials Applied to Structural Members.

.6 ASTM E759 - Standard Test Method for Effect of Deflection of Sprayed Fire-Resistive Materials Applied to Structural Members.

.7 ASTM E760 - Standard Test Method for Effect of Impact on the Bonding of Sprayed Fire-Resistive Materials Applied to Structural Members.

.8 ASTM E761 - Standard Test Method for Compressive Strength of Sprayed Fire-Resistive Material Applied to Structural Members.

.9 ASTM E859 - Standard Test Method for Air Erosion of Sprayed Fire-Resistive Materials (SFRM) Applied to Structural Members.

.10 ASTM E937 - Standard Test Method for Corrosion of Steel by Sprayed Fire-Resistive Materials (SFRM) Applied to Structural Members.

.B Standards Council of Canada / Underwriters Laboratories of Canada (CAN/ULC)

.1 CAN/ULC-S101 – Standard Methods of Fire Endurance Tests of Building Construction and Materials

.2 CAN/ULC-S102 – Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies

.3 CAN/ULC S114 – Standard Method of Test for Determination of Non-combustibility in Building Materials.

.C Underwriters Laboratories, Inc. (UL) Fire Resistance Directory.

.D Underwriters Laboratories of Canada (ULC) List of Equipment and Materials.

.E Uniform Building Code Standard No. 7-6 (current edition): Thickness and Density Determination for Spray-Applied Fire Protection.

.F AWCI Publication: Standard Practice for the Testing and Inspection of Field Applied Sprayed Fire-Resistive Materials. Technical Manual 12-A; an annotated guide.

1.04 SUBMITTALS

.A Section 01300 - Submittals: Procedures for Submittals.

.B Test Reports:

.1 Submit copies of fire test report of sprayed mineral fibre fireproofing application to substrate materials required.

.C Certificates:

.1 Submit manufacturer's certification that materials meet or exceed specification requirements. Submit applicators certification that material has been completed as specified to meet fire resistance ratings, thickness requirements, and application requirements.

1.05 QUALITY ASSURANCE

.A Work shall be performed by a firm with expertise in the installation of sprayed mineral fibre fireproofing.

.B The material and installation shall conform to the applicable building code requirements and the requirements of all authorities having jurisdiction.

1.06 DELIVERY, STORAGE, HANDLING AND PROTECTION

.A Co-ordinate deliveries to comply with construction schedule and arrange ahead for of the ground under cover storage location.

.B Store material as recommended by manufacturer's written instructions in original, undamaged containers with manufacturer's seals and labels in tact. During cold weather, store raw materials in heated storage.

.C Protect adjacent surfaces and equipment from damage by overspray.

1.07 SEQUENCING AND SCHEDULING

.A Co-ordinate the work of this Section with installation of associated work specified under other section.

PRODUCTS

1.08 MATERIALS

.A Materials shall be asbestos-free mineral fibre fireproofing, approved as fire resistant by the Underwriters' Laboratories and shall bear ULC or ULI label on each container.

.B Approved Products and Manufacturers:

.1 ‘Blaze Shield II’ by Cafco Industries Inc./Isolatek International or;

.2 ‘AD Type FP’ by AD Fire Protection Systems.

.C Bonding agents, binders, accessories, cleaning solvents, aggregates and sealers as recommended by manufacturer of mineral fibre fireproofing.

.D Mixing Water:

.1 Clean, potable water and free of deleterious substances.

.E Spray-applied fire resistive materials shall be free of all forms of asbestos, including actinolite, amosite, anthophyllite, chrysotile, crocidolite and tremolite. Material manufacturer shall provide certification of such upon request.

EXECUTION

1.09 INSPECTION

.A Examine surfaces to receive sprayed fireproofing and report any defect or incompatibility which may affect the work of this Section.

.B Ensure that ducts, pipe, conduit and other items which would interfere with application of sprayed fireproofing, have not been installed until sprayed mineral fibre fireproofing work is completed.

.C Do not apply mineral fibre fireproofing until all clips, hangers, inserts, sleeves and the like have been installed in areas to receive sprayed mineral fibre fireproofing.

.D Ensure that temperature of 5°C minimum is maintained on surfaces which are to receive fireproofing for at least one week before application and until fireproofing is cured.

.E Commencement of work shall indicate acceptance of surfaces and conditions.

1.10 PREPARATION

.A Mask and cover adjacent areas to protect from overspray.

.B Apply primers for special conditions as required by foam manufacturer.

.C Clean work area prior to commencing spray operations.

.D Co-ordinate with masonry contractor that the thru-wall flashing and the like are all in place prior to application of foam.

1.11 APPLICATION

.A Apply sprayed mineral fibre fireproofing according to manufacturer's written instructions and using spray equipment approved by manufacturer of fireproofing.

.B Apply sprayed mineral fibre fireproofing to manufacturer’s ULC design requirements for thickness and density. Do not re-temper material.

.C Apply sprayed mineral fibre fireproofing in accordance with manufacturer's instructions to thicknesses and densities which, when combined with the rating of the structure, will achieve one hour rating.

.D Apply sealer or curing compound to surface of sprayed mineral fibre fireproofing as required by manufacturer.

.E Do all cutting, patching and repairing of damages caused by work of this Section due to unsatisfactory mineral fibre fireproofing as directed. Repair areas cut out or damaged as the result of testing.

.F Repair damaged work caused by other trades at the expense of those causing damages.

.G Protect applied mineral fibre fireproofing until permanent covering is installed, or where exposed, until final acceptance.

.H After application is approved, clean surrounding surfaces of all overspray.

END OF SECTION

SECTION 07270
FIRE STOPPING AND SMOKE SEALS

GENERAL

1.01 GENERAL REQUIREMENTS

.A General Conditions, Supplementary Conditions and Division 01 apply to this Section.

1.02 SUMMARY

.A Work Included:

.1 Provide fire stopping and smoke seals as indicated wherein, as shown on Drawings and as required by code.

.B Related Sections:

.1 Section 04200 – Masonry

.2 Section 05300 – Steel Deck

.3 Section 07900 – Sealants

.4 Section 09260 – Gypsum Board Systems

.5 Division 15 – Mechanical

.6 Division 16 – Electrical

1.03 REFERENCES

.A National Fire Protection Institute (NFPA):

.1 NFPA 101 – Life Safety Code

.B Standards Council of Canada / Underwriters Laboratories of Canada (CAN/ULC)

.1 CAN/ULC S101 – Standard Methods of Fire Endurance Tests of Building Construction and Materials

.2 CAN/ULC-S102 – Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies

.3 CAN/ULC-S115 – Standard Method of Fire Test of Firestop Systems

.C Underwriters Laboratories of Northbrook, IL (UL tests conforming to ULC-S115 given ULC listing published by UL in their “Products Certified for Canada (cUL) Directory"

1.04 DEFINITIONS

.A General: Firestop systems intended for installation in fire separations shall have assigned fire ratings when tested in accordance with ULC-S115. Firestop systems intended for use

in fire resistive wall and/or floor assemblies shall be evaluated in accordance with CAN/ULC-S101-M.

.B Type of firestop systems:

.1 Head of Wall Joint Firestop Systems (HW): Systems intended for installation in vertical separations between wall and floor or roof structures. These systems shall not incorporate penetrating items such as pipes or cables.

.2 Joint Firestop Systems (JF): Systems intended for installation in openings such as construction joints, gaps and spaces in floors or walls or at floor and wall intersections in accordance with approved systems. These systems shall not incorporate penetrating items such as pipes or cables.

.3 Perimeter Joint Firestop Systems (PJ): Perimeter joint firestop system rating are governed by lowest of fire resistance ratings of individual components (i.e. the wall, floor or joint system). These systems consist of floor with fire endurance rating, exterior wall with or without fire endurance rating and perimeter joint system. These perimeter joint firestop systems shall not incorporate penetrating items such as pipes or cables.

.4 Service Penetration Firestop Systems (SP): Systems intended for installation in openings of limited dimensions and shape in floor or wall assemblies in accordance with approved systems. Penetrating pipes, cable trays and similar items shall be in exact accordance with approved systems.

.5 Service Penetration for Combustible Systems (SPC): Systems intended for installation in openings of limited dimensions and shape in floor or wall assemblies in accordance with approved systems. Penetrating pipes shall be in exact accordance with approved systems. These systems are tested with a minimum differential pressure of 50 Pa between exposed and unexposed surfaces of assembly to meet Code requirements for Combustible Pipes for Use in Drain, Waste and Vent Piping.

.6 Ratings: Rating of firestop system applies to its use in specific assembly of materials, penetration and floor or walls in which it is tested.

.7 F Rating: When system remains in opening during fire test for rating period without permitting passage of flame through openings or occurrence of flaming on any element of unexposed side of assembly.

.8 FT Rating: When system remains in opening during fire test in accordance with F Rating requirement and additionally, transmission of heat through firestop system during rating period shall not have been such as to raise temperature of any thermocouple on unexposed surface of system more than 163°C (325°F) above initial temperature.

.9 FH Rating: When system remains in opening during fire and hose test in

accordance with F Rating requirement and additionally, during hose stream test firestop system shall not develop any opening that would permit a projection of water from stream beyond unexposed side.

.10 FTH Rating: When system remains in opening during fire test and hose stream test within limitations described for F, FT and FH ratings.

.11 L Rating: Based on volume of air flowing, per unit of time through opening around test sample under specified pressure difference applied across surface of system. L Ratings are intended to determine acceptability of firestop systems with reference to control of air movement through assembly. Rating is expressed in litres per second (l/s) per linear metre of opening for joint systems.

1.05 SUBMITTALS

.A Section 01300 – Submittals: Procedure for Submittals

.B Closeout Submittals: Provide maintenance data for materials and prefabricated devices, providing descriptions sufficient for identification on site in accordance with requirements of Section 01700.

.C Product Data: Submit manufacturers' specifications and technical data for each material including compositions, limitations, documentation conforming ULC and/or cUL firestop system proposed for this Project and manufacturers' installation instructions.

.D Submit Shop Drawings within (21) Working Days of award of Contract.

.1 Submit shop drawings in accordance with Section 01300. Submit complete and detailed shop drawings for each condition encountered on site.

.2 Indicate following:

.a ULC and/or cUL assembly number certification and material safety data sheets.

.b Required temperature rise and flame rating.

.c Hose stream rating (where applicable).

.d Thickness.

.e Proposed installation methods.

.f Material of fire stopping and smoke seals, primers, reinforcements, support and securement methods, damming materials, reinforcements and anchorages /fastenings.

.g Size of opening.

.h Adjacent materials.

.i Number of penetrations.

.E Designate on shop drawings both fixed and moving penetrants, relative positions, number of penetrations, expansion and control joints in rated slabs and walls, fire stopping details at receptacles and similar poke-through devices and surrounding permanent materials. Identify re-entry locations.

.F Submit fireproofing manufacturer's written verification that manufacturers have identified where fire stopping is required, have selected correct firestop system and applicators have been trained by system manufacturers. Products, systems and assemblies have been installed in accordance with manufacturer's requirements.

.G Samples: Submit only as requested and in accordance with Section 01300, various types of fire stopping and smoke seal material.

.H Certificates:

.1 Submit manufacturer's verification that installed fire stopping and smoke seal materials comply with specified requirements.

.2 Submit copies of ULC, Warnock Hersey and/or cUL Listing cards for review.

1.06 QUALITY ASSURANCE

.A Qualification: Provide work of this Section executed by component installers experienced, trained, licensed and approved, by material ort system manufacturer for application of materials and systems being used having minimum 5 years experience in application of Products, systems and assemblies specified. Fire stopping systems shall conform to requirements of ULC-S115 tested assemblies that provide fire rating as shown.

.B Regulatory Requirements: Where required, provide a Pre-Start Health and Safety Review in accordance with the Occupational Health and Safety Act (Ontario), Regulation 851, as amended.

.C Fire stopping systems shall not affect structural integrity of load bearing walls and assemblies. Coordinate with Consultant prior to penetrating any load bearing assembly. For unusual firestop application for which no tested system is available, manufacturers shall submit their proposal to local authorities having jurisdiction for their review and approval prior to installation.

.D Work of this Section shall be by 1 Subcontractor responsible for fire stopping materials and systems for all of work except as specified herein.

.E Conform to both temperature and flame ratings of standards listed hereinafter and other requirements of authorities having jurisdiction.

.F Consult with Product manufacturer's technical representative about following items:

.1 Fire separation required.

.2 Curing characteristics of materials specified.

.3 Joint characteristics as built.

.G Pre-Installation Meetings: Prior to commencement of sealing, arrange for Product manufacturer's knowledgeable representative to meet and discuss installation procedures and unique conditions at the Place of the Work, inspect substrate surfaces and recommend solutions to accommodate adverse conditions, periodically visit and verify installations before being concealed and report unsatisfactory conditions to Contractor, attend final inspection and to submit written certification that Products, systems and assemblies have been installed in accordance with manufacturer's requirements.

1.07 PROJECT CONDITIONS

.A Comply with manufacturer's temperature, relative humidity and substrate moisture content for storage, mixing, application and curing of Products.

.B Maintain minimum temperature of 5°C (40°F) for minimum period of 1 week before application, during application and until application is fully cured.

.C Ventilate areas in which fire stopping is being applied. Protect water-soluble material from wetting until fully cured.

1.08 SCHEDULING

.A Coordinate with work of other Sections involved and advise dated where work will take place throughout various areas of work.

1.09 WARRANTY

.A Warrant work of this Section against defects and deficiencies for period of 5 years in accordance with General Conditions of the Contract. Promptly correct any defects or deficiencies which become apparent within warranty period, to satisfaction of Consultant and at no additional expense to Owner. Defects include but are not limited to cracking, breakdown of bond, failure to stay in place or bleeding.

1.10 DELIVERY, STORAGE AND HANDLING

.A Deliver materials to site in manufacturer’s sealed and labeled containers. Materials are subject to Consultant’s inspection.

.B Store materials inside building for 25 hours prior to use; store in area designated by Consultant; protect from damage and environmental conditions detrimental to material.

PART 2 PRODUCTS

2.01 MATERIALS

.A Supply materials and systems capable of providing effective barrier against passage of fire, smoke, gasses and where specifically indicated passage of liquids. Use only firestop systems that have been ULC and/or cUL tested for specific fire rated construction conditions conforming to construction assembly type, penetrating item type, annular space requirements and fire rating involved for each separate instance.

.B Ensure fire stopping system provides fire-resistance rating, flame and temperature not less than fire resistance rating of surrounding floor, wall or assembly, in accordance with requirements of OBC.

.C Firestop System Rating: Where applicable, comply with F rating based on number of hours system can resist flames and gases; T rating based on maximum temperature rise of 163°C (325°F) above ambient for any thermocouple in addition to flame, gas and stream performance and H rating based on capacity to withstand hose stream after burn. Design combined and/or built-up site systems in accordance with approved restrictions and technical evaluations acceptable to Consultant and authorities having jurisdiction.

.D Systems shall provide fire and temperature rating in accordance with those outlined in OBC and provide effective barrier against passage of flame, smoke and gasses.

.E Fire stopping seals except for wall joints in visible areas must be of easily identifiable colour, such as red or yellow to be clearly distinguished from other building materials.

.F Service penetration components and assemblies, including back-up materials and supports shall be certified in accordance with ULC-S115 or CAN/ULC-S101-M and be ULC listed by a certified authority recognized by building Code officials in locality in which Building is situated.

.G Ensure suitability of Products for application and compatibility of materials with surfaces to which it will be applied.

.H Site system assembly shall be in accordance with ULC-S115 labeled and listed system design limitations, unless proposed assembly is approved by authorities having jurisdiction and meets Consultant's approval. Design combined and/or built-up site systems in accordance with approved restrictions and technical evaluations acceptable to Consultant and authorities having jurisdiction. Engineering judgments from fire stopping manufacturers reviewed by Consultant and authorities having jurisdiction may be used for conditions where a ULC and/or cUL fire stopping system is not available.

.I Sealants and putty for overhead and vertical joints shall be non-sagging; seals for floors, self-levelling. Flexible fire stop sealant shall provide movement capability in fire rated joint applications. Sealants shall be compatible with base materials such as without limitations masonry, concrete, metal, gypsum board and other similar items.

.J Products shall have a compressive strength capable of providing self support at a penetrating item and shall maintain their integrity as tested in a ULC vertical application.

.K Products shall be compatible with abutting dissimilar architectural coatings and finishes at floors, walls, ceilings, waterproofing membranes and the like.

.L .Integral Pipe Sleeves/Fire stopping Components: Other Sections within Divisions 15 may specify fire-rated pipe sleeves, ‘zero' clearance pipe/sleeve assemblies and integral firestopped penetration devices and accessories listed by authorized testing and certification authorities. These systems may eliminate need for separate fire stopping applications at certain designated locations and it is responsibility of this Section to determine any and all locations where such devices will be utilized on Project.

.M Do not provide Products containing asbestos.

.N Fire stopping System 1 (JF Systems):

.1 This Fire stopping System is primarily an expansion, control and perimeter seal without smoke resistance and be non-combustible, semi-rigid, felt fire protection, 65 kg/m3 (4 lb/cu ft) minimum density, depth, length and required width. Provide sealant of spray fire stopping over mineral wool.

.2 Blanket type fire stopping shall be listed and labelled in accordance with certified ULC listed system, with reference to `JF System Listings'.

.3 Where required by listing, impaling clips shall be heavy gauge galvanized wire or 25 mm (1") wide x 0.607 mm (24 ga) galvanized steel, Z formed with horizontal bottom and dimensions conforming to location of fire stopping and width of void to be filled. Ensure compression of joint do not damage clips.

.O Fire stopping System 2:

.1 Same materials as in System 1, but without use of impaling clips and with smoke and fluid seal with hose stream resistance.

.P Fire stopping System 3:

.1 Fire, gas, fluid and hose stream resistant elastomeric sealant with movement capabilities, certified ULC listed assembly. Materials shall have elastic characteristics where used at openings subject to movement. Intumescent pads may form part of this system, at Contractor's option.

.Q Fire stopping System 4:

.1 Fire stopping, gas, fluid and hose stream resistant seals at openings intended for ease of re-entry such as cables shall be an elastomeric seal or proprietary assembly of following types; a cementitious or rigid seal at such locations is not permitted.

.R Fire stopping System 4-A:

.1 Where openings are considered large such as at cable trays and bus ducts.

.S Fire stopping System 5 (Cavity Wall Compartment Closer and Fire stopping):

.1 Strips of "RXL Safe" semi-rigid mineral fibre insulation by Roxul Inc. 75 mm (3") wide by depth of cavity plus 13 mm (1/2") with galvanized skewers for securement at 300 mm (12") oc., or compressed 25% to fill depth of cavity.

.T Primers: To manufacturer's recommendations for specific material, substrate and end use.

.U Damming and Backup Materials, Supports and Anchoring Devices: Non-combustible, to manufacturer's recommendations in accordance with tested assembly being installed and as acceptable to authorities having jurisdiction. Sheet steel covers over temporarily unused sleeves in Owner and similar spaces shall be minimum 0.912 mm (20 ga) thick galvanized sheet steel formed to a tight fit over opening with specified fire stopping materials installed beneath. Combustible materials are acceptable only if they are approved under ULC or cUL systems, otherwise they should be removed after permanent firestop materials have cured.

.V Pipe and Duct Insulation and Wrappings Compatible with Fire stopping Systems: TREMstop WS by Tremco Canada Limited.

.W Intumescent Pads: "FSP 1077" by Grace Construction Products or "FSP Pads" by Nelson Electric, or "Instant Putty 200" by Instant Firestop Inc., or "Type PLW Firestop Pillow" by Electrovert Ltd.

.X Re-Entry Pillows: TREMstop PS" by Tremco Canada Limited.

2.02 MIXING

.A Mix materials at correct temperature and in accordance with manufacturer’s directions.

.B Cleaning Materials: As recommended by Firestop manufacturer.

PART 3 EXECUTION

3.01 PROTECTION

.A Fully protect walls, windows, floors and other surfaces around areas to be firestopped from marring or damage. Mask where necessary to avoid spillage on to adjoining

surfaces. Mask areas adjacent to openings, where necessary to prevent contamination or marring of adjacent surface materials. Remove masking after seal has been completed and an initial set has been achieved. Remove stains on adjacent surfaces as required.

.B Provide primer or surface conditioner if required by Product manufacturer. Prime surfaces in accordance with manufacturer's directions.

.C Verify openings, dimensions and surfaces conform to fire and smoke seal assembly.

.D Comply with manufacturer's recommended requirements for temperature, relative humidity, moisture content and presence of any sealer or release agents on substrate during application and curing of materials. Ensure surfaces are dry and frost free.

.E Remove combustible material and loose material detrimental to bond from edges of penetration. Clean, prime or otherwise prepare substrate material to manufacturer's recommendation.

.F Remove insulation from insulated pipe and duct where such pipes or ducts penetrate a fire separation unless ULC certified assembly permits such insulation to remain within assembly, or where mechanical trades have installed special fire rated insulated sleeves. Ensure continuity of thermal and vapour barriers where such are removed, altered or replaced, acceptable to Divisions 15 and Consultant.

.G Alternatively, ensure pipe and duct insulation and wrappings occurring within openings to receive fire stopping and smoke seals under this Section are installed prior to work of this Section and insulation and wrappings within fire seals are ULC listed components of system to be installed under this Section, unless ULC certified assembly permits such other insulation and wrappings to remain within assembly. Coordinate work of this Section with Divisions 15.

.H Do not apply firestop 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.

.I Provide temporary 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.

.J Install damming and fire stopping materials as per manufacturer's instructions.

.K Examine sizes of penetrating service and sleeve or opening sizes with exact annular space calculations, anticipated movement and all conditions necessary to establish correct type, thickness and installation of back-up materials and seals.

.L Clean bonding surfaces to remove deleterious substances including dust, paint, rust, oil, grease, moisture, frost and other foreign matter which may otherwise impair effective bonding.

3.02 INSTALLATION

.A Mix and apply fire stopping and smoke seals in accordance with manufacturer's instructions and tested designs to provide required fire (temperature and flame) rated seal, to prevent passage of smoke and where specifically designated, passage of fluids.

.B Provide temporary forming and packing as required. Apply materials with sufficient pressure to properly fill and consolidate mass to seal openings.

.C Tool or trowel exposed surfaces. Allow materials to cure by not covering up materials until full curing has taken place.

.D Where a designated system described hereinafter does not meet Code requirements for particular service condition, substitute with next higher system meeting required rating.

.E Notify Consultant when completed installations are ready for inspection and prior to concealing or enclosing fire stopping and smoke seals.

.F Fire stopping System 1:

.1 Install fire rated joint fire stopping by compressing material minimum of 25% to ensure complete sealing and to follow irregularities of concrete slabs at perimeter of building where junction occurs with back of cladding system. Apply fire stopping sealant of spray over compressed mineral wool.

.2 Butt succeeding sections of fire stopping material tightly up against preceding. Leave no voids.

.3 Provide fire stopping between exterior wall cladding and concrete floor slab. Secure and support to suit design requirements.

.4 Use this System for joint seals through fire-resistance rated floor slabs, ceilings and roofs unless otherwise stipulated.

.G Fire stopping System 2:

.1 At fire-rated masonry walls and gypsum board partitions which extend nominally to within 19 mm (3/4") of underside of deck above, insert fire rated joint assembly fire stopping material in 25% compression in accordance with ULC test requirements and manufacturer's instructions. Provide adequate depth of material to fill gap flush with face of wall, except as otherwise specified. Apply fire stopping sealant of spray over compressed mineral wool.

.2 Insert at intersection of fire-resistance rated masonry and gypsum board partitions.

.3 Insert at both sides of control and sway joints in fire-resistance rated masonry and gypsum board partitions and walls.

.4 Where wall/slab junction is exposed in finished work, keep fibre back 9 mm (3/8") from face of block and apply fire-resistant sealant to gap, tooling to a concave joint.

.5 At perimeter slab locations where this system would otherwise be exposed in finished work and where smoke seal is required, provide cover spray material of thickness as recommended by manufacturer of System 3 material set flush with top of slab and tooled smooth. Minimum cover spray thickness 3 mm (1/8"). Where anticipated movement in joint width is inevitable, select sealant with elastic capabilities.

.H Fire stopping System 3:

.1 This System establishes fire rated fire stopping for service penetrations throughout the Project. Seal gaps and holes in fire-rated walls and slabs and composite construction through which conduit, wire, cables, ductwork, piping and all other protrusions pass as a result of work using fire-resistant penetration sealant. Include opening which have been formed, sleeved and cored.

.2 Apply at unpenetrated openings and sleeves installed for future use through fire-resistance rated assemblies.

.3 Apply this System between spaces having different air pressures. (See Mechanical Drawings for pressurized areas and locations of moving penetrants.)

.4 Apply at "wet" rooms supported by suspended slabs at locations over Electrical and Equipment Rooms or similar areas containing power devices in which future re-entry is not required.

.5 Apply at Mechanical Rooms and similar rooms having systems containing liquids, including piping runs, unless such rooms are located over slab-on-grade.

.6 Install System 3 materials at elevator shafts, duct shafts and other similar locations over occupied spaces.

.7 Install 6 mm to 9 mm (1/4" to 3/8") bead of firestop caulking at interface of retaining angles around fire dampers, where angles meet fire-rated assembly and between retaining angles and fire damper, both sides of penetration. At floor locations, sealant bead at top of assembly is adequate.

.8 Where necessary, remove insulation from insulated pipe and duct where such services penetrate a fire separation unless certified assembly permits such insulation to remain within assembly. Apply wrapping materials as listed herein.

.9 Install System 3 materials at open wall joints, including expansion joints between fire rated enclosures and assemblies.

.I Fire stopping Systems 4 and 4A: Install at following locations,

.1 At Electrical, Electrical Switchgear, Electrical Transformer Rooms and at Telephone Equipment Rooms requiring re-entry for additional services.

.2 Install at communications and computer cable penetration points throughout.

.J Accessories: At hollow fire-rated walls, apply intumescent pads to back surfaces and cable entry points of electrical boxes, panels and other service penetration points, ensuring close coordination with electrical, mechanical and drywall trades. Where greater dimension of panel exceeds 500 mm (20"), gypsum board trades construct fire-rated enclosure around recessed panels.

.K Fire stopping System 5: Maintain maximum cavity wall compartments to lesser of following 2 criteria by bridging gap between cavity back-up material and back face of brick with full-depth strips of compartment closer and fire stopping material, securing in position with mechanical fasteners and sealing against firm, primary cavity materials:

.1 10 m² (100 sq ft).

.2 Paragraph 3.1.11 of OBC.

3.03 INSPECTION AND TESTING

.A Performs a series of 5 fog tests to random locations as designated by Consultant. Should any penetration, joint or void, under jurisdiction of this Section, emit visible fog, make repairs and replace deficiencies and re-perform fog test at no additional cost to Owner.

.B Fog units (machines) shall have a formulation output range of (1.5 gal/hr). Formulation particle size 0.5 - 25 m. Fogging agent shall be non-toxic, non-staining and shall provide a heavy fog at 30 ppm with a permissible airborne level concentration of 50 ppm.

.C Fog at a rate of 4 s/100 cu ft. Maintain fog density until inspection is complete.

.D Where work or materials fail to meet requirements as indicated by test results, pay costs of additional inspection and testing required for new replacement work or materials.

3.04 CLEANING

.A Remove excess materials and debris and clean adjacent surfaces immediately after application acceptable to Consultant. Remove and or correct staining and discolouring of adjacent surfaces as directed.

.B Remove temporary dams after initial set of fire stopping and smoke seal materials where such materials are left exposed in finished areas and flame spread rating of such materials exceed a value of 25, in accordance with CAN/ULC-S102-M.

3.05 PENETRATION SIZING

.A Following shall regulate sizing of service penetrations to be firestopped, other than for fire dampered openings:

.1 Single, circular penetration shall be sleeved by work of Divisions 15 and 16.

.2 Multiple penetrations of circular elements are defined as more than 1 circular penetration having a maximum space of 100 mm (4") between closest faces of such penetrating elements. Forming of such multiple penetrations is responsibility of respective trades whose service penetrates rated assembly and such formed opening shall be square or rectangular frame around group of penetrations in which maximum clearance between outer penetration element and face of opening shall be 25 mm (1").

.3 Create single and multiple rectangular penetrations in same manner as specified above, but edge clearance may be increased to a maximum of 50 mm (2").

.4 Exception; at fire dampers, clearances are governed by testing authorities' requirements.

.5 For purposes of this specification, a moving penetrant is defined as a penetrating device having an anticipated movement of greater than 9 mm (3/8") when measured at right angles to face of rated assembly.

END OF SECTION

SECTION 07412
STANDING SEAM SHEET METAL ROOFING

PART 1 GENERAL

1.01 GENERAL REQUIREMENTS

.A General Conditions, Supplementary Conditions and Division 01 apply to this Section.

1.02 SUMMARY

.A Section includes:

.1 Waterproof Underlayment/Overlayment Membrane.

.2 19 mm exterior plywood

.3 Standing Seam Sheet Metal Roofing

.4 Snow Guards

.B Related Sections:

.1 Section 06100 – Rough Carpentry

.2 Section 07620 – Sheet Metal Flashing and Trim

.3 Section 07900 – Joints Sealants

.4 Section 09260 – Gypsum Board Systems

1.03 REFERENCES

.A Conform to the requirements of the local Building Code, local by-laws and Authorities having jurisdiction, and the following standards:

.B American Society for Testing and Materials (ASTM)

.1 ASTM A653 – Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvalume) by the Hot Dip Process

.2 ASTM A792 – Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process

.C Canadian General Standards Board (CGBS)

.1 CAN/CGSB 19.24 – Multi-component, Chemical Curing Sealing Compound

.D Canadian Sheet Steel Building Institute (CSSBI)

.1 CSSBI - Technical Bulletin #6 Metric Zinc Coated Sheet Steel For Structural Building Products.

.2 CSSBI - Metric Standard For Sheet Steel Cladding.

.3 CSSBI - Prefinished and Post-Painted Galvanized Sheet Steel For Exterior Building Products Technical Bulletin #7.

.E Standards Council of Canada (CSA)

.1 CSA G40.20/G40.21 – General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel

.2 CAN/CSA G164 – Hot Dip Galvanizing of Irregularly Shaped Articles

.F Standards Council of Canada / Underwriters Laboratories of Canada (CAN/ULC)

.1 CAN/ULC-S102 – Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies

.G The Society for Protective Coatings (SSPC):

.1 SSPC Paint 20 – Zinc-Rich Coating (Type I – Inorganic and Type II – Organic), Includes all Revisions.

1.04 SUBMITTALS

.A Section 01300 - Submittals: Procedures for submittals.

.B Section 01700 – Contract Closeout: Procedures and documents required for partial and full occupancy.

.C Submit Shop Drawings with twenty-one (21) Working Days of award of Contract.

.D Submit copy of Contractor's Shop Drawing Review form at end of the Section within twenty-one (21) Working Days of Award of Contract.

.E Shop Drawings:

.1 Submit complete shop and erection drawings, stamped and signed, bearing the seal of a qualified professional engineer registered to practice in the place of work, required for the work of this Section to the Consultant for review prior to fabrication.

.2 Co-ordinate shop drawings for work of this Section with those for other trades to ensure correct interface details required to provide proper installation.

.3 Shop drawings shall incorporate plans, elevations, sections and details for all work in this Section. The details shall show and specify all metal, types and finishes and the adjoining related work of other Sections.

1.05 QUALITY ASSURANCE

.A The Contractor erecting the Work of this Section shall be a firm approved in writing by system manufacturer, with a minimum of (5) five years experience in this type of project, employing trained workers familiar with current installation methods and materials.

1.06 SYSTEM DESCRIPTION

.A Standing seam Sheet Metal Roofing system shall consist of the following:

.1 Standing seam sheet metal roofing panels over self-adhering waterproof overlayment applied to semi-rigid insulation, over self-adhering waterproof underlayment applied to exterior plywood on metal deck.

1.07 DESIGN CRITERIA

.A Snow Guard System:

.1 Design snow guard system to take shearing forces of design snow load, drift factor and impact load in accordance with the NBC (latest edition), having minimum snow density of 15.0 lbs/cu.ft., and having 0.03 coefficient of friction between the snow and the sloping surface and in accordance with National Research Council of Canada, Canadian Building Digest ISSN 0008-3097, Sliding Snow on Sloping Roofs, and local authorities having jurisdiction.

1.08 WARRANTY

.A Warrant the work of this section in accordance with General Conditions but for a period of three (3) years and agree to repair or replace faulty materials or work which becomes evident during the warranty period without cost to the Owner and at the Owner's convenience.

1.09 DELIVERY, HANDLING, PROTECTION AND STORAGE

.A Deliver materials to the site in their original unopened packages, clearly marked with the manufacturer's name, brand name, and description of contents. Store materials in accordance with manufacturer's recommendations for storage and handling.

.B Stack preformed material to prevent twisting, bending, or abrasion, and to provide ventilation.

.C Prevent contact with materials during storage which may cause discolouration, staining, or damage.

PART 2 PRODUCTS

2.01 MANUFACTURERS

.A Subject to compliance with requirements, provide preformed metal cladding system manufactured by one of the following:

.1 Standing Seam Metal Roofing:

.a Vicwest Steel

.b Flynn Canada Ltd.

.c Ideal Roofing.

2.02 STEEL

.A Sheet steel conforming to ASTM A653, structural quality, Grade 'A' with AZ150 aluminum/ zinc alloy coating (Galvalume), conforming to ASTM A792, shall be used for brackets, clips, battens, curved roofing and flashings.

.B Metal, roofing and flashings shall be of required base steel nominal thickness to meet design requirements.

.C Clips and brackets shall be of the required base steel nominal thickness to meet design requirements. Thermal clips shall be slotted to minimize through-metal conductivity.

.D Preformed metal roofing and related metal flashings shall be prefinished coil coated material in accordance with Technical Bulletin No. 7 "Prefinished and Post Painted Galvanized Sheet Steel for Exterior Building Products" of the Canadian Sheet Steel Building Institute (CSSBI), in CSSBI 8,000 Series finish or WeatherX finish. Refer to drawings for colours of curved roofing and flashings.

.E Flatstock Material:

.1 Minimum 0.024" (25 GSG gauge) thick or thicker to suit design requirements, galvanized sheet steel conforming to ASTM 653, structural quality, Grade 'A' with AZ150 aluminum/zinc alloy coating (Galvalume), conforming to ASTM A792.

2.03 SEALING TAPE

.A Macro-polyisobutylene preformed sealant tape designed for use in metal cladding assemblies.

2.04 SEALANTS AND GASKETS

.A Sealants and gaskets shall be of types to allow for maximum movements anticipated, maintaining life cycle expectancy, adhesion and flexibility under temperature ranges of -25°C up to +80°C, without undue softening or deleterious effects.

2.05 FASTENING DEVICES

.A Exposed fasteners used on exterior facing panels, flashing and all trim members shall be Series 400 stainless steel and nylon coloured coated head to match substrate colour, Atlas 'Colormate', or similar by Pioneer Screw & Nut Co.

2.06 BITUMINOUS PAINT

.A Conforming to CAN/CGSB-1.108-M, Type 2.

2.07 FIELD TOUCH-UP PAINT

.A Zinc rich anti-corrosion primer, conforming to conforming to SSPC Paint 20 and top coating of type and colour to match finish sheet.

2.08 UNDERLAYMENT/OVERLAYMENT "PEEL AND STICK" MEMBRANE

.A Minimum 40 mils thick, self-adhesive, composite sheet comprised of rubberized asphalt integrally bonded to a film of proprietary, high density, cross laminated polyethylene. Provide Waterproof Underlayment Membrane of one of the following:

.1 Blueskin RF 200 by Bakor.

.2 Lastobond Shield HT, by Soprema Inc.

2.09 ROOF BOARD

.A See Section 06100- Rough Carpentry for exterior plywood.

2.10 SNOW GUARD SYSTEM

.A Snow Guards: Adhesive mounted, clear, durable UV resistant polycarbonate, compatible with all non-copper metal roof systems. 'Mullane Snow Boss Model #650 for Metal Roofs', by Berger Building Products, Inc., or other as approved by Consultant.

.B Adhesive: 'Surebond Everseal (SB-190)' by Surebond, Inc., as recommended by snow guard manufacturer to suit condition.

.C Fasteners: Stainless steel, #10 Type A, self-tapping fasteners, as recommended by manufacturer.

2.11 FABRICATION

.A Comply with dimensions, profile limitations, gauges and fabrication details shown.

.B Fabricate components of the system in factory, ready for field installation.

.C Apply specified finishes in conformance with manufacturer's standards, and according to manufacturer's instructions.

.D Fabricate snow guards to meet design criteria requirements. Contractor shall review roofing conditions and design criteria to determine placement of snow guards.

PART 3 EXECUTION

3.01 EXAMINATION

.A Examine surfaces and adjacent areas in which Work under this Section is to be performed. Report in writing to Tenant's Construction Manager prevailing conditions that may adversely affect satisfactory execution of Work. Do not proceed with Work until unsatisfactory conditions have been corrected.

.B Starting Work constitutes acceptance of the existing conditions and this Contractor shall then, at his expense, be responsible for correcting unsatisfactory and defective Work encountered.

3.02 INSTALLATION - GENERAL

.A Follow manufacturer's printed instructions for installation of preformed metal siding at locations indicated on Drawings.

.B Deviations from printed manufacturer’s instruction will not be permitted without written authorization from the manufacturer stating that deviations will not void warranty and will be warranted as specified above.

3.03 WATERPROOF UNDERLAYMENT/OVERLAYMENT MEMBRANE

.A Install underlayment membrane under flashings and sloped roofing as recommended by manufacturer.

.B Ambient air temperature shall be 5°C. or greater and rising at the time of installation of waterproof underlayment.

3.04 STANDING SEAM METAL ROOFING

.A Install prefinished roofing panels over underlayment membrane using fasteners of the type and size recommended by manufacturer to resist uplift forces.

.B Provide notched and formed closures, sealed against weather penetration, as required.

3.05 SNOW GUARDS

.A Install snow guards in accordance with reviewed shop drawings and manufacturer's written recommendations.

.B Snow guard placement will vary from region to region and will be influenced by roof pitch, as well as lengths of runs and spacing between seams. Contractor shall determine with manufacturer correct placement of snow guards to suit condition.

.C Strict compliance with manufacturer's recommendations regarding environment conditions and surface preparation shall be adhered to.

.D Evenly spaced holes in base of snow guards shall allow the solvents to dissipate quickly, and become 'glue rivets' when the adhesive keys in the holes for a more secure application.

.E If mechanical fasteners are used, neoprene washer for a watertight seal is required. Snow guards shall be fastened into a structural member, rafter or purlin at least 1-1/2" through each screw point.

3.06 JOINTING

.A Install sealant at joints within system, and where system abuts dissimilar materials.

3.07 TOUCH-UP AND CLEANING

.A Touch-up minor paint abrasions with touch-up paint.

.B Clean sloped roofing and flashings as per manufactures written instructions.

END OF SECTION

SECTION 07421
INSULATED METAL WALL PANEL SYSTEM

GENERAL

1.01 GENERAL REQUIREMENTS

.A General Conditions, Supplementary Conditions and Division 01 apply to this Section.

1.02 SUMMARY

.A Section includes:

.1 air/vapour barrier.

.2 Plywood (as per section 06100)

.3 structural steel framing members required for support of ACM panels.

.4 preformed ACM panels.

.5 related trims and extrusions.

.B Related Sections:

.1 Section 06100 – Rough Carpentry

.2 Section 07620 – Sheet Metal Flashing and Trim

.3 Section 09900 – Painting

1.03 REFERENCES

.A American Society for Testing and Materials (ASTM)

.1 AAMA 2604-05 - Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings and Aluminum Extrusions and Panels

.2 AAMA 2605-05 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings and Aluminum Extrusions and Panels

.3 ASTM A653/A653M-08 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by Hot Dip Process

.4 ASTM B117-07a - Practice for Operating Salt Spray (Fog) Apparatus

.5 ASTM B244-97(02) - Test Method for Measurement of Thickness of Anodicn Coatings on Aluminum and of Other Nonconductive Coatings on Nonmagnetic Basis Metals with Eddy-Current Instruments

.6 ASTM D523-89(99) - Test Method for Specular Gloss

.7 ASTM D714-02e - Test Method for Evaluating Degree of Blistering of Paints

.8 ASTM D968-05e - Test Methods for Abrasion Resistance of Organic Coatings by Falling Abrasive

.9 ASTM D2244-07 - Practice for Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates

.10 ASTM D2274-03a - Test Method for Oxidation Stability of Distillate Fuel Oil (Accelerated Method)

.11 ASTM D3363-05 - Test Method for Film Hardness by Pencil Test

.12 ASTM D4214-07 - Test Methods for Evaluating the Degree of Chalking of Exterior Paint Films

.13 CGSB 71-GP-24M - Standard for: Adhesive, Flexible, for Bonding Cellular Polystyrene Insulation

.14 CAN/ULC-S134-92 - Fire Test of Exterior Wall Assemblies

.15 CAN/ULC-S702-97 - Standard for Mineral Fibre Thermal Insulation for Buildings

1.04 SUBMITTALS

.A Section 01300 – Submittals: Procedure for submittals.

.B Section 01700 – Contract Closeout: Procedures and documents required for partial and full occupancy.

.C Submit Shop Drawings with twenty-one (21) Working Days of award of Contract.

.D Submit copy of Contractor's Shop Drawing Review form at end of the Section within twenty-one (21) Working Days of Award of Contract.

.E Shop Drawings:

.1 Furnish drawings showing panel layout, gauge of face and liner sheets, thickness of Panels, finishes, corners, custom geometry's, locations of openings etc. Provide detailed drawings of joints, anchorage system, sealants, edge conditions, closures and other details as may be required for a weathertight installation. Distinguished between factory and field assembly work. No panels shall be fabricated until shop drawings have been reviewed by the Consultant.

.2 Shop drawings shall bear the seal of an Engineer registered to practice in the place of work, employed by the metal wall fabricator.

.F Samples:

.1 Submit full size panel sections of 8" length showing joints, insulation, profiles and finishes for Consultant's approval.

.G Testing:

.1 Submit copies of all testing when requested by the Consultant.

1.05 QUALITY ASSURANCE

.A Erector: Firm, approved in writing by system manufacturer, with a minimum of (5) five years' experience in this type of project, employing trained workers familiar with current installation methods and materials.

.B Conform to the requirements of the Ontario Building Code, local by-laws and Authorities having jurisdiction, and the following standards:

.C The insulated panel products by Alucobond, Vicwest or by Sobotec or by Ontario Panelization.

.D Alternate products pre-approved by the Owner and meeting the specifications and submitted in writing to Consultant shall be considered. Manufacturer to have a minimum of five (5) year history in panel production on continuous line. Approval will be issued via addendum. No verbal approval will be given.

1.06 SYSTEM DESCRIPTION

.A Supply of all labour, materials, equipment, tools, and supervision required for the fabrication and installation of the preformed metal wall panels in a workmanlike and weathertight building environment.

.B Accessories as necessary to install the panels as specified.

1.07 PERFORMANCE TESTING AND PROPERTIES

.A The following performance tests are considered the minimum acceptable requirements.

.1 Design, fabricate and erect preformed ACM panel system to meet following requirements:

.a Rain Penetration: Prevent rain penetration through wall system.

.b Design system based on "Rain Screen Principle" by NRCC. Incorporate means of draining moisture to exterior. Design drainage system to provide clear, internal paths of drainage of any trapped moisture to exterior. Ensure weep water discharges in a manner that avoids staining of architectural finishes, collecting in puddles or the formation of icicles.

.c Design metal framing system to support thermal insulation and ACM panel system.

.d Wind Load: Design wall system to resist wind loads, positive and negative, expected in this geographical region (NBC climatic data, 10 year probability) without causing rattling, vibration or excessive deflection of panels, over stressing of fasteners, clips and other detrimental effects on wall system.

.e Structural and Thermal Movement: Accommodate movement of supporting structural framing and movement caused by thermal expansion and contraction of system component parts without causing bowing, backing, delamination, oil canning, failure of joint seals, excessive stress on fasteners or any other detrimental effects.

.f Air/Vapour Barrier: Ensure it is continuous and sealed at joints, laps, terminations and penetrations to prevent air infiltration and exfiltration and to effectively retard moisture vapour migration through system.

.B Panel Fire Tests:

.1 Fire Endurance Tests:

.a CAN/ULC-S101:

.b Stay in Place Fire Test 10 Minutes.

.c Results: Panels must remain in place for 10 minutes and no joint fastener required holding panel together.

.d CAN/ULC-S126: Fire Spread Under Roof Deck Assemblies Test.

.e CAN/ULC-S127: Standard Corner Wall Method of Test for Flammability Characteristics of Non-Melting Building Materials.

.f CAN/ULC-S134: Standard Method of Fire Test for Exterior Wall Assemblies.

.g CAN/ULC-S138: Fire Growth Full Scale Room.

.2 Flame Spread Tests:

.a CAN/ULC-S102:

.b Standard Method of Testing for Surface Burning Characteristics of Building Materials and Assemblies.

.c Results: Flame spread index less than 25. Smoke density developed less than 450.

.3 Factory Mutual Approvals (FM):

.a FM Standard 4880 Approval for Class 1 fire classification (UL 1040):

.b Meet the FM Standard 4880 Approval requirements for Class 1 fire classification to a maximum height of 30 feet without sprinkler protection.

.c FM Standard 4880 (50') Approval for Class 1 fire classification:

.d Meet the FM Standard 4880 Approval requirements for Class 1 fire classification to unlimited height.

.4 Panel flatness tolerance applies to even rises and falls across panel. Local bumps and depressions will not be accepted. Fabricate panels not exceeding following tolerances:

.a 1.5 mm (0.06") in a convex direction, measured perpendicularly to normal plane.

.b 1.5 mm (0.06") in a concave direction, measured perpendicularly to normal plane.

.5 Maximum deviation from vertical and horizontal alignment of erected panels: 6 mm (1/4") in 6 m (20' - 0").

.6 Ensure maximum deviation from panel flatness is 3 mm (1/8") in 1500 mm (59") panel in any direction for assembled units (non-accumulative).

.7 Structural Design: Employ a registered structural engineer specified herein to:

.a design components for work of this Section requiring structural performance.

.b be responsible for determining sizes, yield strengths, gauge thicknesses and joint spacing to allow thermal movement and loading of components in accordance with applicable codes and regulations.

1.08 DELIVERY, STORAGE, AND HANDLING

.A Deliver materials to the site in their original unopened packages, clearly marked with the manufacturer's name, brand name, and description of contents. Store materials in accordance with manufacturer's recommendations for storage and handling.

.B Stack preformed material to prevent twisting, bending, or abrasion, and to provide ventilation.

.C Prevent contact with materials during storage which may cause discolouration, staining, or damage.

1.09 WARRANTY

.A Manufacturer Warranty: Warrant work of this Section for period of 10 years against defects and/or deficiencies in accordance with General Conditions of the Contract.

Promptly correct any defects or deficiencies which become apparent within warranty period, to satisfaction of Consultant and at no expense to Owner.

PRODUCTS

1.10 METAL WALL PANELS

.A Manufacturer List: Products of following manufacturers are acceptable subject to conformance to requirements of Drawings, Schedules and Specifications:

.1 Alucobond, www.alucobond.com

.2 Flynn Canada Ltd.; www.flynn.ca

.3 Ontario Panelization; www.ontariopanelization.com

.4 Sobotec Ltd.; www.sobotec.com

.5 VicWest; www.vicwest.com

.B Substitution Limitations: Comparable Products from manufacturers listed herein will be accepted provided they meet requirements of this Specification. No further substitutions will be permitted.

1.11 MATERIALS

.A SAT Membrane: SBS modified bitumen membrane, minimum 1 mm (40 mils) thick with polyethylene film membrane on 1 side and siliconized release paper on the other, cut to suit design and lap requirements, “Perm-A-Barrier” by Grace Construction Products, “Blueskin SA” by Bakor Inc., “IKO AquaBarrier AVB” by IKO Industries Ltd., “Air Shield” by W. R. Meadows of Canada or “ExcAir 110/110LT Self-Adhered” by Tremco Canada.

.B Primer: Recommended by membrane manufacturer.

.C Preformed ACM Panels:

.1 Face and Liner Material: Minimum 0.51 mm (0.02") 3003 aluminum alloy.

.2 Core: Extruded thermoplastic “fr” core.

.3 Panel Thickness: 4 mm (5/32").

.D Tolerances:

.1 Panel Bow: Maximum 0.80% per lineal foot panel dimension (width or length).

.2 Panel Dimensions: Make allowance for field adjustments, in manner recommended by manufacturer, where final dimensions cannot be established by field measurement prior to panel manufacturing.

.3 Panel lines, breaks and angles to be sharp and true: panel surfaces to be free from warp or buckle.

.E Strippable Coating: Applied prior to roll forming and embossing.

.F Panel, Wall and Soffit Accessories:

.1 Complete Installation: Provide proprietary aluminum extrusions compatible with panel edges, manufacturer's standard profiles, vertical and horizontal joint closures and perimeter trim as required for a complete installation.

.2 Fasteners: As recommended by panel manufacturer, concealed and non-corrosive.

.3 Extrusions and Extrusion Clips for Attaching Panels to Substructure: Purpose made aluminum. Install a separator between extrusions and sub-girts.

.4 Joint Filler Strip: Same material as panels.

.G Sub-Girts, Z-bars: Sheet steel conforming to ASTM A653/A653M, Grade A Zinc coating to Z275 (G90) designation, formed from minimum 1.219 mm (18 ga) base thickness.

.H Dielectric Separator: Provide best grade, quick drying non-staining alkali resistant bituminous paint or epoxy resin solution or membrane type to acceptance of Consultant.

.I Fasteners: Corrosion resistant and in accordance with manufacturer's recommendations to meet design load requirements specified and to maintain a weather-resistant installation.

.J Flashings: Panel design to include for corners, jambs and abutments. Flashings will not be permitted at these locations.

.K Sill flashings to be of matching gauge and finish as panels complete with reinforce back up splice plates at joints and directional changes.

.L Sealants:

.1 As recommended by panel manufacturer.

1.12 FINISH

.A Colour Anodized Finish: Ensure aluminum finish is colour anodized in accordance with Aluminum Association; www.aluminum.org, Finish Designation AA-M12C22A44, Class I, minimum 0.018 mm (0.7 mils) thick finish for exterior and interior exposure. Colour to match approved sample and as indicated on drawings.

.B Painting: Ensure concealed surfaces of aluminum and galvanized steel which would otherwise come in direct contact with structural steel, concrete, masonry are given a heavy coating of bituminous paint.

EXECUTION

1.13 EXAMINATION

.A Examine surface and adjacent areas in which Work under this Section is to be performed. Report in writing to Owner's Construction manager prevailing conditions that may adversely affect satisfactory execution of Work. Do not proceed with Work until unsatisfactory conditions have been corrected.

.B Starting work constitutes acceptance of the existing conditions and this Contractor shall then, at his expense, be responsible for correcting unsatisfactory and defective Work encountered.

1.14 INSTALLATION

.A Air/Vapour Barrier:

.1 SAT System:

.a Begin installation after mechanical insulation clips have been applied to substrate, have cured and are examined for bond.

.b Priming:

.i Apply fluid primer to concrete and masonry and other surfaces and allow to dry 1 hour or until tack-free. Prime only areas to be covered by membrane within 24 hours. Re-prime surfaces not covered within 24 hours.

.ii Apply primers at a rate of 6 - 8 m2/l (300 - 400 sq ft/gal) for SAT membrane.

.c Form fillets at inside corners of walls/slabs with liquid membrane.

.2 Flashing, Corner Reinforcing and Transition Membrane:

.a Install membrane flashing in 900 mm (36") widths. Where applicable, bring flashing a minimum of 150 mm (6") onto horizontal surfaces and a minimum of 200 mm (8") up walls from horizontal elevation shown.

.b SAT membrane will be acceptable materials for transition conditions at frames and like.

.c Stagger flashing and membrane seams.

.d Install flashing to protrusions, expansion joints, control joints and like. Bring flashing a minimum of 150 mm (6") onto membrane.

.e Apply mastic with inorganic mesh to flashing seams.

.3 Installation:

.a Install membrane in accordance with manufacturer's printed instructions over flashings and corner reinforcement.

.b Lay membrane without buckles, fishmouths and avoid stretching membrane. Where membrane cannot extend at least 100 mm (4") onto horizontal surface, terminate in a horizontal reglet and seal.

.c Lap membranes 65 mm (2-1/2") on side laps and 150 mm (6") on end laps. Stagger end laps.

.d Roll membrane with 75 mm (3") wide hand roller.

.4 Inspection: Inspect membrane for punctures, misaligned seams and fishmouths, apply additional layer of membrane over affected area, extending minimum of 150 mm (6") beyond damaged area in all directions.

.B Sub-Girt Installation: Erect sub-girts fastened through air/vapour barrier to steel studs or concrete block, as applicable, in accordance with system manufacturer's installation details and instructions.

.C Wall Panel System:

.1 Erect panels and joint filler strip in accordance with system manufacturer's details and instructions and so as to meet specified design and performance requirements.

.2 Ensure finished work is securely anchored, free of distortion and surface imperfections, uniform in colour and gloss.

.3 Use concealed fastenings only, except where exposed fastenings are specifically permitted by Consultant in writing.

.4 Install panels plumb, true, level and in alignment to established lines and elevations.

.5 Where indicated on Drawings or as required to complete work of this Section, supply and install closures, caps, fascias, covers and trims with colour matching panel finish, where exposed.

1.15 SITE QUALITY CONTROL

.A Repair or replace damaged materials to the satisfaction of the Owner’s Construction manager. The cost of repairing or replacing damaged material will be charged to the responsible party.

.B Manufacturer Services:

.1 Ensure manufacturer’s representative carries out intermediate inspections of air barriers and insulations in the system prior to enclosure and concealment of

cladding and soffit cladding system.

.2 Ensure walls and openings are within +/-3 mm (+/-1/8") and structure is plumb within 1:1000 of overall height.

.3 Have manufacturer’s representative and Contractor carry out final inspection and approval of completed work.

.4 Ensure membrane manufacturer's representative is on site at beginning of installation to provide training and supervision of Contractor's personnel in installation of air/vapour barrier. Ensure manufacturer’s representative provides frequent inspection visits thereafter to assure quality and competence of membrane installation.

1.16 CLEANING AND PROTECTION

.A After completing panel installation, strip interior protective film if so instructed by Owner’s Construction manager. Panel surface shall be free of deleterious material including dirt and shall be free of any discolouration resulting from the installation process.

.B Remove protective film immediately after installation.

.C Touch-up, repair or replace panels and trim that have been damaged.

.D After metal wall panel installation, clear weep holes and drainage channels of obstructions, dirt, and sealant.

END OF SECTION

SECTION 07544
PVC SINGLE PLY FULLY ADHERED ROOFING SYSTEM

1.01 GENERAL REQUIREMENTS

.A General Conditions, Supplementary Conditions and Division 01 apply to this Section.

1.02 SUMMARY

.A Section includes:

.1 Provide single ply PVC roofing system including but not limited to the following:

.a Cleaning deck surface

.b Roof sheathing

.c Vapour retarder

.d Roof insulation

.e Fully adhered PVC membrane

.f Incidental & accessory items

.g Expansion Joints

.h Provide for roof penetrations for Division 15 and 16.

.B Related Sections:

.1 Section 03400 – Architectural Precast Concrete

.2 Section 04200 – Masonry

.3 Section 05300 – Roof Deck

.4 Section 05500 – Metal Fabrications

.5 Section 06100 – Rough Carpentry

.6 Section 07421 – Insulated Metal Wall Panel System

.7 Section 07620 – Sheet Metal Flashing and Trim

.8 Section 07722 – Roof Hatches and Accessories

.9 Division 15 – Mechanical

.10 Division 16 – Electrical

1.03 REFERENCES

.A American Society for Testing and Materials (ASTM)

.1 ASTM C1289 - Standard Specifications for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board.

.B Canadian General Standards Board (CGSB)

.1 CAN/CGSB-51.34 - Vapour Barrier Sheet, Polyethylene, for Use in Building Construction

.C Standards Council of Canada (CSA)

.1 CSA A123.21 – Standard Test Method for the Dynamic Wind Uplift Resistance of Membrane Roofing Systems

.D Underwriters Laboratories of Canada (CAN/ULC)

.1 CAN/ULC S107 – Method of Fire Tests of Roof Coverings

.2 CAN/ULC S126 – Standard Method of Test for Fire Spread Under Roof-Deck Assemblies

.3 CAN/ ULC S704 – Standard for Thermal Insulation, Polyurethane and Polyisocyanurate Boards, Faced

.4 CAN/ ULC S770 – Standard Test Method for Determination of Long-term Thermal Resistance of Closed-Cell Thermal Insulating Foams.

.E CRCA – Canadian Roofing Contractors' Association.

.F FM - Factory Mutual Research Corporation, Current Edition Approval Guide, Roof Coverings

.G ULC -Underwriters Laboratories of Canada, Building Materials and Systems Directory, Fire Resistance Directory, Current Edition

.H CCMC Listing 13206-R (Carlisle) and 13348-R (Firestone) – Evaluation for Thermoplastic Polyolefin

1.04 SUBMITTALS

.A Section 01300 – Submittals: Procedure for Submittals

.B Letter of Certification: Submit certification from manufacturer, verifying that the roofing contractor is a manufacturer's authorized applicator within twenty-one (21) Working Days of award of Contract.

.C Submit Shop Drawings with twenty-one (21) Working Days of award of Contract.

.1 Include plans, sections, and details including base flashings and membrane terminations.

.2 Indicate setting plan for tapered insulation, joint or termination detail conditions and conditions of interface with other materials.

.D Contract Closeout Submittals: Submit under provisions of Document 01700.

.E Warranty: Submit warranty sample.

.F Submit product data indicating membrane and base flashing materials.

.G Submit two (2) samples of roofing materials to be used, samples to be standard factory samples.

.H Submit manufacturer's installation instructions under provisions of Section 01300.

.I Submit manufacturer's certification that products are physically and chemically compatible with each other and meet listed specifications and requirements.

.J Submit manufacturer's written "Design Review" recommendations including Wind Uplift Resistance rating verification for each individual project location.

.K Submit manufacturer's written copy of "Warranty Reserve Fund" documentation as proof of financial warranty endorsement.

.L Submittals as per article 1.07.E.

1.05 REGULATORY REQUIREMENTS

.A Conform to the applicable local building code requirements.

1.06 SYSTEM PERFORMANCE

.A Roofing System: Prevent water migration from entering building through the roof membrane.

.B All materials shall be from one (1) manufacturer.

.C External Fire Resistance: CAN/ULC S107 Class A.

.D Resistance to Fire Spread Under Steel Deck: CAN/ULC S126 and FM Global Class 1.

.E Wind uplift Resistance: The roofing manufacturer shall submit wind testing approvals to CSA A123.21 from an independent third party laboratory and provide a system description for the roof system to be installed on the project. Confirm that the system provided meets the criteria that follow including resistance to the wind loads (hourly wind velocity for 1 in 50 return value) identified in the current National Building Code for Canada for the project location.

.F Wind Zone system requirements:

.1 Zone 1: Projects located where the hourly wind velocity is less than 0.60 kPa, the maximum membrane sheet width shall be 10'-0". Provide roof system that is

rated for a minimum of 90-psf of wind uplift resistance. Provide a membrane manufacturer's warranty with minimum wind speed warranty of 72-mph.

.2 Zone 2: Projects located where the hourly wind velocity pressure is equal to or greater than 0.60 kPa, but less than 0.80 kPa, the maximum membrane sheet width shall be 8'-0". Provide roof system that is rated for a minimum of 90-psf of wind uplift resistance. Provide a membrane manufacturer warranty with minimum wind speed warranty of 72-mph.

.3 Zone 3: Projects located where the hourly wind velocity pressure is equal to or greater than 0.80 kPa, but less than 0.95 kPa, the maximum membrane sheet width shall be 8'-0". Provide roof system that is rated for a minimum of 105-psf of wind uplift resistance. Provide a membrane manufacturer warranty with minimum wind speed warranty of 80-mph.

.4 Zone 4: Projects located where the hourly wind velocity pressure is equal to or greater than 0.95 kPa, the maximum membrane sheet width shall be 8'-0". Provide roof system that is rated for a minimum of 120-psf of wind uplift resistance. Provide a membrane manufacturer warranty with minimum wind speed warranty of 90-mph.

1.07 QUALITY ASSURANCE

.A Source Limitations: Obtain Products from one manufacturer.

.B Manufacturer: Company specializing in manufacturing the products specified in this section, with minimum ten (10) years experience.

.a Ensure manufacturer is a member in good standing of CaGBC.

.b Ensure manufacturer of membrane is able to show Owner or Consultant an existing operational PVC roof system supplied by same manufacturer that has been operational for a minimum of 15 years.

.C Conform to CRCA's "Roofing Specifications" manual as amended to date of this Specification, as applicable, except where indicated or specified otherwise. More stringent requirements in Consultant's opinion shall govern.

.D Applicator:

.1 Applicator of roofing work shall be a member in good standing with CRCA and have a minimum of 5 years experience in installing single-ply roofing and have specialized equipment in proper operating condition to perform work in accordance with manufacturer's printed instructions.

.2 Shall be approved, licensed, or authorized applicator of the membrane manufacturer.

.3 The Work shall be executed by workmen skilled and trained in the application of flexible membrane.

.4 Shall provide payment and performance bond to building Owner.

.E Conform to CRCA Roofing Specification Manual as amended to date of this specification, as applicable, except where indicated or specified otherwise. Do roofing work employing roofing Products, roof sheathing, plates and fasteners conforming to FM data for proposed roofing system. Stringent requirements in Consultant's opinion shall govern.

1.08 PRE-INSTALLATION CONFERENCE

.A Convene a pre-installation conference at the site, one (1) week prior to commencing Work of this Section. Require attendance of parities directly affecting work of this section, including, but not limited to, the Owner's representative, Consultant, Contractor, Roofing Inspector, Roofing Applicator and Job Foreman, Plumber and Roofing Manufacturer's Representative, deck installer, and installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.

.B Contact Consultant two weeks prior to pre-installation conference to confirm schedule.

.C Review preparation and installation procedures and coordinating and scheduling required with related work.

.1 Review manufacturer's written design review recommendations.

1.09 DELIVERY, STORAGE AND HANDLING

.A Deliver and store materials undamaged in original containers with manufacturer's labels and seals intact. Allow no un-labeled materials on site.

.B Co-ordinate deliveries to comply with construction schedule and arrange ahead for strategic locations.

.C Handle and store roofing materials, and place equipment in a manner to avoid permanent deflection of deck. Do not load any area beyond the design limits.

.D Keep all combustible materials away from ALL ignition sources.

.E Materials found to be damp at time of installation or having been damp or exposed to moisture shall be rejected and removed from site.

.F Any materials which are found to be damaged shall be removed and replaced at the applicator's expense.

.G Protect sheet metal materials against bending, scratching and exposure which will cause corrosion or damage to appearance.

.H Store membrane rolls flat and protected from moisture.

.I Store products in weather-protected environment, clear of ground and moisture. Protect all insulation and liquid materials from direct sunlight exposure and the elements. Store in a dry location. Keep dry during application. Outdoors, keep clear of ground and moisture.

.J Store liquid materials containing solvents in well ventilated spaces with proper fire and safety precautions. Keep lids on tight.

.K Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.

.L Store solvent based liquids, adhesives and sealants away from excessive heat and open flames, and at temperatures between 15°C (59°F) and 26°C (79°F). Contact adhesives and cleaning fluids are extremely flammable, avoid open flame and sparks. Smoking is prohibited in area of roofing application. Contact adhesives contain petroleum distillates; avoid breathing vapours and provide adequate ventilation when using same within enclosed areas.

.M Do not expose insulation or roof sheathing to wet weather. Store and handle insulation to prevent broken edges and corners, punctures, indentations or other damage. Remove damaged insulation from site.

.N Store materials at site within temporary sheds or trailers; such facilities must be well sealed and kept at least 3°C (5°F) warmer than exterior ambient temperature to ensure materials remain dry in terms of roofing. Do not use wet, damp, frozen or damaged materials.

.O Do not store more than one day supply of materials on the roof at any time. On roof, stack materials on pallets, and completely cover with incombustible waterproof tarpaulin whenever work is interrupted, or when there is precipitation of any kind. Securely tie covering to pallets in such way as to be weather-tight. Plastic covers and shrink-wrap covers by manufacturers shall not be acceptable for site storage and shall be removed upon delivery to roof.

.P Distribute materials stored on roof to stay within designated live load limits of the roof construction. Provide ample bases under equipment and materials to distribute weight to conform to these live-load limits. Do not store materials on, or transport materials across, completed roof areas.

.Q Provide adequate protection of materials and work of this Section from damage by weather, traffic and other causes. At the end of each Day's work provide temporary water cutoff between finished roofing membrane and roof deck substrate to prevent weather damage and water from entering finished roof assembly. Remove such temporary cutoff strip completely prior to commencing with work.

.R Provide protection covering out of 13 mm (1/2") [19 mm (3/4")] thick plywood underlaid with 25 mm (1") thick polystyrene insulation board adhered to it, over all roofed areas when working from, or over, such roof surfaces. Provide such protection below hoist

rigs, ladders, pallets of material, and in other circumstances where the roofing membrane is exposed to potential damage. Secure protection boards mechanically against wind storm loss.

.S Protect work of other trades from damage resulting from work of this Section. Make Good such damage at no cost to Owner.

1.10 ENVIRONMENTAL REQUIREMENTS

.A Do not apply roofing system during inclement weather.

.B Do not apply roofing system to dirty, dusty, wet, damp or frozen deck surface.

1.11 EXISTING SITE CONDITIONS

.A Modifications may take place on existing adjacent roof areas as part of work of this Section. Do not use existing roof areas as storage, except to extent required for removal, alteration and replacement work.

.B Existing roofing may be covered by roofing warranty or guarantee. Obtain from Owner all necessary information regarding such warranty or guarantee and notify guarantor system manufacturer and guarantor roofing contractor, by letter before work is commenced on existing roofing system.

.C Execute alteration work in manner as to maintain existing warranty or guarantee.

.D Provide temporary protection as specified in Section 01500, while existing construction is open.

1.12 SEQUENCING AND SCHEDULING

.A Co-ordinate work as per construction schedule.

.B Co-ordinate the work of installing associated metal flashings as the work of this section proceeds.

1.13 WARRANTY

.A Manufacturer shall provide:

.1 A five (5) year watertight “Total System” warranty that shall not be pro-rated or have a dollar limit. Submit a sample of the Warranty exactly as it will be worded in the final form before Bid Closing. Warranty shall cover materials, labour, workmanship and the following wind speed coverage:

.a Zone 1: (for locations under 0.60 kPa) – 72-mph

.b Zone 2: (for locations between 0.60 and 0.80 kPa) – 72-mph

.c Zone 3: (for locations between 0.80 and 0.95 kPa) – 80-mph

.d Zone 4: (for locations over 0.95 kPa) – 90-mph

.2 A twenty (20) year membrane material warranty that states the roofing membrane will retain the properties necessary to serve as a roofing membrane for a period of twenty (20) years.

.3 Provide current copy of Single Ply Manufacturers Reserve Fund Documentation.

.4 Provide written approval for design and specification review by Single Ply Manufacturer, prior to project start-up.

.5 CSA 123.21 and Single Ply Manufacturers Wind Speed Warranty are applicable for all projects; except when FM Global Insurance is required for the projects.

.B Roofing Contractor shall provide:

.1 Provide a written warranty conforming to the Local Industrial Roofing Contractors Association's Certificate of Guarantee to the Owner, for roofing and related work, against defects in workmanship and actual leakage, for a period of two (2) years from final acceptance and that any and all damage resulting from failure to perform shall be made good at no additional expense to the Owner.

PART 2 PRODUCTS

2.01 MANUFACTURERS

.A Products of following manufacturers are acceptable subject to conformance to requirements of Drawings, Schedules and specifications:

.1 Carlisle SynTec Incorporated.

.2 Johns Manville.

.3 Sika Sarnafil.

.B Substitutions shall not be permitted.

2.02 MATERIALS

.A General:

.1 All materials shall be products of established manufacturers and shall conform to CSA, CGSB and ASTM standards, including all revisions to date.

.2 Complete roofing system shall be by single manufacturer.

.B Fiber Cants: Install cants at intersections of roofing and vertical surfaces except where indicated otherwise on Drawings. Install in accordance with manufacturer's recommendations. Lay true to line, level and with flush, butt joints and accurate corner miters.

.C Vapour Retarder:

.1 6 mil polyethylene meeting the requirements of CAN/CGSB-51.34 type II and ULC.

.D Roof Insulation:

.1 Square edged, closed cell polyisocyanurate foam rigid roof insulation boards manufactured with HCFC free blowing agent bonded to glass fibre reinforced organic facers on top and bottom surfaces during the manufacturing process meeting the requirements of:

.a CAN/ULC S704, S770 and ASTM C1289,

.b evaluated by CCMC and listed in their current guide with a report number for the appropriate shipping plant and

.c Factory Mutual approved Class 1 component for roof deck construction.

.2 Roof insulation boards:

.a 2 layers, one layer of 75 mm and one layer of 110 mm for R-value of not less then R25; maximum board size 4' x 8'.

.b Acceptable products:

.i Carlisle SynTec Corporation

.ii Johns Manville

.iii Sika Sarnafil

.3 Manufactured tapered insulation and crickets:

.a Maximum 4’ x 4’ board size, thickness to suit required slopes.

.4 Drain Sumps:

.a Maximum 8’ x 8’ board size

.E Insulation Overlay Board: Supply gypsum glass mat reinforced silicone treated board conforming to ASTM C1177/C1177M, non combustible according to ASTM E136/CAN/ULC-S114 thermal barrier as tested to UL 1256/CAN/ULC-S126, flame spread 0, smoke developed 0 to ASTM E84/CAN/ULC-S102 and ASTM D3273 with a rating of 10, no mould growth after 4 weeks exposure, 15 mm thick gypsum board 1200 mm (4') wide, maximum practical length, tapered edge as required, "DensGuard DensDeck Prime Roof Board" by Georgia-Pacific Canada, Inc.

.F Insulation and Overlay Board Adhesive: Provide as recommended by manufacturer.

.G Roof Membrane:

.1 1.5mm (60 mils) thickness, polyester reinforced, ultra-violet light resistant sheet polyvinyl chloride elastomeric sheet membrane conforming to ASTM D6878. Sheet width as per Article 1.07.F. Colour to be **white.**

.H Membrane and Flashing Adhesive: Provide elastomer solvent based, colour red, viscosity 800 cps.

.I Aluminum Tape: Provide 50 mm (2”) wide pressure-sensitive aluminum tape used as a separation layer between small areas of asphalt contamination and membrane and as a bond-breaker under coverstrip at joints.

.J Sealing Tape Strip: Compressible foam with pressure-sensitive adhesive on 1 side. Used with metal flashings as a preventive measure against air and wind blown moisture entry.

.K Multi-Purpose Tape: A high performance sealant tape used with metal flashings as a preventive measure against air and wind blown moisture entry.

.L Cleaner: Provide as recommended by manufacturer.

.M Flashing Membrane:

.1 1.5 mm (0.060") thickness, non-woven glass fibre reinforced, ultra-violet light resistant, polyvinyl chloride elastomeric sheet membrane. Color to match roofing.

.N Roof Walkway Pads: Supply walkway consisting of an additional layer of roofing membrane 900 mm (36") wide at locations shown.

.O Related PVC Accessories:

.1 Bonding Adhesive: As recommended by roofing membrane manufacturer.

.2 Edge Sealant: One component sealing compound. As recommended by roofing membrane manufacturer.

.3 Primer: As recommended by roofing membrane manufacturer.

.4 Water Cut-Off Mastic: Used as a mastic to prevent moisture migration at drains, compression terminations and beneath conventional metal edging.

.5 Inside/Outside Corners: Heat weldable pre-formed PVC corners.

.6 Vent Pipe Boots: Reinforced 1.5mm PVC base and non-reinforced PVC cone used to flash stack and pipes.

.7 Sealant Pocket: Pre-moulded PVC pocket.

.8 Pourable Sealer: Manufacturer's recommended sealant used with the PVC pitch pans.

.9 Termination Bar: 3mm thick extruded aluminum bar, pre-punched fur securing membranes.

.10 Termination Bar Fasteners: Premium No. 15, Phillips head fastener, Climaseal coated for superior corrosion resistance.

.11 Termination Bar Fasteners at Concrete Substrate (if required): Hammer driven, compression type faster, diamond point.

.P Expansion Joints:

.1 Expansion joints crossing roof shall be detailed as per manufacturer's standard expansion joint details. See drawings for location and assembly details.

PART 3 EXECUTION

3.01 EXAMINATION

.A Verify that surfaces and site conditions are ready to receive work.

.B Engineer to verify that deck is properly supported, secured and is minimum 22 gauge (0.76mm) for steel as per FM Loss Prevention Data Sheet 1-28 and ½" exterior grade plywood for wood.

.C Verify that deck is clean and smooth, free of depressions, irregularities, or projections, properly sloped to drains, valleys or eaves.

.D Verify that deck surfaces are dry and free of dirt and debris. Verify flutes of metal deck are clean and dry.

.E Verify that roof openings, curbs, pipes, sleeves, ducts, and vents through roof are solidly set, and wood nailing strips and reglets are in place.

.F Start of Work means installer accepts condition of existing surfaces and substrates.

3.02 PROTECTION

.A Protect building surfaces against damage from roofing work.

.B Protect metal, glass, plastic, and painted surfaces from adhesives and sealants.

.C Protect neighbouring work, property, cars, and persons from spills and overspray from adhesives, sealants and coatings and from damage related to roofing work.

.D Protect finished areas of the roofing system from roofing related work traffic and traffic by other trades. When remaining construction will not affect or endanger roofing, inspect

roofing for deterioration and damage, describing its nature and extent in a written report, with copies to Consultant and Owner.

3.03 INSTALLATION

.A Perform work per roof membrane manufacturer's printed installation instructions for the specified system, per NRCA's "The NRCA Roofing and Waterproofing Manual", "FM" and "UL" requirements and as specified herein which may also include CSA 123.21

.B Do not phase roofing installation. Install complete roof system on a daily basis, including flashings.

3.04 PREPARATION – METAL DECK

.A Verify that all units are properly secured in place and that deck is clean, ready to receive membrane.

3.05 PARAPET WALL INSTALLATION

.A Where indicated on Drawings, Provide roof board sheathing mechanically fastened to parapet walls and as herein specified.

.B Secure 5/8" Dens-Deck Prime roof board to parapet walls (full height). Adhere PVC membrane to substrate as per manufacturers written instructions.

3.06 ROOF BOARD INSTALLATION

.A Insulation [and Insulation Overlay Board] Adhesion:

.1 One step low-rise polyurethane foam used to attach insulation [and insulation overlay board] to approved compatible substrates. Adhesive is applied with a gravity fed applicator or by hand with a dual component caulk gun in bands 300 mm (12") oc. Additional adhesive may be required for rougher surfaces. Consult Product Data Sheets for additional information. Application rates are as follows:

.a 600 ml cartridge: 15 – 20 m2 (50 – 65 sq ft).

.b 1500 ml cartridge: 45 – 61 m2 (150 – 200 sq ft).

.2 Notes:

.a Not recommended for use with insulation [and insulation overlay] boards larger than 1220 mm x 1220 mm (48" x 48").

.3 Place insulation [and insulation overlay] board into adhesive shortly after it has reached its maximum rise (typically within 30 - 45 seconds at 16 deg C to 27 deg C (60 deg F to 80 deg F)) and walk into place.

.4 Ensure minimum Product temperature before entering dispenser is 16 deg C (60 deg F).

.5 Store between 16 deg C (60 deg F) and 27 deg C (80 deg F). Protect from freezing.

.6 Do not use adhesive during inclement weather.

.7 Do not apply adhesive to wet or damp surfaces.

.B Place roof sheathing with long axis of each sheet transverse to ribs, with end joints staggered and fully supported on ribs. Butt boards together to moderate contact. Adjust spacing so screws are centered on ribs.

.C Hold roof sheathing in-place as required by site conditions until covered by complete roof system.

.D Tape joints in roof sheathing.

.E Temporarily cover roof sheathing not covered by membrane at the end of each Day's Work with polyethylene film.

3.07 VAPOUR RETARDER APPLICATION – METAL DECK

.A Apply vapour retarder loose over the deck and seal all laps with tape, fire retardant adhesive or sealant depending on type.

.B Extend vapour retarder onto all vertical surfaces, under cant strips and blocking and seal with adhesive. Seal vapour retarder with adhesive, tape or water cut-off mastic to air seal membrane in perimeter walls and expansion joint tie-ins.

3.08 INSULATION APPLICATION

.A Ensure vapour retarder is clean and dry.

.B Install insulation in two (2) layers minimum. Install insulation boards with edges in moderate contact, without forcing. Cut insulation to fit neatly to perimeter blocking and around penetrations through roof. Stagger end joints in adjacent rows. Lay multiple layers with joints offset minimum 12" (300mm) from underlying layer.

.C Fully adhere the top layer of insulation to the steel deck securing the layers below. The layers below can be loose laid.

.D Reduce the insulation thickness by 1/2" at the drain for an area 8' x 8' to create a sump and facilitate drainage. Pre-manufactured drain sumps to be used.

.E Place the tapered thickness insulation to the required slope pattern in accordance with manufacturer's instructions

.F Apply no more insulation than can be sealed with membrane in the same day.

3.09 EXPANSION JOINTS

.A At roof expansion and movement joints as indicated on drawings, install continuous membrane expansion joint as detailed and as per manufacturer’s written instructions.

3.10 MEMBRANE APPLICATION

.A Unroll prefabricated sheet membrane and draw tight without folds or wrinkles. Lap side joints minimum 100 mm (4") for hand welding; minimum 75 mm (3") for machine welding; minimum 150 mm (6") for machine welding of seam as per membrane manufacturer's recommendations.

.B Refer to and comply with membrane manufacturer's welding equipment requirements and techniques.

.C Additional securement must be provided at the perimeter of each roof level, roof section, expansion joint, curb flashing, skylight, interior wall, penthouse, at any inside angle change where slope exceeds 2" in one horizontal foot, and at other penetrations in accordance with membrane manufacture's published details.

3.11 FLASHINGS AND ACCESSORIES

.A Complete flashings concurrently with the installation of the membrane and associated PVC-clad metal.

.B Install flashing adhesive onto clean substrate at rate specified by manufacturer taking care to allow it to dry prior to installation of membrane flashing.

.C Coat membrane flashing sheet with adhesive and while adhesive is active, roll membrane onto substrate extending over perimeters as shown on detail drawings.

.D Lap flashing sheet onto membrane a minimum 200mm in order to cover fasteners and seal by hot air welding. Provide 75mm side lap and seal by hot air welding.

.E Properly secure flashings to their support, without sags, blisters, fishmouths or wrinkles with termination bars as indicated on drawings and details.

.F Execute work in accordance with manufacturer’s printed recommendations, literature and details.

.G All procedures relating to temporary tie-ins shall conform to manufacturer’s recommendations.

3.12 PAVERS, STEPS AND WALKWAY TREADS

.A Install walkways treads by heat welding the undersides of the PVC tread to the PVCsurface as per manufacturer’s written instructions. Refer to drawings for layout.

3.13 FIELD QUALITY CONTROL

.A Field inspection and testing will be performed as directed by the Consultant at his direction.

.B Correct identification defects or irregularities to the satisfaction of the Consultant.

3.14 MANUFACTURER'S FIELD SERVICES

.A Request site attendance of roofing and insulation material manufacturers or his representative during installation of the work when required.

.B Provide final inspection for issuance of Guarantee.

3.15 CLEANING

.A Remove bituminous markings from finished surfaces.

.B In areas where finished surfaces are soiled by asphalt or any other source of soiling cause by work of this section, consult manufacturer of surfaces for cleaning advice and conform to their (documented) instructions.

.C Repair or replace defaced or disfigured finishes caused by work of this Section.

.D Clean debris and garbage from entire roof including all areas of the existing roof and all accumulated organic and other debris from in and around the roof drain screens and in the roof valleys.

END OF SECTION

SECTION 07620
SHEET METAL FLASHING AND TRIM

GENERAL

1.01 GENERAL REQUIREMENTS

.A General Conditions, Supplementary Conditions and Division 01 apply to this Section.

1.02 SUMMARY

.A Section includes:

.1 Parapet and Cap flashings.

.2 Roof flashings.

.3 Metal Gutters and Downspouts.

.B Related Sections:

.1 Section 06100 – Rough Carpentry

.2 Section 07240 – Exterior Insulation and Finish System

.3 Section 07411 – Preformed Metal Siding

.4 Section 07544 –PVC Fully Adhered Single Ply Roofing System

.5 Section 07900 – Joint Sealers

.6 Division 15 – Mechanical

.7 Division 16 - Electrical

1.03 REFERENCES

.A American Society for Testing and Materials (ASTM)

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

.B Canadian Standards Association (CSA)

.C Sheet Metal and Air-Conditioning Contractors National Association (SMACNA) - Architectural Sheet Metal Manual

1.04 SUBMITTALS

.A Section 01300 - Submittals: Procedures for submittals.

.B Letter of Conformance: Submit one (1) copy of Letter of Conformance form at end of this Section within twenty-one (21) Working Days of award of Contract.

.C Samples: Submit samples of materials to the Consultant prior to purchase.

.1 Samples shall be in size and quantities as required for testing and visual approval directed by the Consultant.

.2 Prepare prototype sample approximately 12" long, of gutter and downspout connection, and upon Consultant's request, other flashing components.

.3 Materials and jointing shall match approved samples. Approval of samples shall not be construed as acceptance of work subsequently executed.

1.05 DELIVERY, STORAGE, AND HANDLING

.A Stack preformed material to prevent twisting, bending, or abrasion, and to provide ventilation.

.B Prevent contact with materials during storage which may cause discolouration, staining, or damage.

PRODUCTS

1.06 SHEET MATERIALS

.A Prefinished Metal Flashing:

.1 26 Gauge spangle free zinc coated sheet steel to ASTM A653 with a coating designation G90 (Z275). Material to be factory primed and top coated Stelco/Dofasco 'Baycoat Perspectra' or 'WeatherX' finish, colours, and location of each colour, as indicated on drawings.

.B Starter Strips:

.1 Of same material as metal flashing 1-1/2" wide and continuous.

.C Prefinished Metal Gutters and Downspouts:

.1 22 Gauge spangle free zinc coated sheet steel to ASTM A653 with a coating designation G90 (Z275). Material to be factory primed and top coated Stelco/Dofasco 'Baycoat Perspectra' or WeatherX colours and location of each colour, as indicated on drawings.

1.07 ACCESSORIES

.A Fasteners: Galvanized steel with soft EPDM washers at exposed fasteners. Finish exposed fasteners same colour as surrounding prefinished metal.

.B Brackets for Gutters and Downspouts: Prefinished metal, profile to suit application.

.C Protective Backing Paint: Bituminous.

.D Slip Sheet: Rosin sized building paper.

.E Sealant: Type specified in Section 07900.

.F Cutback Asphalt Plastic Cement: Fibrated cut back type plastic asphalt compound.

.G Splash Blocks (if indicated on drawings): Precast concrete units, minimum 3000 psi at 28 days, with 5% air entrainment, size and profile to suit application.

1.08 FABRICATION

.A Fabricate metal lashings and other sheet metal work to applicable CRCA 'FL' Series and as detailed.

.B Form flashing, copings and fascias to profiles indicated. Use prefinished steel in all locations except in concealed locations, where galvanized steel may be used. Form pieces in 8' maximum lengths. Make allowance for expansion at joints.

.C Fabricate sheet metal components with lines, arrises and angles sharp and true and plane surfaces free from objectionable wave, warp or buckle. Exposed edges of sheet metal shall be folded back to form a 1/2" wide hem on the side concealed from view. The workmanship and methods employed for forming, anchoring, cleating and the provision for expansion and contraction of sheet metal work shall be to the approval of the Consultant.

.D Apply two coats of bituminous paint to metal surfaces to be in contact with concrete, mortar or dissimilar metals.

.E Prefabricate corner pieces for copings.

EXECUTION

1.09 INSPECTION

.A Verify roof openings, curbs, pipes, sleeves, ducts, or vents through roof are solidly set, cant strips and reglets in place, and nailing strips located.

.B Verify membrane termination and base flashings are in place, sealed, and secure.

.C Beginning of installation means acceptance of existing conditions.

1.10 PREPARATION

.A Field measure site conditions prior to fabricating work.

.B Install starter and edge strips, and cleats before starting installation.

1.11 SHEET METAL WORK

.A Provide continuous starter strips to present true, non-waving leading edge. Provide clips and anchor to backup in an approved manner to provide rigid, secure installation. Conceal fastenings in completed flashing. Provide fasteners at 8" O.C.

.B Lap, lock and seal all seams.

.C In general, use flat lock seams. Make joints to permit thermal movement. Make surfaces free from buckling, warp, wave, dents, oil canning or other defects. Make corners square and surfaces straight and in true planes. Equally space joints in cap flashings to suit wall panel module. Space seams not farther apart than 8'-0".

.D Install flashings on mechanical and electrical equipment, piping, conduits and related items passing through roof.

.E Where sheet metal is indicated in details to extend to roofing, it shall press firmly on top of aggregate with a vertical hemmed edge for rigidity.

.F Exposed fastenings will be permitted where indicated or where concealed fastening is not possible. Obtain Consultant's approval of exposed fastenings and methods of making same.

.G Insert metal flashing into reglets under cap flashing, as indicated, to form weather tight junction.

.H Turn top edge of flashing into recessed with suitably formed upstand. Mechanically fasten flashing inside reglet at maximum 12" o.c.

.I Gutters and Downspouts:

.1 Verify surfaces behind gutters and downspouts are painted prior to installation. Gutters and downspouts shall not be in place while surfaces behind such items are being painted.

.2 Install downspouts after application of exterior wall coating.

.3 Install gutters and downspouts in locations as indicated on drawings.

.4 Size and profile to suit application to the approval of the Consultant.

.5 Gutter brackets: Space alternately with gutter spacers at 36” O.C.

.6 Install downspouts and space straps at 48” O.C.

.7 Lap gutter joints 2”, set laps in bead of sealant and rivet at 1” O.C.

.J Apply bituminous coating on surfaces in contact with dissimilar materials, including preservative treated wood.

.K Caulk flashing with sealant.

.L If exposed screws or bolts are used, use neoprene washers.

.M Fill mastic cup with expansion joint filler to 3/4" below top. Fill top of cup with poly roof shaped to shed water.

END OF SECTION

SECTION 07722
ROOF HATCHES AND ACCESSORIES

GENERAL

1.01 GENERAL REQUIREMENTS

.A General Conditions, Supplementary Conditions and Division 01 apply to this Section.

1.02 SUMMARY

.A Section includes:

.1 Prefabricated steel roof hatch, with integral support curbs, operable hardware, and counter flashings.

.2 Roof Pipe Entry Hatches.

.3 Safety Bar.

.B Related Section:

.1 Section 05500 – Metal Fabrications

.2 Section 06100 – Rough Carpentry

.3 Section 07544 –PVC Fully Adhered Single Ply Roofing System

.4 Section 07620 – Sheet Metal Flashing and Trim

.5 Section 09900 – Painting

.6 Division 15 – Mechanical

.7 Division 16 - Electrical

1.03 REFERENCES

.A Underwriters Laboratories of Canada (ULC): Building Materials Directory

1.04 SUBMITTALS

.A Section 01300 - Submittals: Procedures for submittals.

.B Letter of Conformance: Submit one (1) copy of Letter of Conformance form at end of this Section within twenty-one (21) Working Days of award of Contract.

PRODUCTS

1.05 ROOF HATCHES

.A Roof Hatches: Type "S-20", by Bilco Canada.

.B Manufactured Units:

.1 Size: 2'-6" X 3'-0".

.2 Curb: 14 gage galvanized G90 steel; 1 inch rigid insulation; integral cap flashing to receive roof flashing system; extended flange for mounting.

.3 Cover: 14 gage galvanized G90 steel with one inch glass fibre insulation retained by 22 gage steel inner liner. Continuous gasket to provide weatherproof seal.

.4 Hardware: Manufacturer's standard manually operated type with compression spring operators, positive snap latch with turn handles inside and out and padlock hasp inside; automatic hold-open arm with vinyl covered grip handle for easy release; cadmium plated finish.

.5 Hinges: Heavy duty pintle type.

.6 Fasteners: Corrosive resistant fasteners recommended by roof hatch manufacturer.

.C Substitutions: Subject to compliance with requirements, one of the following may be substituted for that specified.

.1 Model R-100-G by Lexsuco Canada Ltd.

.2 Model PLH, by Precision Stair Corp. distributed by Par Zee & Associates Inc.

.3 Model G3844 by Acudor Acorn Limited.

1.06 ROOF PIPE ENTRY HATCHES

.A Pipe openings sizes, shapes, quantity and locations through hatch curb shall be as per drawings. Curb and cover shall be fabricated from 14 ga. primer coated galvanized steel and shall be neatly welded and ground at corners. Covers shall have 1" thick glass fibre insulation with minimum density of 4 lbs, backed by a cover liner of 22 ga. steel. Curb shall be 24" high with 3.5" wide flange pre-punched for securement to roof deck. Curb shall be insulated with 2" thick glass fibre insulation. Pipe entry openings shall protrude 1/2" on each side of curb and be neatly welded all around to ensure watertightness.

.B Roof pipe entry hatches shall be completely assembled with heavy duty pintle hinges, torsion spring operated doors, latching mechanisms, exterior padlock hasps, automatic hold-open arm with rubber grip handle and neoprene draft seal. All hardware to be cadmium plated. Factory finish shall be grey primer coating.

.C Size: 2'-6" x 3'-0", with door hinged on short side. 'Model No. RPE-100', by Lexsuco Canada Limited.

1.07 SAFETY BAR

.A Safety Bar Handle: by Lexsuco.

.B Unit to be complete, with stainless steel fasteners for securing to hatch curb.

.C Finish: PVC coated, colour coded Roof Safety Green.

.D Roof Hatch shall be equipped with 1-3/8" (35mm) diameter Safety Bar coated with 20mil PVC colour coated safety green. Safety Bar shall be mounted on the corner of hatch curb as shown on drawings without impeding operation of the door.

1.08 ROOF HATCH LADDER

.A Steel Wall Ladder: As specified in Section 05500 - Metal Fabrications.

1.09 FABRICATION

.A Fabricate free of visual distortions and defects. Weld corners and joints/

.B Fabricate units weather tight with integral cap flashing, providing for removal of condensation.

.C Prime paint; one coat.

.D Spot weld hasp. Latch and hinges to prevent removal from interior.

EXECUTION

1.10 INSTALLATION

.A Install in accordance with manufacturer's instructions. Co-ordinate with installation of roofing system and related flashings. Provide weather tight installation.

.B Apply bituminous paint on metal surfaces of units in contact with cementitious materials and dissimilar metals.

.C Roof Pipe Entry Hatches:

.1 Install in accordance with manufacturer's written instructions. Co-ordinate with installation of roofing system and related flashings. Provide weather tight installation.

.2 Apply bituminous paint on metal surfaces of units in contact with cementitious materials and dissimilar metals.

.D Safety Bar: Install in strict accordance with manufacturer's published instructions.

END OF SECTION

SECTION 07900
JOINT SEALANTS

GENERAL

1.01 GENERAL REQUIREMENTS

.A General Conditions, Supplementary Conditions and Division 01 apply to this Section.

1.02 SUMMARY

.A Section includes:

.1 Substrate surface preparation

.2 Joint Sealants

.3 Read other sections of the specifications for extent of sealant specified in those Sections. Do all other sealing indicated, specified or required.

.B Related Sections:

.1 Section 03300 – Cast-In-Place Concrete

.2 Section 04200 – Masonry

.3 Section 05810 – Expansion Joint Assemblies

.4 Section 07270 – Fire stopping and Smoke seals

.5 Section 07420 – Preformed Composite Wall Panel System

.6 Section 07544 –PVC Fully Adhered Single Ply Roofing System

.7 Section 07620 – Sheet Metal Flashing and Trim

.8 Section 08110 – Steel Doors and Frames

.9 Section 08800 – Glass and Glazing

.10 Section 09260 – Gypsum Board Systems

1.03 REFERENCES

.A American Society for Testing and Materials (ASTM)

.1 ASTM C920 – Standard Specification for Elastomeric Joint Sealants

.B Canadian General Standards Board (CAN/CGSB)

.1 CAN/CGSB 19.6 – Caulking Compound, Oil Base

.2 CAN/CGSB 19.21 – Sealing and Bedding Compound, Acoustical

.3 CGSB 19-GP-14M – Sealing Compound, One Component, Butyl-Polyisobutylene Polymer Base, Solvent Curing

1.04 SUBMITTALS

.A Section 01300 - Submittals: procedures for submittals.

.B Submit for approval and colour selection sample of each type of compound, recommended primers and joint filler or fillers proposed to be used.

.C Submit manufacturer's literature describing each material to be used in the Work of this Section. Literature shall contain a statement that the material complies with the specified standard.

1.05 QUALITY ASSURANCE

.A Applicator shall have the manufacturer's approval for competency in the use of each of the products specified.

.B Manufacturer's recommendations for mixing or preparation of materials shall be strictly adhered to.

.C Pot life or installation times shall not be exceeded.

.D Integral materials which compose a joint detail shall be compatible.

.E Component parts, where possible, shall have the same manufacturer.

.F A representative of sealant material manufacturer shall visit the site during application to ensure that all Work is carried out according to the manufacturer's printed instructions.

.G Interior sealants in food preparation areas shall meet the compositional requirements for use in CFIA regulated facilities, as required by local authorities having jurisdiction.

1.06 DELIVERY AND STORAGE

.A Receive and store materials as recommended by materials manufacturer.

.B Maintain containers and labels in undamaged condition.

1.07 ENVIRONMENTAL CONDITIONS

.A Apply sealants only to completely dry surfaces, and at air and material temperatures above minimum established by manufacturer's specifications.

.B Do not install solvent curing sealants in enclosed building spaces.

1.08 WARRANTY

.A Provide a written warranty endorsed and issued in the name of the Owner stating that all sealant Work is warrant against leakage, cracking, deterioration, shrinkage, loss of cohesion, loss of adhesion, staining or failure to provide intended seal; for a period of five (5) years from the Date of Substantial Performance of the project, and that any

defects will be made good including related materials and installation at no additional Cost to the Owner.

PART 2 PRODUCTS

2.01 MANUFACTURERS

.A Manufacturer List: Products of following manufacturers are acceptable subject to conformance to requirements of Drawings, Schedules and Specifications:

.1 ChemRex Inc.; www.chemrex.com

.2 CPD Construction Products; www.cpd.com

.3 Dow Corning; www.dowcorning.com

.4 Euclid Chemical Canada Ltd.; www.euclidchemical.com

.5 Momentive Performance Materials; www.momentive.com

.6 Sika Canada Inc.; www.sika.ca

.7 Tremco Canada; www.tremcosealants.com

.8 W.R. Meadows of Canada; www.wrmeadows.com

2.02 MATERIALS

.A Joint Cleaner: Non-corrosive and non-staining solvent, recommended by sealant manufacturer for applicable substrate material.

.B Primer: Non-staining type recommended by sealant manufacturer.

.C Joint Back-Up: Round closed cell foam, reticulated extruded polyethylene, Shore A hardness of 20, tensile strength 140 to 200 kPa, outsized -50% compatible with sealant and primer, non-adhering to sealant. 'Sof Rod' by Tremco Ltd. or approved equal.

.D Bond Breaker: Pressure sensitive polyethylene tape by 3M, 470 or 481, not bondable to sealant.

.E Threshold Sealant: Oil base caulking compound complying with CAN/CGSB-19.6.

.F Acoustical Sealant: Sealing and bedding compound complying with CAN/CGSB-19.21 at soundproof partitions. 'Tremco Acoustical Sealant' by Tremco Ltd.

.G Sealant Type "A":

.1 Non-sag type, 1 component medium-modulus, pre-pigmented, neutral cure elastomeric silicone sealant conforming to ASTM C920, Type S, Grade NS, Class 50, Use NT, G, M, A and O. Supply in standard colours as selected. Supply 1 of following:

.a "Dow Corning 795 Silicone Building Sealant" or "CWS/CCS" by Dow Corning.

.b "GE SilPruf SCS2000" by Momentive Performance Materials.

.c "Spectrem 2" by Tremco Canada.

.H Sealant Type 'C' provide 1 of the following:

.1 Oil based type sealant conforming to CAN/CGSB 19.6, or blended butyl rubber and polyisobutylene type sealant providing soft, flexible seal with minimum shrinkage and conforming to CGSB 19-GP-14M, 'Tremco Butyl 200' by Tremco (Canada) Ltd., division of RPM Company, or 'Butyl Caulking' by U.S.E. Hickson Products Ltd., or approved equal.

.2 Non-sag type, 1 component, acrylic latex sealant conforming to ASTM C834, Type OP, Grade -18°C. Supply in standard colours as selected. Supply 1 of following:

.a "GE RCS20" by Momentive Performance Materials.

.b "Sonolac" by Sonneborn.

.c "Tremflex 834" by Tremco Canada.

.3 Non-sag type, multi-component polyurethane sealant conforming to ASTM C920, Type M, Grade NS, Class 50, Use T, I, M, A and O. Supply in standard colours as selected. Supply 1 of following:

.a "Sonoplastic NP 2" by ChemRex Inc.

.b "Eucolastic II" by Euclid Chemical Canada Ltd.

.c "Sikaflex -2c NS" by Sika Canada Inc.

.d "DYmeric 240" by Tremco Canada.

.4 Non-sag type, 1 component polyurethane sealant conforming to ASTM C920, Type S, Grade NS, Class 25, Use NT, M, A and O. Supply in standard colours as selected. Supply 1 of following:

.a "Sonoplastic NP1" by ChemRex Inc.

.b "Sikaflex -1a" by Sika Canada Inc.

.c "DyMonic" and/or "Vulkem 116" by Tremco Canada.

.I Sealant Type 'D':

.1 One component silicone base, solvent curing conforming to ASTM C920, 'Proglaze' by Tremco Ltd., division of RPM Company, 'Dow Corning 786' by

Dow Canada Inc. or 'Sanitary 1700' by Canadian General Electric Company.

.J Sealant Type 'E':

.1 One component, low modulus, silicone base, neutral curing type conforming to ASTM C920, 'Tremco Spec 1' by Tremco (Canada) Ltd., or 'CWS/CCS' or '790' by Dow Corning.

PART 3 EXECUTION

3.01 INSPECTION

.A Verify that previously executed Work and surfaces are satisfactory for installation or application, or both and that performance of subsequent Work will not be adversely affected.

.B Examine joints to be sealed for construction defects which would adversely affect execution of Work.

.C Ensure masonry and concrete have cured 28 days minimum.

.D Commencement of Work will constitute acceptance of site conditions and previously executed Work as satisfactory.

3.02 PREPARATION

.A Clean joint surfaces using joint cleaner as necessary, to be free of dust, dirt, oil, frost, grease, rust lacquers, laitance, release agents, moisture or other matter which might adversely affect adhesion of sealant.

.B Mask areas adjacent to joists prior to priming and sealing.

.C Prepare surfaces as recommended by sealant manufacturer.

.D Install joint back-up to achieve correct joint depth.

.E Prime sides of joints to manufacturer's directions immediately prior to sealing.

.F Seal joints in surfaces to be painted before painting. Where surfaces to be sealed are prime painted in shop before sealing, check to make sure prime paint is compatible with primer and sealant. If incompatible inform Consultant, consult the manufacturer, and change primer and sealant to approved compatible types.

.G Check form release agent used on concrete for compatibility with primer and sealant. If incompatible inform Consultant and change primer and sealant to approved compatible types or clean concrete to Consultant's approval.

.H Joint Form:

.1 Form joints in the exterior walls in accordance with the Rainscreen Principal described in Canada Building Digest #40.

3.03 APPLICATION

.A Apply sealant in accordance with manufacturer's directions, using a gun with proper nozzle size, to leave a weather tight, airtight installation. use sufficient pressure to fill voids and joints solid. Superficial pointing with skin bead is not accessible.

.B Form surface of sealant smooth, free from ridges, wrinkles, sags, air pockets, embedded impurities. Neatly tool surface to a slight concave joint.

.C In masonry cavity construction, vent sealant joints from cavity to 1/8" beyond external face of wall by inserting 1/8" diameter plastic tubing at bottom of each joint and maximum of 5'-0" o.c. vertically.

.D Clean adjacent surfaces immediately and leave Work neat and clean. Remove excess sealant and droppings, using recommended cleaners as Work progresses. Remove masking tape after tooling of joints.

.E Use polyurethane sealant as required to maintain the integrity of the building air seal.

.F Unless specified otherwise in this Section use specified sealants in following locations and as required :

.1 Type A: Typically used in joints between metal frames and adjacent masonry and/or concrete construction in exterior walls, exterior and interior sides; control and expansion joints in exterior and interior surfaces of poured-in-place concrete walls, precast architectural wall panels and unit masonry walls; sealing of joints between underside of pre-stressed precast concrete floor slabs and masonry; and other locations where sealant is required or noted on Drawings except in locations designated for Type B, C, D, E, and except where sealant is specified in other Sections.

.2 Type C: Typically used in joints between interior metal and/or wood frames and adjacent construction in interior partitions.

.3 Type D (traffic bearing): Typically used in joints with movement in horizontal surfaces between concrete slabs, pavers and precast concrete panels.

.4 Type E (load bearing): Typically used in static joints in horizontal surfaces where self-levelling sealants are required.

END OF SECTION

DIVISION 8
DOORS AND WINDOWS

08110	Steel Doors and Frames
08330	Insulated Rolling Service Door
08710	Door Hardware
08800	Glass and Glazing

SECTION 08110
STEEL DOORS AND FRAMES

GENERAL

1.01 GENERAL REQUIREMENTS

.A General Conditions, Supplementary Conditions and Division 01 apply to this Section.

1.02 SUMMARY

.A Section includes:

.1 Non-rated rolled steel doors, panels, and frames.

.2 Glazed light frames.

.B Related Sections:

.1 Section 04220 – Masonry

.2 Section 06200 – Finish Carpentry

.3 Section 07900 – Joint Sealants

.4 Section 08710 – Door Hardware

.5 Section 08800 – Glass and Glazing

.6 Section 09900 – Painting

.7 Division 15 – Mechanical (Door Louvres if required)

1.03 REFERENCES

.A American Society for Testing and Materials (ASTM)

.1 ASTM C1289 – Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board

.B Canadian Welding Bureau:

.1 CSA W59 - Welded steel construction (Metal Arc Welding), Includes all Updates.

.C Standards Council of Canada / Underwriters Laboratories of Canada (CAN/ULC)

.1 CAN/ULC S702 – Standard for Thermal Insulation Mineral Fibre for Buildings, Includes all amendments and updates

1.04 SUBMITTALS

.A Section 01300 – Submittals: Procedures for submittals.

.B Submit Shop Drawings within twenty-one (21) Working Days of award of Contract:

.1 Submit detailed shop drawing showing fabrication and installation requirements, sizes, anchorage and size and type of fasteners.

.C Samples:

.1 Supply for Consultant's review, if requested, sample of frame corner showing construction, workmanship and finish.

1.05 DELIVERY, STORAGE, HANDLING AND PROTECTION

.A Co-ordinate deliveries to comply with construction schedule and arrange ahead for off-the-ground, under cover storage location. Do not load any area beyond the design limits.

.B Adequately protect units against rust and damage during manufacture, delivery and storage.

.C Store materials on planks in a dry area and cover to protect from damage. Make good immediately any damage done. Clean scratches and touch-up with rust-inhibitive primer.

PRODUCTS

1.06 MANUFACTURERS

.A Doors and Frames: Subject to specification requirements, provide flush doors and frames by one of the following manufacturers:

.1 S.W. Fleming.

.2 Day Bar.

.3 Artek.

.4 Shanahan’s Manufacturing Limited

1.07 MATERIALS

.A Sheet Steel:

.1 Commercial quality, stretcher levelled or temper rolled to stretcher level of flatness. Wipe coat galvanized steel with a minimum zinc coating of .25 oz./sq. ft.

.B Gauges:

.1 Door Frames: 16 gauge.

.2 Doors (Honeycomb or Polyisocyanurate Core):

.a Door Faces: 18 gauge.

.b Top and Bottom End Channels: 18 gauge.

.3 Reinforcements:

.a Lock and Strike Reinforcements: 16 gauge.

.b Hinge Reinforcements: 10 gauge.

.c Flush Bolt Reinforcements: 16 gauge.

.d Door Closer or Holder Reinforcements: 12 gauge.

.C Anchors: As required to suit condition:

.D Door Core:

.1 Exterior Doors: Polyisocyanurate, rigid foam, closed cell, faced board, having minimum R-value R12.3 and conforming to ASTM C1289.

.2 Interior doors, except fire rated doors: Structural small cell honeycomb core consisting of kraft paper having 1" cell size to thickness indicated. Laminate honeycomb core to both inside faces of door, completely filling the inside hollow of the door.

.E Insulation:

.1 Fiberglas insulation, minimum 1.5 pcf density, conforming to CAN/ULC S702, 1-1/2" thick, by Owens Corning Canada Inc., A.F. 110.

.2 Materials for fire rated doors shall conform to ULC or ULI requirements.

.F Accessories:

.1 Rubber Silencers: Black neoprene rubber, single or double stud type.

.a Single Doors: 3 per door single silencers on strike side.

.b Double Doors with Mullions: 3 single silencers on each door, on strike side.

.c Double Doors without Mullions: 2 single silencers on frame head.

.2 Glazing Stops: Rolled steel channel shape, butted corners, prepared for countersunk screws.

.3 Guard Boxes: Minimum 22 gauge steel guard boxes, welded to frame, at back of hardware cut-outs.

1.08 FABRICATION AND MANUFACTURE

.A Gauges of metal shall be as specified. No deviations or substitutions will be accepted.

.B Reinforcing specified is the minimum acceptable. Provide additional reinforcement where required to ensure a permanent, rigid, trouble free installation able to withstand the stresses of heavy commercial usage.

.C Cut, shear, straighten and work the steel in manner to prevent disfigurement of the finished work.

.D Punch frames for rubber door bumpers.

.E Fill seams, joints and weld depressions with epoxy metal filler, disc sand to a smooth, flat, uniform scratch-free surface, with all arrises sharp and true to line. Drilled and punched holes shall be reamed and have all burrs removed.

.F Finished work shall be free of warp, open seams, buckles, weld and grind marks and other surface defects detrimental to the production of a good paint finish.

.G Fastenings shall be concealed except those required for loose glazing stops.

.H Welding shall conform to CSA specification W59.

.I Seams in Honeycomb Doors:

.1 Doors shall have vertical, mechanically interlocking seams on hinge and lock edges.

.J Hardware Requirements:

.1 Blank, mortise, reinforce drill and tap doors and frames to receive templated hinges and other hardware as required. Check hardware lists for requirements.

.K Frames:

.1 Fabricate frames to profiles shown. Frames shall be fabricated to suite the header conditions of masonry work. Mitre corners of frames. Cut frame mitres accurately and weld continuously on inside of frame. Fabricate header frame to suit. Where site welding or splicing is required due to size of unit, the location of field joints shall be shown on the shop drawings and strictly adhered to.

.2 Protect strike and hinge reinforcements and other openings with mortar guard boxes welded to frame.

.3 Cutouts in doors for mortise lock sets shall be fitted with leaf spring clips and back limit stop to facilitate easy positioning and setting of locksets.

.4 Weld floor clip angles to inside of each jamb profile, two holes in each for anchorage to floor. Where required provide adjustable type floor clip angles.

.5 Fit frames with channel or angle spreaders, two per frame, to ensure proper frame alignment. Install stiffener plates or spreaders between frame trim where required, to prevent bending of trim and to maintain alignment when setting and

during construction.

.6 Where frames occur in masonry provide and adjustable T-strap type or wire type anchor for every 2'-0" of jamb length. Special anchors for frames to be set in concrete shall be as detailed.

.7 Construct door frames of labelled fire doors as approved by ULC or ULI. Ratings for frames shall match doors. Locate label on the frame jamb midway between the top hinge and the head of door frame so that it is concealed when the door is closed.

.L Doors:

.1 Fabricate doors to present one continuous face free from joints, tool markings and abrasions. Assemble by welding.

.2 Reinforce, stiffen honeycomb doors with small cell honeycomb core laminated to the inside faces of panels. The core shall completely fill the inside hollow of the door.

.3 Exterior doors shall be completely filled with polyisocyanurate foam core.

.4 Reinforce door edges with channel reinforcing. Bevel stiles 1/8" (3 mm).

.5 Provide flush top edge on exterior doors.

.6 Undercut non-fire rated doors as indicated on drawings.

.7 Fabricate fire rated door assemblies in accordance with ULC or ULI requirements. Provide labels for all fire rated doors. Do not paint over labels.

EXECUTION

1.09 DELIVERY

.A Deliver doors and frames to Section 06200 for installation.

END OF SECTION

SECTION 08330
INSULATED ROLLING SERVICE DOORS

PART 1 GENERAL

1.01 GENERAL REQUIREMENTS

.A General Conditions and Division 01 apply to this Section.

1.02 SUMMARY

.A Section includes:

.1 Manually operated (refer to drawings) insulated rolling service doors.

.2 Operating hardware and supports.

.B Related Sections:

.1 Section 05500 – Metal Fabrications

.2 Section 06100 – Rough Carpentry

.3 Section 07900 – Joint Sealants

.4 Section 08710 – Door Hardware

.5 Section 09900 – Painting

1.03 REFERENCES

.A American Society for Testing and Materials (ASTM):

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

.2 ASTM D1929 – Standard Test Method for Determining Ignition Temperature of Plastics

.3 ASTM E84– Standard Test Method for Surface Burning Characteristics of Building Materials.

.B Canadian Standards Association (CSA):

.1 CSA S16 – Design of steel structures, includes all Updates.

1.04 SUBMITTALS

.A Section 01300 – Submittals: Procedures for submittals.

.B Letter of Conformance: Submit one (1) copy of Letter of Conformance form at end of this Section within twenty-one (21) Working Days of Award of Contract.

.C Submit Shop Drawings within twenty-one (21) Working Days of award of Contract:

.1 Shop drawings shall clearly show and describe in detail, detailed door assemblies and adjacent construction, including elevations, sections and details of door, track, hardware and operating components, dimensions, gauges, finishes and of relationship of door, track, hardware and operating components to adjacent construction.

.2 Provide complete installation instructions for all components of the overhead door, including but not limited to installation of door panels, accessories and hardware, etc.

.D Provide operating and maintenance data for incorporation into maintenance manual specified under section 01300.

1.05 QUALITY ASSURANCE

.A Design doors and tracks to withstand minimum horizontal wind loads while in the closed position of 1 kPa (20 psf) and have a maximum deflection under the full design load, while in the open horizontal position, of 1/120 of the full overall width.

.B Cycle Life:

.1 Design doors of standard construction for normal use of up to 20 cycles per day maximum, and an overall maximum of 50,000 operating cycles for the life of the door.

.C Insulated Door Slat Material Requirements:

.1 Flame Spread Index of 0 and a Smoke Developed Index of 10 as tested per ASTM E84.

.2 Sound Transmission Class (STC) rating up to 30 for the curtain and up to 32 for the entire assembly, as tested per ASTM E90 and based on testing a complete, operable assembly.

.3 Minimum R-value of 8.0 (U-value of 0.125) as calculated using the ASHRAE Handbook of Fundamentals.

.4 Insulation to be CFC Free with an Ozone Depletion Potential (ODP) rating of zero.

.D Safety: Chain operated doors shall be designed so that the door immediately stops upward or downward travel and is maintained in a stationary position when the hand chain is released by user.

.E Qualifications: Installation shall only be by a specified manufacturer or manufacturer's authorized representative in accordance with manufacturer's written instructions.

PART 2 PRODUCTS

2.01 SECTIONAL OVERHEAD DOORS (INSULATED)

.A "Model ESD20 Thermiser Insulated Roll up door", as manufactured by Cookson Canada Inc.

.B No Substitutions.

2.02 MATERIALS AND COMPONENTS

.A Door Sections:

.1 Exterior Skin: Manufacturer recommended gauge based on performance requirements. Minimum 24/24 gauge, Grade 40, ASTM A 653 galvanized steel zinc coating.

.2 Ends of each door section shall be sealed with 16 ga. hot dipped galvanized steel full height end caps.

.3 Total Slat Thickness: 15/16 inch (24 mm)

.4 Flame Spread Index of 0 and a Smoke Developed Index of 10 as tested per ASTM E84

.5 R-value: 8.0

.6 STC Rating: Up to 30 for the curtain and up to 32 for the entire assembly, as tested per ASTM E90 and based on testing a complete, operable assembly

.B Insulation:

.1 7/8 inch (22 mm) foamed-in-place, closed cell urethane.

.C Door Finish:

.1 Exterior and Interior Slat Finish: GalvaNex™ Coating System (Stock Colors):

.a ASTM A 653 galvanized base coating treated with dual process rinsing agents in preparation for chemical bonding baked-on base coat and gray, white, or tan as selected by Consultant, baked-on polyester enamel finish coat.

.D Endlocks: Fabricate interlocking sections with high strength nylon endlocks on alternate slats each secured with two ¼" (6.35 mm) rivets. Provide windlocks as required to meet specified wind load.

.1 Nylon: Required up to 21'-5" width (DBG - Distance Between Guides).

.E Bottom Bar:

.1 Configuration:

.a Insulated Bottom Bar: Reinforced extruded aluminum interior face with full depth insulation and exterior skin slat to match curtain material and gauge. Minimum 4” tall x 1-1/16” thickness.

.b Finish of exterior to match slats and interior finish shall be mill finish.

.F Guides:

.1 Fabrication:

.a Minimum 3/16 inch (4.76 mm) structural steel angles. Provide windlock bars of same material when windlocks are required to meet specified wind load. Top of inner and outer guide angles to be flared outwards to form bellmouth for smooth entry of curtain into guides. Provide removable guide stoppers to prevent over travel of curtain and bottom bar.

.b Top 16 ½” (419.10 mm) of coil side guide angles to be removable for ease of curtain installation and as needed for future curtain service.

.c Powder Coat (Stock Colors): Zirconium treatment followed by a gray, tan, or white as selected by Consultant, baked-on polyester powder coat; minimum 2.5 mils (0.065 mm) cured film thickness.

.G Counterbalance Shaft Assembly:

.1 Barrel: Steel pipe capable of supporting curtain load with maximum deflection of 0.03 inches per foot (2.5 mm per meter) of width

.2 Spring Balance: Oil-tempered, heat-treated steel helical torsion spring assembly designed for proper balance of door to ensure that maximum effort to operate will not exceed 25 lbs (110 N). Provide wheel for applying and adjusting spring torque.

.H Brackets:

.1 Fabricate from minimum 3/16 inch (5 mm) steel plate with permanently lubricated ball or roller bearings at rotating support points to support counterbalance shaft assembly and form end closures.

.a Powder Coat (Stock Colors): Zirconium treatment followed by a gray, tan, or white as selected by Consultant, baked-on polyester powder coat; minimum 2.5 mils (0.065 mm) cured film thickness.

.I Hood:

.1 Minimum 24 gauge galvanized steel with reinforced top and bottom edges. Provide minimum 1/4 inch (6.35 mm) steel intermediate support brackets as required to prevent excessive sag.

.2 GalvaNex™ Coating System (Stock Colors):

.a ASTM A 653 galvanized base coating treated with dual process rinsing agents in preparation for chemical bonding baked-on base coat and gray, white, OR tan as selected by Consultant, baked-on polyester enamel finish coat.

.J Weatherstripping:

.1 Bottom Bar: Manually Operated Doors**:** Replaceable, bulb-style, compressible EDPM gasket extending into guides.

.2 Guides: Replaceable vinyl strip on guides sealing against both sides 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.

.K OPERATION

.1 Manual ControlGard Chain Hoist: Provide chain hoist operator with endless steel chain, chain pocket wheel and guard, geared reduction unit, and chain keeper secured to guide. Chain hoist to include integral brake mechanism that will immediately stop upward or downward travel and maintain the door in a stationary position when the hand chain is released by the user.

.L Locking:

.1 Padlockable chain keeper on guide. (Manual Chain operated.).

.M Vision Panels: 10 x 1-1/2 x 3/4 inch thick (254 x 38 x 19 mm) oval acrylic panes set with double-sided foam glazing tape and fully contained within slat assembly. Refer to drawings for number and placement. Smaller vision panels are not acceptable.

2.03 FABRICATION

.A Fabricate the work true to dimensions detailed and square, and to reviewed shop drawings, free from distortion and defects detrimental to the appearance and performance.

.B Ensure that Site dimensions are taken and confirmed prior to the fabrication of the doors, frames and other components etc.

.C Accurately fit joints and intersecting members with adequate fastenings.

PART 3 EXECUTION

3.01 EXAMINATION

.A Prior to commencement of work of this Section, thoroughly examine location where rolling door(s) and all other related components are scheduled to be installed. To ensure

a true and satisfactory installation, the overhead door installer must inspect the opening that is scheduled to receive the overhead door and ensure that the opening is square and true, and that the floor is level and square to building lines, so as to ensure a continuous and proper seal at floor when the door is in the fully closed position.

.B Report in writing, to the Consultant, any condition adversely affecting this work.

.C Proceed with work only when conditions are satisfactory for the performance of a first class installation. Commencement of the overhead door installation constitutes acceptance of the door opening conditions, and any subsequent problems arising during overhead door installation due to problems with the original rough opening will be the responsibility of the overhead door installer, with no cost being incurred by the Owner, for either materials or labour.

3.02 INSTALLATION

.A Installation shall be by door manufacturer or by authorized manufacturer's representative for the region, as specified herein.

.B Install doors, tracks and operating equipment complete with necessary hardware, weather-stripping, anchors, hangers, brackets and accessories, in accordance to manufacturer's printed instructions.

.C Assemble and erect work plumb, true, square, straight, level and accurate as per Drawings and reviewed shop drawings.

.D Isolate metals where necessary to prevent corrosion due to contact with dissimilar metals and between metals, masonry and concrete. Use bituminous paint or butyl tape or as recommended, in writing, by the door manufacturer.

.E Supply written instructions, drawings, and where necessary provide supervision for the installation of items to be built in by work of other Sections.

.F Complete installation must be to the satisfaction of the Consultant. Any and all aspects of installation adversely affecting appearance and/or performance of such installation shall be deemed unacceptable and shall be fully replaced within the original time schedule and at no cost to the Owner.

.G Door:

.1 Install rolling door in strict accordance with final reviewed shop drawings, manufacturer's instructions and as specified herein.

.2 Fit, align and adjust overhead door assemblies, level and plumb, to ensure smooth operation and to provide correct closure to the satisfaction of the Consultant.

.3 Ensure that complete installation includes tracks, operating equipment, necessary hardware, weather-stripping, anchors, hangers, brackets and any other accessories deemed necessary. Include any other items, not specified herein, but required for a complete installation.

3.03 ADJUSTMENT AND DEOMSTRATION

.A Lubrication:

.1 Upon completion of erection of units and operating equipment, lubricate moving parts before operation.

.2 Grease sprockets, bearings, cables, link chains and guides. Lubricant shall be as recommended by the manufacturer.

.B Demonstration:

.1 Test operate and adjust doors to perform smoothly, free from warp, twist or distortion. Demonstrate the operation of same to the satisfaction of the Consultant at the same time of acceptance of the completed work.

.2 Submit to the Owner a copy of proposed preventative maintenance program for overhead doors and other related components requiring regular maintenance and check-ups.

END OF SECTION

SECTION 08710
DOOR HARDWARE

PART 1 GENERAL

1.01 GENERAL REQUIREMENTS

.A General Conditions, Supplementary Conditions and Division 01 apply to this Section.

1.02 SUMMARY

.A This Section covers the Work for:

.1 Hinges.

.2 Lock cylinders and keys.

.3 Exit devices.

.4 Push/pull units.

.5 Closers.

.6 Weatherstripping for exterior doors.

.7 Automatic drop seals (door bottoms).

.8 Astragals or meeting seals on pairs of doors.

.9 Thresholds.

.B Products furnished but not installed under this Section include:

.1 Final replacement cores to be installed by Owner.

1.03 QUALITY ASSURANCE

.A Single Source Responsibility: Obtain each type of hardware (latch and lock sets, hinges, closers, etc.) from a single manufacturer.

.B Supplier Qualifications: A recognized architectural door hardware supplier in the Project's vicinity, that has a record of successful in-service performance for supplying door hardware similar in quantity, type, and quality to that indicated for this Project and that employs an experienced architectural hardware consultant (AHC) who is available to the Owner, Architect/Engineer, and Contractor, at reasonable times during the course of the Work, for consultation.

.C Provide templates for doors, frames, and other work specified to be factory prepared for the installation of door hardware. Provide adequate provisions for locating and installing door hardware to comply with indicated requirements.

1.04 SUBMITTALS

.A Submit hardware schedule.

1.05 PRODUCT HANDLING

.A Tag each item or package separately with identification related to final hardware schedule, and include basic installation instructions with each item or package.

.B Packaging of door hardware is responsibility of supplier. As material is received by hardware supplier from various manufacturers, sort and repackage in containers clearly marked with appropriate hardware set number to match set numbers of approved hardware schedule. Two or more identical sets may be packed in same container.

.C Inventory door hardware jointly with representatives of hardware supplier and hardware installer until each is satisfied that count is correct.

.D Deliver individually packaged door hardware items promptly to place of installation (shop or Project site).

.E Provide secure lock-up for door hardware delivered to the Project, but not yet installed. Control handling and installation of hardware items that are not immediately replaceable so that completion of the Work will not be delayed by hardware losses both before and after installation.

1.06 MAINTENANCE

.A Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.

1.07 REFERENCES

.A Standard hardware location dimensions in accordance with Canadian Metric Guide for Steel Doors and Frames (Modular Construction) prepared by Canadian Steel Door and Frame Manufactures' Association.

.B CAN/CGSB-69.17-M86/ANSI/BHMA A156.2-1983, Bored and Preassembled Locks and Latches.

.C CAN/CGSB-69.18-M90/ANSI/BHMA A156.1-1981, Butts and Hinges.

.D CAN/CGSB-69.19-M89/ANSI/BHMA A156.3-1984, Exit Devices.

.E CAN/CGSB-69.20-M90/ANSI/BHMA A156.4-1986, Door Controls (Closers).

.F CAN/CGSB-69.21-M90/ANSI/BHMA A156.5-1984, Auxiliary Locks and Associated Products.

.G CAN/CGSB-69.22-M90/ANSI/BHMA A156.6-1986, Architectural Door Trim.

.H CAN/CGSB-69.23-M90/ANSI/BHMA A156.7-1981, Template Hinge Dimensions.

.I CAN/CGSB-69.24-M90/ANSI/BHMA A156.8-1982, Door Controls - Overhead Holders.

.J CAN/CGSB-69.26-M90/ANSI/BHMA A156.10-1985, Power-operated Pedestrian Doors.

.K CAN/CGSB-69.28-M90/ANSI/BHMA A156.12-1986, Interconnected Locks and Latches.

.L CAN/CGSB-69.29-M90/ANSI/BHMA A156.13-1980, Mortise Locks and Latches.

.M CAN/CGSB-69.30-M90/ANSI/BHMA A156.14-1985, Sliding and Folding Door Hardware.

.N CAN/CGSB-69.31-M89/ANSI/BHMA A156.15-1981, Closer/Holder Release Device.

.O CAN/CGSB-69.32-M90/ANSI/BHMA A156.16-1981, Auxiliary Hardware.

.P CAN/CGSB-69.33-M90/ANSI/BHMA A156.17-1987, Self-closing Hinges and Pivots.

.Q CAN/CGSB-69.34-M90/ANSI/BHMA A156.18-1984, Materials and Finishes.

.R CAN/CGSB-69.35-M89/ANSI/BHMA A156.19-1984, Power Assist and Low Energy Power Operated Doors.

.S CAN/CGSB-69.36-M90/ANSI/BHMA A156.20-1984, Strap and Tee Hinges and Hasps.

.T All hardware to be designed and installed in conformance to the requirements of the British Columbia Building Code. This facility is not designed for the disabled

PART 2 PRODUCTS

2.01 MANUFACTURERS

.A MANUFACTURERS

.B Refer to drawing A-014 Door Schedule.

.C Hardware sets indicated are used to indicate level of quality. Subject to compliance with requirements, provide products by one of the following:

.D Hinges

.1 Hager Hinge Co.

.2 McKinney Products Co.

.3 Stanley Hardware, Div. Stanley Works.

.4 All hinges shall be heavy duty, ball bearing type 7 non removable pin when hinge is exposed to exterior. Use stainless steel butts in all process locations and in all damp locations .

.E Lock Cylinders and Key Control System

.1 Sargent Lock Corp. 10 line, with lever handles

.2 Lock and Latch Sets

.3 Sargent Lock Corp. 10 line, with lever handles

.F Bolts

.1 Glynn-Johnson Corp.

.2 Hager Hinge Co.

.G Stanley Hardware, Div. Stanley Works.

.H Exit/Panic Devices

.1 Corbin & Russwin Architectural Hardware, Div. Black & Decker Corp.

.2 Von Duprin, Div. Ingersoll-Rand Door Hardware Group.

.I Push/Pull Units

.1 Baldwin Hardware Corp.

.2 Corbin & Russwin Architectural Hardware, Div. Black & Decker Corp.

.3 Hager Hinge Co.

.4 Pulls shall be type 4009. Pushes to be type 82 anodized alum. 0.625 material

.J Overhead Closers (10-year warranty type)

.1 LCN, Div. Ingersoll-Rand Door Hardware Group.

.2 Door Control Devices

.3 Baldwin Hardware Corp.

.4 Corbin & Russwin Architectural Hardware, Div. Black & Decker Corp.

.5 Glynn-Johnson Corp.

.6 Hager Hinge Co.

.K Thresholds

.1 Zero International, Inc.

.L Padlock

.1 Best Lock Type 41B772.

2.02 MATERIALS AND FABRICATION

.A Base Metals: Produce hardware units of basic metal and forming method indicated using manufacturer's standard metal alloy, composite on, temper, and hardness, but in no case of lesser (commercially recognized) quality than specified for applicable hardware units for finish designations indicated.

.B Fasteners: Provide hardware manufactured to conform to published templates, generally prepared for machine screw installation. Do not provide hardware that has been prepared for self-tapping sheet metal screws, except as specifically indicated.

.C Furnish screws for installation with each hardware item. Provide Phillips flat-head screws except as otherwise indicated. Finish exposed (exposed under any condition) screws to match hardware finish or, if exposed in surfaces of other work, to match finish of this other work as closely as possible including "prepared for paint" surfaces to receive painted finish.

.D Provide concealed fasteners for hardware units that are exposed when door is closed except to the extent no standard units of type specified are available with concealed fasteners. Do not use thru-bolts for installation where bolt head or nut on opposite face is exposed in other work unless their use is the only means of reinforcing the work adequately to fasten the hardware securely. Where thru-bolts are used as a means of reinforcing the work, provide sleeves for each thru-bolt or use sex screw fasteners.

2.03 HINGES

.A Templates: Provide only template-produced units.

.B Screws: Provide Phillips flat-head screws complying with the following requirements:

.1 For metal doors and frames install machine screws into drilled and tapped holes.

.2 For fire-rated wood doors install #12 x 32 mm, threaded-to-the-head steel wood screws.

.3 Finish screw heads to match surface of hinges.

.C Hinge Pins: Except as otherwise indicated, provide hinge pins as follows:

.1 Out-Swing Exterior Doors: Nonremovable pins.

.2 Tips: Flat button and matching plug, finished to match leaves.

.D Continuous steel hinge by Stanley.

.E Number of Hinges: Provide not less than 3 hinges per door leaf for doors 2.2 m or less in height and one additional hinge for each 0.75 m of additional height.

2.04 LOCK CYLINDERS AND KEYING

.A Equip locks with cylinders for 7-pin interchangeable-core pin tumbler inserts. Furnish only temporary inserts for the construction period, and remove these when directed.

.1 Furnish one complete set of keys and change key directly to Owner.

.2 Coordinate additional construction key requirements with Contractor.

.B Metals: Construct lock cylinder parts from brass or bronze, stainless steel, or nickel silver.

2.05 LOCKS, LATCHES, AND BOLTS

.A Operating Mechanism: Provide mortise style locks, latches, and bolts that meet ANSI A156.13, Series 1000, Grade 1 heavy duty.

.B Strikes: Provide manufacturer's standard wrought box strike for each latch or lock bolt, with curved lip extended to protect frame, finished to match hardware set, unless otherwise indicated.

.1 Provide flat lip strikes for locks with 3-piece, antifriction latchbolts as recommended by manufacturer.

.2 Provide recess type top strikes for bolts locking into head frames, unless otherwise indicated.

.3 Provide dust-proof strikes for foot bolts, except where special threshold construction provides nonrecessed strike for bolt.

.C Lock Throw: Provide 16 mm minimum throw of latch on pairs of doors. Comply with UL requirements for throw of bolts and latch bolts on rated fire openings.

.1 Provide 19 mm minimum throw of latch for mortise locks. Provide 1-inch minimum throw for all dead bolts.

.D Flush Bolt Heads: Minimum of 12 mm-diameter rods of brass, bronze, or stainless steel with minimum 300 mm-long rod for doors up to 84 inches in height. Provide longer rods as necessary for doors exceeding 84 inches in height.

.E Trim: Provide the following:

.1 Handle: Solid round bar type with return.

.2 Rose: 75 mm round cast rose.

.F Padlocks are to be provided for Overhead Doors.

2.06 CLOSERS AND DOOR CONTROL DEVICES

.A Size of Units: comply with the manufacturer's recommendations for size of door control unit depending on size of door, exposure to weather, and anticipated frequency of use.

.1 Provide parallel arms for all overhead closers, except as otherwise indicated.

.2 Provide metal cover box for surface mounted closers.

.B Provide overhead concealed stop.

.C Provide grey resilient parts for exposed bumpers.

2.07 WEATHERSTRIPPING AND SEALS

.A Provide continuous weatherstripping on exterior doors. Provide noncorrosive fasteners.

.B Weatherstripping at Jambs and Heads: Provide bumper-type resilient insert and metal retainer strips, surface applied, and of the following metal, finish, and resilient bumper material:

.1 Extruded aluminum with natural anodized finish, 1.6 mm minimum thickness of main walls and flanges.

.2 Expanded neoprene: Cellular rubber conforming to ASTM D 1056 Type 2 (closed-cell); Class B (low-swell, oil-resistant); Grade 2 (compression-deflection of 35-62 kPA); and self-extinguishing in following size:

.3 6mm x 19 mm.

.C Weatherstripping at Door Bottoms: Provide threshold consisting of contact-type resilient insert and metal housing of design and size shown and of following metal, finish, and resilient seal strip:

.1 Extruded aluminum with natural anodized finish, 1.6 mm minimum thickness of main walls and flanges.

.2 Solid neoprene wiper or sweep seal complying with MIL R 6855, Class II, Grade 40

2.08 THRESHOLDS

.A Provide metal threshold units.

.B Exterior Hinged: Provide units not less than 100 mm wide, formed to accommodate change in floor elevation and to comply with the ADAAG, fabricated to accommodate door hardware and to fit door frames.

2.09 HARDWARE FINISHES

.A Provide quality of finish, including thickness of plating or coating (if any), composition, hardness, and other qualities complying with manufacturer's standards, but in no case less than specified by referenced standards for the applicable units of hardware.

.B The designations used in schedules and elsewhere to indicate hardware finishes are the industry-recognized standard commercial finishes, except as otherwise noted.

.C Finish: stainless steel US32D unless indicated otherwise.

PART 3 EXECUTION

3.01 INSTALLATION

.A Mount hardware units at heights indicated in following applicable publications, and to comply with governing regulations.

.1 "Recommended Locations for Builders Hardware for Standard Steel Doors and Frames" by the Door and Hardware Institute.

.B Install each hardware item in compliance with the manufacturer's instructions and recommendations. Where cutting and fitting is required to install hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation or application of surface protection with finishing work specified in the Division 9 Sections.

.C Do not install surface-mounted items until finishes have been completed on the substrates involved.

.D Set units level, plumb, and true to line and location. Adjust and reinforce the attachment substrate as necessary for proper installation and operation.

.E Set thresholds for exterior doors in full bed of butyl-rubber or polyisobutylene mastic sealant.

.F Weatherstripping and Seals: Comply with manufacturer's instructions and recommendations to the extent installation requirements are not otherwise indicated.

3.02 ADJUSTING, CLEANING, AND DEMONSTRATING

.A Adjust and check each operating item of hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate freely and smoothly or as intended for the application made.

.1 Where door hardware is installed more than one month prior to acceptance or occupancy of a space or area, return to the installation during the week prior to acceptance or occupancy and make final check and adjustment of all hardware

items in such space or area. Clean operating items as necessary to restore proper function and finish of hardware and doors. Adjust door control devices to compensate for final operation of heating and ventilating equipment.

.B Clean adjacent surfaces soiled by hardware installation.

.C Instruct Owner's personnel in the proper adjustment and maintenance of door hardware and hardware finishes.

END OF SECTION

SECTION 08800
GLASS AND GLAZING

GENERAL

1.01 GENERAL REQUIREMENTS

.A General Conditions, Supplementary Conditions and Division 01 apply to this Section.

1.02 SUMMARY

.A Section includes:

.1 Glass and glazing for aluminum windows.

.2 Glazing sealants.

.3 Door Glazing.

.B Related Sections:

.1 Section 06200 – Finish Carpentry

.2 Section 08110 – Steel Doors and Frames

1.03 REFERENCES

.A American Society for Testing and Materials (ASTM)

.1 ASTM B221 – Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles and Tubes

.2 ASTM D2000 – Standard Classification System for Rubber Products

.B Canadian General Standards Board (CGSB)

.1 CAN/CGSB 12.1 – Tempered or Laminated Safety Glass

.2 CAN/CGSB 12.5 – Mirrors, Silvered

.3 CAN/CGSB 12.8 – Insulating Glass Units

.4 CAN/CGSB 12.9 – Spandrel Glass

.5 CAN/CGSB 12.11 – Wired Safety Glass

.6 CAN/CGSB 19.13 – Sealing Compound, One-Component, Elastomeric, Chemical Curing

.7 CAN/CGSB 19.18 – Sealing Compound, One-Component, Silicone Base, Solvent Curing

.C National Building Code (NBC)

.D National Fire Protection Institute (NFPA)

.E Provincial Building Codes (where applicable in Ontario, Alberta and British Columbia).

1.04 SUBMITTALS

.A Section 01300 - Submittals: Procedures for submittals.

1.05 QUALITY ASSURANCE

.A Conform to FGMA (Flat Glass Marketing Association) Glazing Manual for glazing installation methods.

.B Conform to the requirements of the latest CAN/CGSB and ASTM Standards and the Local Building Code.

.C Provide permanent labelling for safety glass indicating conformance with specified standards.

PRODUCTS

1.06 GLASS MATERIALS

.A Clear tempered Float Glass: Fully tempered float glass, clear, conforming to CAN/CGSB 12.1, Type 2, Tempered Glass, Class B – Float Glass. Tempering shall be performed using horizontal tong-free method.

.1 Thickness: 1/4”, unless indicated otherwise.

.2 Location: Interior glazing.

.3 Identification: Each unit of tempered glass shall be permanently identified by the manufacturer. The identification shall be etched or ceramic fired on the glass and be visible when the unit is glazed.

.B Tinted Tempered Float Glass: Fully tempered float glass, tinted, and conforming to CAN/CGSB 12.1, Type 2, Tempered Glass, Class B - Float Glass. Tempering shall be performed using horizontal tong-free method.

.1 Thickness: 1/4”, unless indicated otherwise.

.2 Colour: shall be selected by Consultant.

.3 Location: Provide at exterior glazing locations as indicated on drawings.

.4 Identification: Each unit of tempered glass shall be permanently identified by the manufacturer. The identification shall be etched or ceramic fired on the glass and be visible when the unit is glazed.

.C Insulated Units: Double pane units with inner pane of tempered float glass and outer pan of tinted tempered float glass. Conforming to CAN/CGSB 12.8 and CAN/CGSB 12.1.

.1 Glass Thickness: 1/4”, unless indicated otherwise.

.2 Colour: shall be selected by Consultant.

.3 Unit Thickness: 1” thick units. 1/4” thick, clear inner panes. 1/4” thick, tinted outer panes. 1/2” air space between.

.4 Location: Provide at exterior glazing locations as indicated on drawings.

.5 Identification: Each unit of tempered glass shall be permanently identified by the manufacturer. The identification shall be etched or ceramic fired on the glass and be visible when the unit is glazed.

1.07 GLAZING COMPOUNDS

.A Polyurethane Sealant: One component, chemical curing, non-sagging type; cured Shore A hardness of 15-25. Conforming to CAN/CGSB 19.13, Dymonic by Tremco.

.B Silicone Sealant: Single component, chemical curing; capable of water immersion without loss of properties; non-bleeding, non-staining; cured Shore A hardness of 15-25. Conforming to CAN/CGSB-19.13, 'Spectrum II' by Tremco. Colour clear.

.C Acrylic terpolymer compounded especially for glazing; non-hardening, non-staining, and non-bleeding.

1.08 GLAZING ACCESSORIES

.A Setting Blocks: EPDM or neoprene of 80 to 90 Shore A durometer hardness; compatible with glazing sealant.

.B Spacers: Resilient blocks of 40 to 50 Shore A durometer hardness; self adhesive on one side; compatible with glazing sealant.

.C Filler Rods: Closed cell or jacketed foam rods of polyethylene, butyl, neoprene, polyurethane, or vinyl; compatible with glazing sealant.

.D Joint Cleaners, Primers, and Sealers: As recommended by glazing sealant manufacturer.

.E Gaskets: ASTM D2000, SBC 415 to 3BC 620; extruded or moulded neoprene or EPDM, black.

.F Aluminum Glazing Channels and Posts: Extruded aluminum glazing channels and posts of alloy 6063-T52 conforming to ASTM B221 with clear anodized finish, sized to suit glazing, by Julius Blum & Company Inc.

.1 Sealant: One component, silicone rubber type sealant conforming to CAN/CGSB-19.18.

EXECUTION

1.09 EXAMINATION

.A Verify surfaces of glazing channels or recesses are clean, free of obstructions, and ready for work of this Section.

.B Beginning of installation means acceptance of substrate.

1.10 PREPARATION

.A Clean contact surfaces' prime or seal where recommended by sealant manufacturer for intended application.

.B Inspect glass edges immediately prior to setting' discard those with edge damage that will contribute to glazing failure.

1.11 ALUMINUM WINDOWS

.A Aluminum: Extruded to CSA HA.5M, alloy 6063 T5; sheet to CSA HA.4M, alloy 0.1100.

.B Sealant: In accordance with Section 07 9200.

.C Fasteners: Stainless steel or cadmium plated steel and in accordance with AAMA 76 specifications to suit base metal in which they occur.

.D Glazing Gaskets: Dense EPDM, Durometer 50, Shore A to ASTM C509.

.E Glass, Setting Blocks and Tapes: In accordance with Section 08800.

.F Fibreglass Insulation: Packing insulation to CSA A101, Type 1.

.G Acceptable Manufacturer: Shall be based on Kawneer Windows c/w manufacturer's companion deflection headers and custom breakshape trims as selected by Consultant.

.H FINISH

.1 Ferrous Metals: Clean, degrease and apply shop coat of primer.

.2 Aluminum:

.a Clear Anodic Coating: AAM10C22 A31, Class II.

1.12 GLAZING

.A Locate setting blocks at quarter points of sill; set in sealant if heel or toe bead is required.

.B Install spacers inside and out except where pre-shimmed tape or glazing gaskets are to be used.

.C Set each piece in a series to other pieces in pattern draw, bow, or other visually perceptible characteristics.

.D Provide glazing sealants and gaskets as required for particular glazing application. Co-ordinate with other Sections for material compatibility.

.E Gaskets:

.1 Provide adequate anchorage, particularly for driven-in wedge gaskets.

.2 Mitre and weld ends of channel gaskets at corners to provide continuous gaskets.

.3 Seal face gaskets at corners with sealant to close opening and prevent withdrawal of gasket from corners.

.F Do not leave voids in glazing channels except as specifically indicated or recommended by glass manufacturer. Force sealant into channel to eliminate voids. Tool exposed surfaces to slight wash away from joint. Trim and clean promptly.

.G Do not allow sealant to close weeps of aluminum framing.

.H Provide filler rod where sealants are used in the following locations:

.1 Head and jamb channels.

.2 Coloured glass over 75 united inches in size.

.3 Clear glass over 125 united inches in size.

1.13 WINDOW FABRICATION

.A Shop fabricate aluminum windows in accordance with manufacturer's details and reviewed shop drawings. Build square, true, accurate to size, free from defects detrimental to appearance and performance.

.B Machine all joints, corners, mitres accurately. Fit to provide rigid weathertight and waterproof assembly. Hide mechanical fasteners in completed installation.

.C Obtain all dimensions from site. Fabricate aluminum windows in largest practical size for handling, transport and installation. Trial assemble in shop and match mark for field assembly.

.D Punch sill members on face of exterior leg at 600 mm (24”) o.c. to provide drainage of glazing channel.

.E Provide glazing stops of continuous length corner to corner and neatly fitted at corners.

.F Seal all shop fabricated assemblies weathertight and watertight. Build in weep holes to divert moisture to exterior. Build in weathertight and waterproof thermal movement capabilities. Design aluminum windows to drain glazing pocket.

.G Provide and install all brackets, clips, fastenings, anchors, etc., for fabrication and assembly. Type, size, quantity and spacing of all fasteners to suit specified standards. Ship loose items required for field installation.

.H Provide all sills, flashings, trim, closures and caps required to complete field installation. Fabricate sills and flashing to be continuous without joints. Fabricate sills from a minimum 3.0 mm thick material.

.I Back-paint all surfaces in contact with concrete, masonry, mortar, plaster or other dissimilar materials with approved bituminous protective paint.

.J Colour as indicated on drawings.

1.14 CLEANING

.A Immediately prior to Owner acceptance of Project, replace broken or otherwise damaged glass. Wash and polish glass inside and out.

.B Remove excess sealants and primer stains from finished surfaces.

.C After approval of glass, remove all manufacturers' labels from glass.

END OF SECTION

DIVISION 9
FINISHES

09260	Gypsum Board Systems
09675	Resinous Flooring
09900	Painting

SECTION 09260
GYPSUM BOARD SYSTEMS

GENERAL

1.01 GENERAL REQUIREMENTS

.A General Conditions, Supplementary Conditions and Division 01 apply to this Section.

1.02 SUMMARY

.A Section includes:

.1 Metal wall framing.

.2 Gypsum board.

.3 Gypsum sheathing.

.4 Cementitious board.

.5 Soffit vents.

.6 Taped and sanded joint treatment.

.B Related Sections:

.1 Section 04200 – Masonry

.2 Section 05400 – Cold Formed Metal Framing

.3 Section 06100 – Rough Carpentry

.4 Section 07210 – Building Insulation

.5 Section 07270 – Firestopping and Smoke seals

.6 Section 07900 – Joint Sealants

.7 Section 08110 – Steel Doors and Frames

.8 Section 09900 - Painting

1.03 REFERENCES

.A American Society for Testing and Materials (ASTM)

.1 ASTM C442 – Standard Specification for Gypsum Backing Board, Gypsum Coreboard and Gypsum Shaftliner Board

.2 ASTM C475 – Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board

.3 ASTM C840 – Standard Specification for Application and Finishing of Gypsum Board

.4 ASTM C1177 – Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing

.5 ASTM C1396 – Standard Specification for Gypsum Board

.6 ASTM F1267 – Standard Specification for Metal, Expanded, Steel

.B Standards Council of Canada / Underwriters Laboratories of Canada (CAN/ULC)

.1 CAN/ULC-S102 – Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies

.2 CAN/ULC-S102.2 – Method of Test for Surface Burning Characteristics of Flooring, Floor Coverings and Miscellaneous Materials and Assemblies

.C Canadian Standards Association (CSA)

.D National Building Code (NBC)

.E Provincial Building Codes (where applicable in Ontario, Alberta and British Columbia).

.F Underwriters Laboratories of Canada (ULC)

1.04 SUBMITTALS

.A Section 01300 – Submittals: Procedures for Submittals.

.B Section 01700 – Contract Closeout: Procedures and documents required for partial and full occupancy.

.C Submit Shop Drawings, stamped, signed and dated by the professional Engineer within twenty-one (21) Working Days of award of Contract.

.D Letter of Conformance: Submit one (1) copy of Letter of Conformance form at end of this Section twenty-one (21) Working Days of award of Contract.

1.05 QUALITY ASSURANCE

.A The Contractor executing work of this Section shall have a minimum of five (5) years continuous Canadian experience in successful installation of work of type and quality shown and specified. Submit proof of experience upon Consultant's request.

.B Submit shop drawings, stamped, signed and dated by the professional Engineer responsible for the design in accordance with General Conditions, construction and relevant details of furring, enclosures, bulkheads and partitions, including those which require a fire resistance rating.

.C Gypsum Wallboard products containing fly ash are not acceptable.

1.06 DELIVERY, STORAGE, HANDING AND PROTECTION

.A Co-ordinate deliveries to comply with construction schedule and arrange ahead for off the ground, under cover storage location. Do not load any area beyond the design limits.

.B Materials shall be carefully checked, unloaded, stored and handled to prevent damage. Protect materials with suitable non-staining waterproof coverings.

.C Store materials in original, undamaged containers or wrappings with manufacturer's seals and labels intact.

.D Protect bagged products from excessive moisture or wetting. Store metal component sections in crates to prevent damage to material. Do not use bent or deformed material.

.E Stack gypsum board flat to prevent sagging.

1.07 ENVIRONMENTAL REQUIREMENTS

.A Do not begin work of this Section until substrate and ambient air temperature is above 15°C and relative humidity is below 80%.

PRODUCTS

1.08 MANUFACTURERS

.A Subject to compliance with requirements, provide gypsum board and accessories of one of the following manufacturers:

.1 CGC Inc.

.2 Certain Teed Gypsum, Canada Inc.

.3 Georgia-Pacific Canada Inc.

.4 Envirowall Partition Systems Limited

1.09 FRAMING MATERIALS

.A Studs and Tracks: Galvanized sheet steel.

.1 Normal Height Framing: 25 gauge.

.2 Framing Carried from slab-on-grade, to Underside of Deck: 20 gauge.

.3 Framing behind all Abuse Resistant Gypsum Board or Fire Resistant Gypsum Board: 20 gauge.

.4 Minimum deflection of the wall assembly shall never be less than L/240 for interior partitions.

.5 Provide knockout openings in web at 24" intervals to accommodate bracing and/or electrical or mechanical lines. Horizontal bracing to be provided at

minimum 48" spacing from slab to underside of roof.

.B Furring, Framing and Accessories: ASTM C840.

.1 Cold-Rolled Channels: 3/4 x 1/2 inch and 1-1/2 x 17/32 inch, minimum 16-ga steel.

.2 Furring Channels: 7/8 x 2-1/2 inch, 25-ga steel.

.3 Wood furring as shown on drawings.

.C Fasteners and Adhesives: ASTM C840.

1.10 GYPSUM BOARD MATERIALS

.A Standard Gypsum Board: ASTM C1396; 1/2 inch thick, maximum permissible length; ends square cut, tapered edges.

.B Fire Resistant Gypsum Board (Type X): ASTM C1396; 1/2 and 5/8 inch thick, maximum permissible lengths; ends square cut, tapered edges.

.C Exterior Sheathing Board: Glass mat faces gypsum sheathing, 1/2 inch material, in compliance with ASTM C1177, 'GlasRoc Sheathing' by Certain Teed Gypsum, Canada Inc., or 'Dens-Glass Gold' by Georgia-Pacific Canada Inc., or 'Securock Glass-Mat Sheathing' by CGC Inc.

.D Fire Resistant Exterior Sheathing Board (TypeX): Glass mat faced qypsum sheathing in compliance with ASTM C1177, 'GlasRoc Sheathing' by CertainTeed Gypsum, Canada Inc., or 'Dens-Glass Gold' by Georgia-Pacific, Canada Inc., or 'Securock Glass-Mat Sheathing' by CGC Inc. ASTM C1396; 5/8 inch thick, maximum permissible lengths; ends square cut, tapered edges.

.E Roof Board: Refer to Sections 07544 for products used for roofs board.

.F Parapets Walls: Refer to Sections 07544 for products used for parapets walls.

1.11 ACCESSORIES

.A Corner Beads: Metal or metal paper.

.B Edge Trim: 'L' shape for tight abutment at edges; 'F' shape around perimeter of aluminum windows and 'J' shape at other locations.

.C Control Joint: As recommended by the board manufacturer to suit application, to the approval of the Consultant.

.D Joint Materials: Manufacturer's standard reinforcing tape, joint compound, adhesives, and fasteners.

.E Acoustical (Sound) Insulation: See Section 07210 for unfaced batts.

.F Mesh: ASTM F1267, Type II, Class 1, hot-dip galvanized, flattened, expanded carbon steel security mesh, weighing 125 lbs. per 100 sq.ft., style – 8'-0" SWD x 4'-0" LWD, 1'-1/2" - #9F' by Expanded Metal Corporation.

.G Mesh Fasteners: Suitable self-drilling, self-tapping, corrosion-resistant metal fasteners and washers approved by Consultant.

.H Soffit Vent: Clear anodized aluminum, vented soffit moulding, Model 'DCS-625-V-600' as manufactured by Fry Reglet.

EXECUTION

1.12 METAL FRAMING INSTALLATION

.A Install studding to manufacturer's instructions and as indicated on Drawings.

.B Provide Thru-Wall Membrane Flashing under stud partitions, refer to section 05400 for materials and installation.

.C Partition Heights: Extend partitions to floor or roof structure above. Install additional bracing above ceiling.

1.13 EXTERIOR SOFFIT FRAMING INSTALLATION

.A Follow requirements for ceiling framing except as follows:

.1 Use stud, runner or angle sections in place of hanger rods or adequately brace furring system to withstand expected negative and positive wind loads without detrimental effects.

.2 Connect furring system to perimeter walls.

.3 Space cross furring members at 16" O.C.

1.14 INSTALLATION - FURRING

.A Wall furring: Erect metal furring as indicated on Drawings.

.1 Furring for fire rating: Install metal furring as required for fire resistance ratings indicated on Drawings, and to CSA, NBC, provincial building codes and ULC requirements.

.2 See Sections 06100 and 07210 for wood furring installation.

1.15 GYPSUM BOARD INSTALLTION

.A Install gypsum board in accordance with manufacturer's instructions, and ASTM C840.

.B Apply gypsum wallboard with screws. Erect wallboard with long dimension at right angles to supports. Stagger all vertical joints.

.C Double Layer Applications: Secure second layer to first with screws; apply second layer with screws. Use of adhesive only to hold second layer is prohibited.

.D Place control joints consistent with lines of building spaces, with ½ inch between boards. Apply acoustical sealant at base of space, and apply control join accessory piece at face. Place joints vertically at jamb head of double stockroom doors. Place joints in walls and ceilings at 30'-0" O.C. Place vertical joint at jamb head, latch side, of doors set in gypsum board walls.

.E Place corner beads at external corners. Use longest practical length. Place edge trim where gypsum board abuts dissimilar materials.

1.16 FIRE RESISTANT GYPSUM BOARD

.A Fire resistance rating of gypsum board assemblies and framing shall be as called for on drawings or schedules as required to conform to applicable codes and requirements of authorities having jurisdiction.

.B Appropriate ULC designs as listed in current ULC list of equipment and materials, Volume II, Building Construction, shall be placed when applicable. Extend partitions full height through ceiling space unless otherwise noted on drawings.

.C Vertical bulkheads in ceiling spaces over fire rated glazed partitions, doors and the like shall have same fire rating as the door or partition over which they occur. All such bulkheads shall be of drywall construction unless otherwise noted.

.D Use fire rated gypsum board as specified.

.E Use ULC listed adhesive for multi-layer construction.

.F Where lighting fixtures, diffusers, and the like are recessed into fire rated ceilings or bulkheads, provide enclosure to maintain required fire rating. Form removable panel to give access to fixture outlet box.

.G Where fire hose cabinets or other fixtures or equipment are recessed in fire rated walls or partitions, provide drywall enclosure or backing to maintain required fire rating, unless otherwise detailed.

1.17 EXTERIOR SHEATHING BOARD

.A Install exterior sheathing board to areas indicated on drawings in strict accordance with manufacturer's written instructions. Seal all cut edges, ends, utility holes and fastener heads, as recommended by manufacturer.

.B Co-ordinate installation of exterior wallboard with Sections 04220, 05400, 07195 and 07244.

.C Tape and fill all joints and fastener heads using materials recommended by exterior sheathing board manufacturer.

1.18 JOINT TREATMENT

.A Tape, fill, and sand exposed joints, edges, and corners to produce smooth surface ready to receive finishes. Feather coats onto adjoining surfaces.

.B Taping, filling, and sanding are not required at non-rated locations specifically shown on Drawings.

.C Sand after second and third applications of joint compound.

END OF SECTION

SECTION 09675
RESINOUS FLOORING

GENERAL

1.01 GENERAL REQUIREMENTS

.A General Conditions, Supplementary Conditions and Division 01 apply to this Section.

1.02 SUMMARY

.A Section includes:

.1 Slab preparation requirements.

.2 Epoxy resin floor finish system (RF) and cove base (RFC) as indicated on drawings.

.B Related Sections:

.1 Section 03300 – Cast-In-Place Concrete

.2 Section 07900 – Joint Sealants

1.03 SUBMITTALS

.A Section 01300 - Submittals: Procedures for.

.B Samples: Provide four (4) 6" x 6" samples for flooring in colour and texture specified for approval prior to installation.

1.04 QUALITY ASSURANCE

.A Installer Qualifications:

.1 Coatings shall be applied by manufacturer's franchised applicator and Subcontractor executing work of this Section shall employ installers having a minimum of five (5) years continuous Canadian experience in successful installation of work of type and quality shown and specified. Submit proof of experience upon Consultant's request.

.2 Installer shall have applied a minimum fifteen (15) resinous flooring applications within the last three (3) years similar in type and size to Work of this Contract.

.3 Assign experienced applicators from previous applications, including lead applicator.

.B Manufacturer Certification:

.1 Provide letter of certification from flooring manufacturer stating that installer is an Approved Applicator of flooring system and is familiar with proper procedures and installation requirements required by manufacturer.

.C Regulatory Requirements:

.1 The National Building Code of Canada (latest edition).

.2 Local building code.

.3 Health Act Regulations and Requirements and to the approval of local authorities having jurisdiction.

.D Obtain primary epoxy flooring materials including primers, resins, hardening agents, finish or sealing coats from a single manufacturer with not less than ten (10) years of successful experience in manufacturing and installing principal materials described in this section. Provide secondary materials only of type, and from source recommended by manufacturer of primary materials. Manufacturer must be ISO 9002 certified.

.E Field Samples:

.1 Apply a 2'-0" square resinous flooring system sample of colour and texture to floor at location indicated by Owner's Construction Manager.

.2 Obtain sample approval from Owner's Construction Manager before beginning flooring systems application.

.3 Maintain approved sample floor area during flooring system application as a standard for quality of application of completed flooring system.

.4 Do not alter, move, or destroy sample areas until flooring system application is accepted by Owner's Construction Manager.

1.05 SYSTEM DESCRIPTION

.A Epoxy resin floor system, nominal 3/16" thick system comprised of:

.1 Primer.

.2 Trowelled mortar base.

.3 Undercoat - self-levelling matrix.

.4 Quartz Aggregate.

.5 UV resistant epoxy sealer.

1.06 DELIVERY, STORAGE, AND HANDLING

.A Deliver, store, protect and handle products in accordance with manufacturer's recommendations. Flooring contractor will check material for completeness and shipping damage prior to job start.

.B 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.

.C Store materials in a cool, dry, enclosed, secure area, protected from exposure to moisture for three (3) days prior to installation, in area of installation. Temperature of storage area shall be maintained between 16°C and 32°C.

.D Handle products to avoid damage to containers.

1.07 PROJECT CONDITIONS

.A Environmental Requirements:

.1 Do not apply on frozen or frost-filled surfaces. Protect material from freezing.

.2 Maintain ambient temperature of not less than 18°C and a floor temperature of not less than 16°C for seven (7) days prior to installation, during installation, and at least 48 hours after completion of work and maintain relative humidity not higher than 40% during same period.

.3 Do not apply if temperature is below 16°C or expected to fall below 16°C within 24 hours.

.4 Do not apply material during rapid and extreme changes in temperature.

.B Keep flooring area clear of other trades during installation and for 48 hours after flooring installation.

.C Moisture: Ensure substrate is within moisture limits prescribed by flooring manufacturer.

.D Safety: Comply with requirements of Workplace Hazardous Material Information System (WHMIS) regarding the use, handling, storage and disposal of hazardous materials.

1.08 WARRANTY

.A Warrant the work of this Section against defects in materials and workmanship in accordance with the General Conditions but for a period of two (2) years and agree to repair or replace faulty materials or work which become evident during warranty period without cost to the Owner. Defects shall include, but not be limited to, bond failure, inconsistencies in material or workmanship affecting the performance of the flooring system.

PRODUCTS

1.09 MANUFACTURERS

.A Manufacturer List: Products of following manufacturers are acceptable subject to conformance to requirements of Drawings, Schedules and Specifications:

.1 “Stonshield HRI” by Stonhard contact Dana Gabrielow, telephone 800-263-3112.

.2 'Kromoquartz SLD Broadcast' by Niagara Protective Coatings, contact Dean Karachi, telephone 1-800-461-1672.

.3 ‘Sikafloor Quartzite HDB Blend”, by Sika Canada Inc., contact (Ontario- Nellie Vila-LeGare 1-905-795-3177 Ext: 4493, Cell: 1-416-889-7003,Western Canada – Marv Megley 1-780-486-6111) (Central Canada – Tom Grella 416-684-5912) and (Eastern Canada Richard LaPointe 1-514-268-0695).

.4 'Neo-Quartz 190 BC' by Neogard, contact Ken Mackey, telephone 780-469-3336.

.5 “MasterTop 1254” by BASF Performance Flooring, contact Matt Kunkel, telephone 416-997-0721.

.B These specifications are based on the Resinous Flooring System 'Stonshield HRI' as manufactured by Stonhard. Comparable Products from manufacturers listed herein will be accepted provided they meet requirements of this Specification.

1.10 MATERIALS

.A 100% solids, 0 VOC, 3/16" thick system comprised of a penetrating, two-component epoxy primer, three-component trowelled mortar consisting of epoxy resin, curing agent and finely graded non-silica aggregate, two-component, epoxy undercoat, brightly coloured, quartz silica aggregate broadcast and a high performance, two-component, clear epoxy sealer.

.1 Colour (RF): as selected by Consultant from manufacturers standard colour range.

.B Texture: Stonhard medium texture.

.C Primer: ‘Standard Primer’ by Stonhard.

.D Trowelled Mortar: ‘Stonshield HRI Base’ by Stonhard.

.E Undercoat: ‘Stonshield Undercoat’ by Stonhard.

.F Broadcast: ‘Stonshield Aggregate’ by Stonhard.

.G Sealer: ‘Stoneshield Sealer’ by Stonhard.

.H Joint Sealant: ‘Stonflex MP7’ with ‘Stonflex MP7 Surface Treatment’ by Stonhard. Colour shall be Beeachwood.

EXECUTION

1.11 EXAMINATION

.A Verify that concrete surfaces are smooth and flat with maximum variation of 1/4 inch in 10 ft., and are ready to receive work of this Section.

.B Verify concrete floors have properly cured in accordance with coating manufacturer's requirements and as specified herein.

.C Verify floor is free of substances that may impair adhesion of adhesive and finish materials. Verify that floors are dry, and exhibit negative alkalinity, carbonisation or dusting.

.D If concrete is unacceptable to flooring manufacturer, advise Consultant immediately.

.E Beginning of coating application means acceptance of substrate.

1.12 PREPARATION

.A Prepare concrete substrate by mechanical means by using a shot blast machine for removal of bond inhibiting materials such as curing compounds or laitance.

.B Acid etching as a preparation will not be permitted.

.C Provide depression in concrete slab around floor drains for thickened resinous flooring edge at floor drain, as indicated on drawings.

.D Vacuum clean substrate.

1.13 APPLICATION

.A Manufacturer's representative must be on job site at start of installation.

.B General: Apply each component of epoxy flooring system in compliance with manufacturer's directions to produce a uniform monolithic wearing surface of thickness indicated, uninterrupted except at divider strips, sawed joints or other types of joints (if any), indicated or required.

.C Primer: Mix and apply primer over properly prepared substrate with strict adherence to manufacturer's written installation procedures and coverage rates. Co-ordinate timing of primer application with application of trowelled mortar to ensure optimum adhesion between epoxy flooring materials and substrate.

.D Trowelled Mortar: Mix mortar materials according to manufacturer's written instructions. Uniformly spread mortar over substrate using manufacturer's specially designed screen box adjusted to manufacturer's recommended height. Hand trowel or power trowel apply mixed material over freshly primed substrate using stainless steel finishing trowels.

.E Undercoat: Remove any surface irregularities by lightly abrading and vacuuming the floor surface. Mix and apply undercoat with strict adherence to manufacturer's installation procedures and coverage rates.

.F Broadcast:

.1 Immediately broadcast quartz silica aggregate into the undercoat using

manufacturer's specially designed spraycaster. Strict adherence to manufacturer's installation procedures and coverage rates is imperative.

.2 Mix and apply Sealer to a total dry film thickness of floor system of 3/16” (5mm). During installation, the Owner’s Construction Manager may ask the resinous flooring system installer to take a core sample from a location randomly selected by the Owner’s Construction Manager to verify 3/16” thickness. Patch core holes.

.3 Provide non-skid texture, as indicated on drawings. Owner’s Construction Manager will inspect and approve floor surfaces for appropriate texture.

.G Sealer: Remove any surface imperfections by lightly abrading and vacuuming the floor surface. Mix and squeegee apply sealer with strict adherence to manufacturer's installation procedures and coverage rates.

.H Terminate floors that do not abut against a vertical surface with a 1/2" - 3/4" wide by 1/4" deep chase.

.I Where resinous flooring meets other flooring, feather edge to be flush with adjacent flooring.

.J Cove Base (RFC): Install 3/4” radius, cove base integral with the floor at heights indicated, and locations shown on drawings. All coves shall be capped with manufacturer's specialty designed cove strip. Hand sand base and cove to create smooth surface prior to application of final top coats.

.K Provide saw cut control joints in locations shown on Structural Drawings and/or installed in concrete floor slab.

.L Joint Sealant: Install manufacturer's CFIA approved flexible epoxy or urethane sealant compatible with floor finish.

1.14 FIELD QUALITY CONTROL

.A Inspect resinous flooring installation for scheduled material, colour, specified thickness and coverage.

.B Correct deficiencies in Work which inspection indicates are not in compliance with Contract requirements.

.C Manufacturer's Representative Inspection: Provide inspection by manufacturer's technical representative for the following:

.1 Concrete slab substrate preparation, prior to flooring installation.

.2 Initial flooring installation procedures.

.3 Completion of installation.

.D Manufacturer's Representative Inspection Report: Provide report of inspection describing installation deficiencies to Contractor and Owner's Construction Manager.

1.15 CURING, PROTECTION AND CLEANING

.A Dispose of in separate, closed, metal containers in accordance with applicable regulations.

.B Job area to be free of other trades during, and for a period of 48 hours after floor installation.

.C Cure epoxy flooring materials in compliance with manufacturer's written 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.

.D Protect epoxy flooring materials 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. Contractor is responsible for protection and cleaning of surfaces after final coats.

.E Remove temporary covering and clean epoxy flooring just prior to final inspection. Use cleaning materials and written procedures recommended by epoxy flooring manufacturer.

END OF SECTION

SECTION 09900
PAINTING

PART 1 GENERAL

1.01 GENERAL REQUIREMENTS

.A General Conditions, Supplementary Conditions and Division 01 apply to this Section.

1.02 SUMMARY

.A Section includes:

.1 Surface preparation and field application of paints and finishes for interior and exterior surfaces.

.2 Painting and finishing schedules.

.B Related Sections:

.1 Section 01010- Summary of Work: review of exterior painting project scope by Sherwin Williams.

.2 Read carefully all other Sections of specifications to determine extent of prime and finish coats applied by others.

.3 See Sections in Division 5 for extent of shop coating for metal work.

.4 See Division 15: Mechanical and Division 16: Electrical for instructions on painting work of those Divisions.

.5 Do not paint copper, aluminum, stainless steel, bronze, brass, nickel, anodized and plated finishes, baked enamel finishes, glazing, rubber, asphalt, vinyl or acoustical tile surfaces, unless specifically noted otherwise.

1.03 REFERENCES

.A American Society for Testing and Materials (ASTM)

.1 ASTM D4260 – Standard Practice for Liquid and Gelled Acid Etching of Concrete

.B Master Painter's Institute (MPI)

.C Society for Protective Coatings (SSPC)

.1 SSPC-SP13/NACE 6 – Surface Preparation of Concrete

1.04 SUBMITTALS

.A Section 01300 – Submittals: procedures for Submittals.

.B Letter of Conformance: Submit one (1) copy of Letter of Conformance form at end of this Section within twenty-one (21) Working Days of award of Contract.

.C Samples:

.1 Submit two 12” x 12” samples of each colour and sheen with formulae written on back of sample for approval by Consultant. Samples without formulae will not be accepted and will be rejected.

1.05 QUALITY ASSURANCE

.A Qualification of Manufacturer:

.1 The paint products of the paint manufacturer shall be as listed in the Master Painter’s Institute (MPI) manual, latest edition, under “Paint Product Recommendation” section, premium grade.

.B Qualifications of Applicators:

.1 Contractors shall have minimum of five (5) years proven satisfactory painting experience of projects of similar size and nature subject to Consultant’s approval. Work shall be executed by journeymen having provincial tradesmen qualification certificate of proficiency and under the full time supervision of a qualified representative of the Contractor. Representative shall be thoroughly conversant with the requirements of the specification, schedules, drawings, Master Painter’s Institute Architectural Painting Specification Manual as well as the applicable VOC regulations.

1.06 DELIVERY, STORAGE, HANDLING AND PROTECTION

.A Paint orders to the manufacturer or supplier shall identify the store number, location and address of project. Contractor shall require a record keeping account be established and maintained by the paint supplier which records each paint type, brand, colour, sheen and quantity purchased, for each specific project.

.B Deliver paint materials in sealed original labelled containers, bearing manufacturer’s name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, clean-up requirements, colour designation and instructions for mixing and/or reducing.

.C Provide adequate storage facilities. Store paint materials at minimum ambient temperature of 7°C in well ventilated area and as required by manufacturer’s written instructions.

.D Prevent fire hazards and spontaneous combustions.

1.07 ENVIRONMENTAL REQUIREMENTS

.A Apply paint finishes only when moisture content of surfaces is within acceptable ranges for type of finish being applied.

.B Ensure surface temperatures or surrounding air temperature is above 5°C before applying alkyd finishes; above 7°C for interior latex, and 10°C for exterior latex work. Minimum varnish and transparent finishes is 18°C.

.C Provide adequate continuous ventilation and sufficient heating facilities to maintain temperatures above 7°C for 24 hours prior to, during and 48 hours after application of finishes.

.D Do not apply paint in areas where dust is being generated.

.E Provide lighting level in areas being painted of 80 foot candles measured mid-height at substrate surface.

PART 2 PRODUCTS

1.08 MANUFACTURERS

.A These specifications are based on products as manufactured by The Sherwin-Williams Company. Manufactures listed herein shall be accepted provided they meet the requirements of this specifications.

.1 Benjamin Moore & Co. Ltd.;

.2 ICI Paints (Canada) Inc. (Glidden/C.I.L.);

.3 Para Paints Canada Inc.;

.4 PPG Canada Inc.,

1.09 MATERIALS

.A Paint Accessory Materials: Materials not specifically indicated herein but required to achieve the finishes specified of high quality and approved manufacturer. All materials used shall be lead and mercury free and shall have low VOC content, in compliance with governing regulations of the Place of Work.

.B Paints: Ready-mixed, pigments fully ground maintaining a soft paste consistency, capable of readily and uniformly dispersing to a complete homogenous mixture.

.C Paints to have good flowing and brushing properties and be capable of drying or curing free of streaks or sags.

.D Primer and undercoat products shall be by the same manufacturer as finish coat materials.

PART 3 EXECUTION

2.01 EXAMINATION

.A Examine surfaces and adjacent areas in which work under this section is to be performed. Do not proceed with Work until unsatisfactory conditions have been corrected.

.B Starting work constitutes acceptance of the existing conditions,

2.02 **PREPARATION**

.A Procedures for preparation are for new painting and/or repainting of existing conditions except where otherwise noted.

.B Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces and conditions otherwise detrimental to formation of a durable paint film.

.C Perform preparation and cleaning procedures in accordance with paint manufacturer's published instructions for each particular substrate condition.

.1 Provide barrier coats over incompatible primers or remove and reprime as required.

.2 Remove hardware, hardware accessories, machined surfaces, plates, lighting fixtures and similar items in place and not to b painted or provide surface applied protection prior to surface preparation and painting operations. Reinstall all removed items after completion of paint work.

.3 Clean surfaces to be painted before applying paint or surface treatment. Remove oil and grease prior to mechanical cleaning.

.D Ferrous Metals: Clean ferrous surfaces that are not galvanized or shop-coated, of oil, grease, dirt, loose mill scale and other foreign substances by solvent or mechanical cleaning.

.1 Touch-up shop-applied prime coats, where damaged or bare. Clean and touch-up with same type shop primer.

.E Galvanized Surfaces: Clean free of oil and surface contaminants with non-petroleum based solvent. Apply coat of etching primer if required by paint manufacturer.

.F Cementitious Materials: Prepare cementitious surfaces to be painted by removing efflorescence, chalk, dust, dirt, grease, oils and by roughening as required to remove glaze.

.1 Determine alkalinity and moisture content of surfaces to be painted by performing appropriate tests. pH must be less than 13. If surfaces are found to be sufficiently alkaline to cause blistering and burning of finish paint, correct condition before application of paint.

.2 Do not paint over surfaces where moisture content exceeds that permitted in manufacturer's printed instructions.

.3 Minimum substrate cure is 28 days at 75°F.

.G Poured Concrete Floors: Surface must be clean, dry and in sound condition. Remove all oils, dust, grease, dirt, loose rust and other foreign material to ensure adequate adhesion.

.1 For surface preparation, refer to SSPC-SP13/NACE 6. Surfaces must be clean, dry, sound and offer sufficient profile to achieve adequate adhesion.

.2 Minimum substrate cure is 28 days at 75°F.

.3 Remove all form release agents, curing compounds, salts, efflorescence, laitance and other foreign matter by sandblasting, shotblasting, mechanical scarification, or suitable chemical means.

.4 Refer to ASTM D4260. Rinse thoroughly to achieve a final pH between 6.0 and 10.0. Allow to dry thoroughly prior to coating.

.H Gypsum Board:

.1 Prepare gypsum board surfaces to be painted by removing ridges left from tape lines, chalk, dust, dirt, grease, oils and by roughening, sanding or other means as required to achieve a flat surface.

.2 Fill minor defects with filler compound. Spot prime defects after repair.

2.03 **APPLICATIONS**

.A Apply each coat at proper consistency.

.B Where the selected finish colour requires a specific Colour Prime shade of grey, ensure that this is determined prior to commencement of priming and the correct primer colour is applied. With some bright and /or slightly transparent finish colours, such as Goldenrod, use of the correct shade of grey primer will minimize or eliminate problems achieving the correct finish colour. Contact your paint supplier for additional information and assistance.

.C Each coat of paint is to be slightly darker than preceding coat unless otherwise approved by Owner Construction Manager. Sand lightly between coats if necessary to achieve required finish.

.D Do not apply finishes on surfaces that are not sufficiently dry.

.E The number of coats and film thickness required is the same regardless of the application method. Do not apply succeeding coats until the previous coat has cured as recommended by the manufacturer.

.F Apply additional coats when undercoats, stains or other conditions show through final coat of paint until paint film is of uniform finish, colour and appearance. Give special attention to ensure that surfaces, including edges, corners, crevices, welds and exposed fasteners, receive a dry film thickness equivalent to that of flat surfaces.

.G Minimum Coating Thickness: Apply materials at not less than the manufacturer's recommended spreading rate. Provide a total dry film thickness of the entire system as recommended by the manufacturer.

.H Block Fillers: Apply block fillers to concrete masonry units at a rate to ensure complete coverage with pores filled.

.I Prime Coats: Before application of finish coats, apply a prime coat of material as recommended by the manufacturer to material that is required to be painted of finished and has not been prime coated by others. Recoat primed and sealed surfaces where evidence of suction spots or unsealed areas in first coat appears, to assure a finish coat with no burn through or other defects due to insufficient sealing.

.J Pigmented (Opaque) Finishes: Completely cover to provide an opaque, smooth surface of uniform finish, colour, appearance and coverage. Cloudiness, spotting, laps, brush marks, runs, sags or other surface imperfections will not be acceptable.

.K Transparent (Clear) Finishes: Use multiple coats to produce a glass-smooth surface film of even luster. Provide a finish free of laps, cloudiness, colour irregularity, brush marks, runs, sags, orange peel, nail holes or other surface imperfections.

.L Completed Work: Match approved samples for colour, texture and coverage. Remove, refinish, or repaint work not in compliance with specified requirements.

2.04 MECHANICAL AND ELECTRICAL EQUIPMENT

.A Replace identification markings on mechanical or electrical equipment when painted over or spattered.

.B Paint exposed piping, conduit and electrical equipment occurring in finished areas where it will be exposed to the public. Colour and texture to match adjacent surfaces.

.C Paint both sides and edges of plywood backboards for electrical equipment before installing backboards and mounting equipment on them.

.D Pre-paint gas piping prior to installation, touch-up paint after installation.

.1 Colour:

.a Roof: OSHA Standard ‘Safety Yellow’.

.b Other Areas: Match adjacent surfaces.

2.05 FIELD QUALITY CONTROL

.A Inspect painting and coating application for schedule material, colour, sheen, specified thickness (DFT) and coverage.

.B Manufacturer Services: Arrange for manufacturer’s representative to visit site at intervals during surface preparation and paint coating application to ensure proper specified surface preparation is being performed, specified Product are being used, appropriate number of coats are being applied and specified finishing procedures are being carried out.

2.06 **CLEANING**

.A As work proceeds and upon completion, promptly remove paint where spilled, splashed or spattered.

.B During progress of work keep premises free from any unnecessary accumulation of tools, equipment, surplus materials and debris.

.C Collect waste, cloths and material which may constitute a fire hazard, place in closed metal containers and remove daily from site.

.D Upon completion of work leave premises neat and clean.

2.07 **PROTECTION**

.A Protect other surfaces from paint and damage. Repair damage as a result of inadequate or unsuitable protection.

2.08 **PAINT COLOUR SCHEDULE**

.A Refer to Drawings for location of paint and colours.

2.09 **PAINT SHEEN SCHEDULE**

~~.A~~ Low Sheen:

.1 Exterior metal surfaces.

.2 Exterior hollow metal doors and frames (inside and outside surfaces).

.3 Roof Hatch (inside and outside surfaces).

.4 Interior metal railings.

.5 Metal stair stringers and handrails.

.6 Metal fixed ladders and cages.

.7 Concrete Masonry unit.

.8 Automotive Centre surfaces including Service Area, Service Pit, Toilet, Office,

.9 All surfaces to be painted where sheen is not otherwise specified.

.10 Interior hollow metal doors and frames.

.11 All surfaces to be painted where sheen is not otherwise specified.

.B Satin:

.1 Exterior insulation and finish system.

.2 Architecturally exposed steel joists and galvanized steel deck. (Refer to drawings for the extent of work at existing and new areas)

2.010 **SCHEDULE OF ITEMS TO BE PAINTED**

.A Painted finished shall be provided for, but not limited to, the following items. Refer to the "Finish Schedule" and Drawings for extent and designated finishes of areas.

.1 Exterior: All exterior surfaces shown on Drawings which may include, but are not limited to:

.a Hollow metal doors and frames.

.b Metal opening frames and trim.

.c Metal gutters (surfaces exposed from ground level).

.d Metal Fascias (vertical face).

.e Parapet walls, roof side (where roofing does not occur).

.f Roof hatch.

.g Masonry.

.2 Interior: All interior surfaces shown on Drawings which may be include, but not limited to:

.a Hollow metal doors and frames.

.b Hollow metal window frames.

.c Gypsum wallboard.

.d Exposed concrete unit masonry.

.e Metal Railings.

.f Exposed plywood.

.g Exposed mechanical ductwork, hangers and supports. (If exposed structure is scheduled to be painted) (REFER TO DWGS).

.h Exposed piping and conduit, hangers and supports. (If exposed structure is scheduled to be painted) (REFER TO DWGS).

.i Exposed fire protection piping, hangers and supports. (If scheduled to be painted) (REFER TO DWGS)

.j Exposed overhead structure including joists, girders, bridging, miscellaneous metal fabrications and deck (if scheduled to be painted) (REFER TO DWGS)

.k Metal stair stringers and handrails.

.l Exposed back of masonry.

.m Exposed back of precast concrete.

.B Do not paint the following items:

.1 Aluminum, brass, bronze, stainless steel and chrome plated steel.

.2 mechanical and electrical equipment or factory finished metal panels and trim.

.3 UL, FM and other code-required labels.

.4 Equipment identification, performance rating and name plates.

.5 Finish hardware.

2.011 **PAINTING AND FINISHING SCHEDULE (GENERAL)**

.A Refer to Section 01010 for additional requirements for exterior painting. Expansion and remodels

.B Paint Schedule provides for minimum two-coat application. Third coat may be required by Owner's Construction Manager to give complete coverage and uniform appearance. Omit primer for items shop primed. The primer may be omitted for items which arrive on site shop primed. However, any damaged primer shall be touched up before topcoating.

.C Unless otherwise indicated, paint systems scheduled below are by the Sherwin-Williams Company. Equivalent systems from the other specified manufacturers will be accepted upon verification that any proposed substitutions are of equal or superior performance and offer a benefit to the Owner.

.D Refer to paint sheen schedule.

2.012 **PAINTING AND FINISHING SCHEDULE (EXTERIOR)**

.A Ferrous Metal: (Including pre-painted Sectional Overhead Doors and Hollow Metal Doors and Frames)

.1 1st Coat: Procryl Universal Metal Primer, less than 100 VOC @ 2-4 Mils dft/Coat. (B66A310)

.2 2nd and 3rd Coat: Pro Industrial 0 VOC Acrylic Enamel (Low Sheen) 0 VOC @ 2.5 – 4.0 Mils dft/Coat. (B66W561)

.B Galvanized Metal: (Includes garden centre canopy):

.1 1st Coat: Procryl Universal Metal Primer, less than 100 VOC @ 2-4 Mils dft/Coat. (B66A310)

.2 2nd and 3rd Coat: Pro Industrial 0 VOC Acrylic Enamel (Low Sheen) 0 VOC @ 2.5 – 4.0 Mils dft/Coat.(B66W561)

.3 Paint inside surfaces of guttering.

.C Concrete Unit Masonry:

.1 1st Coat: Loxon Block Surfacer, 81 VOC @ 8 mils dft/Coat. (A24W00200)

.2 2nd and 3rd Coat: A100 Exterior Paint, 49 VOC @ 1.5 mils dft/Coat. (A06W00151)

.3 Back roll both paint coasts as required to ensure good coverage.

2.013 **PAINTING AND FINISHING SCHEDULE (INTERIOR)**

.A Ferrous Metals: Solvent Base, Lo-Lustre, Alkyd Resin. (Hollow Metal Doors and Frames, & Miscellaneous Steel).

.1 1st Coat: Procryl Universal Metal Primer, less than 100 VOC @ 2-4 dft/Coat. (B66A310)

.2 2nd and 3rd Coat: All Surface Enamel 100% Acrylic Zero VOC Latex (Low Sheen), 0 VOC @ 1.4 mils dft/Coat. (A43WQ8051)

.B Ferrous Metals: (Satin) (Columns to 48” AFF and Hollow Metal Door Frames as shown on Drawings to receive epoxy):

.1 1st Coat: Procryl Universal Metal Primer, less than 100 VOC @ 2-4 mils dft/Coat. (B66A310)

.2 2nd and 3rd Coat: Waterbased Acrolon 100 Urethane, less than 100 VOC @ 2-4 mils dft/Coat. (A43WQ8051)

.C Galvanized Steel: (Hollow Metal Doors and Frames, Stair Stringers, Handrails & Miscellaneous galvanized steel)

.1 1st Coat: Procryl Universal Metal Primer, less than 100 VOC @ 2-4 mils dft/Coat. (B66A310)

.2 2nd and 3rd Coat: Waterbased Acrolon 100 Urethane, less than 100 VOC @ 2-4 mils dft/Coat. . (A43WQ8051)

.D Ceiling Area – Steel Joists and Galvanized Deck (Architecturally Exposed): (REFER TO DWGS)

.1 Touch up any damage to the factory shop primer on the ferrous steel (joists etc.) with Procryl Universal Metal Primer, less than 100 VOC @ 2-4 mils dft/Coat or Devoe Deflex DTM 4020 Waterborne Primer by AkzoNobel Canada Inc. (formerly ICI Paints).

.2 1st and 2nd Coats: Sherwin Williams Low VOC Waterborne Acrylic Dryfall, 39 VOC @ 2 mils dft/Coat or ICI "10113" @ 3-4 mils dft/Coat. (B42W1)

.3 Substitutions shall not be permitted.

.E Gypsum Board: (Low Sheen):

.1 1st Coat: Promar 200 Zero VOC Latex Primer, 0 VOC @ 1.5 mils dft/Coat.

.2 2nd and 3rd Coats: Promar 200 Zero VOC Latex, (Semi-Gloss or Eggshell), 0 VOC @ 1.7 mils dft./coat. (B24W2651)

.F Gypsum Board (when ultradeep base is required): (REFER TO DWGS for extent of work).

.1 1st Coat: Promar 200 Zero VOC Latex Primer, 0 VOC @ 1.5 mils dft/Coat.(B24W2651)

.2 2nd and 3rd Coats: Promar 200 Zero VOC Latex, (Semi-Gloss or Eggshell), 0 VOC @ 1.7 mils dft./coat. (B24W2651)

.G Concrete Masonry unit:

.1 1st Coat: Preprite Block Filler, 45 VOC @ 8 mils dft as required to fill.

.2 2nd & 3rd Coat: Pro Industrial 0 VOC Acrylic, Gloss, 0 VOC @ 2.5 - 4 mils dft.

.3 * Back roll all paint coats to ensure good coverage.

.H Poured Concrete Walls:

.1 1st Coat: Loxon Concrete and Masonry Primer, 96 VOC @ 3.2 mils dft/Coat. (A24W08300)

.2 2nd & 3rd Coat: Pro Industrial Pre Catalyzed Epoxy less than 150 VOC @ 2.5-3 mils dft/Coat. (K45W151)

.3 *Back roll both filler and paint coats to ensure good coverage.

.I Concrete Floor: (Refer to drawings for location)

.1 1st & 2nd Coats: Armorseal 8100, less than 100 VOC @ 1.5-2 mils dft/Coat.

.a 1 coat: General Polymers Floors Pace-Cote Polyaspartic, Clear @ 10-15 mils dft/coat.

.2 * Back roll all paint coats to ensure good coverage.

.J Structural Steel and Metal Fabrications (Compactor Areas): (Satin) (CFIA Approved) (Tile Like)

.1 1st Coat: Procryl Universal Metal Primer, less than 100 VOC @ 2-4 mils dft/Coat.

(B66A310)

.2 2nd & 3rd Coats: Waterbased Catalsed Epoxy, less than 150 VOC @ 2.5-3 mils dft/Coat. (B73-360)

END OF SECTION

DIVISION 11
EQUIPMENT

11300	Process Equipment and Support System
11311	Odour Control Unit

SECTION 11300
PROCESS EQUIPMENT AND SUPPORT SYSTEM

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SECTION 11300
PROCESS EQUIPMENT AND SUPPORT SYSTEM

1 PART 1 – GENERAL

1.1 INTENT

.1 This Section covers the work of supplying, installing, supervising the installation, and commissioning of the process equipment. Related work specified elsewhere includes:

.1 General Requirements: Division 1

.2 Equipment – General Clauses: Section 11050

.3 Mechanical: Division 15

.4 Electrical: Division 16

.2 Provide all material, equipment and accessories not herein or elsewhere specifically mentioned or included, but necessary for the supply, installation; testing, operation or commissioning of the equipment.

1.2 SCOPE

.1 Furnish two (2) submersible non-clog wastewater pumps and motors. The pumps shall be supplied with a mating discharge connection and guiderail system. The motors shall be an integral part of the pump unit.

2 PART 2 – PRODUCTS

2.1 MANUFACTURERS

.1 Flygt

.2 KSB

.3 Approved Equivalent

2.2 SUBMERSIBLE PUMPS

.1 Performance Ratings

Service		Submersible - Sewage
.1	Number of pumps:	2 (1 duty, 1 standby)

Service		Submersible - Sewage
.2	Firm rating capacity:	6.5 L/s (Duty)
.3	Total dynamic head:	14.4 m
.4	Static head:	6.7 m
.5	Max Pump Speed:	1800 RPM

2.3 PUMP DESIGN

.1 Pumps to be designed for continuous duty with intermittent standby.

.2 The pumps shall be capable of handling raw unscreened sewage and other similar solids-laden fluids without clogging.

.3 Refer to P&ID in drawing set for required I/O.

.4 The discharge base and elbow shall be permanently installed in the wet well and connected to the discharge piping. In order to prevent binding or separation of the pump from the guide rail system, the pumps shall connect to the guide rail base automatically and firmly, guided by guide bar(s) extending from the top of the station to the discharge base elbow.

.5 Systems using guide cable in lieu of rigid guide bars or pipes shall not be considered acceptable. The sliding guide bracket shall be a separate part of the pumping unit, capable of being attached to standard ANSI or DIN pump flanges so that the base is interchangeable with other pumps.

.6 Non standard flange dimensions shall not be considered acceptable.

.7 There shall be no need for personnel to enter the wet well to remove or reinstall the pumps.

.8 A field replaceable Nitrile rubber profile gasket or o-ring shall accomplish positive sealing of the pump flange/guide rail bracket to the discharge elbow. Metal to metal contact between the pump and the discharge base elbow as a means of sealing shall not be considered acceptable.

.9 The pumps and guide rail system shall be approved for use in Class 1, Division 1, Group D hazardous locations.

2.4 PUMP CONSTRUCTION

.1 Major pump components to be of grey cast iron, ASTM A-48 Class 40. All exposed nuts and bolts to be stainless steel ASTM A193/A194 type 316L. Surfaces in contact with pumped material other than brass or stainless steel will be coated with an approved sewage resistant coating.

.2 Sealing design for the pump/motor assembly shall incorporate metal to metal contact.

.3 Provide pump with leakage sensors to detect water in stator chamber.

.4 The exterior of the pump, including all metal surfaces coming into contact with wastewater shall be protected by a factory applied, non-toxic epoxy spray coating approved for wastewater applications.

.5 Do not paint name plates.

.6 Polished parts (shafts) and surfaces may not be painted but preserved against corrosion.

2.5 CABLE ENTRY SEAL

.1 Cable entry seal designed to insure a watertight submersible seal.

.2 Cable entry junction chamber and motor to be separated by a stator lead sealing gland or terminal board, thereby isolating the interior from foreign material gaining access through the pump.

.3 A cable cap incorporating a strain relief shall mount to the cable entry. The entry as part of the motor shall be approved for use in Class 1, Division 1, Group D hazardous locations.

2.6 CABLE TYPE

.1 Provide composite cable to include power conductors and control conductors. Length as required.

2.7 COOLING SYSTEM

.1 Built in cooling system for the motor designed to enable the motor to operate continuously without heating up the wet well environment. The cooling jacket shall surround the stator housing, thereby providing heat dissipation of the motor.

2.8 VOLUTE

.1 Pump volute to be single piece grey cast iron ASTM A48 Class 30 or ASTM Class 35B. Passages shall be smooth and large enough to pass any solids which may enter the impeller. Discharge connection to be a minimum of 75 mm diameter.

.2 Rotating assembly: Rotating assembly shall be dynamically balanced such that undue vibration or other unsatisfactory characteristics will not result when the pump is in operation.

2.9 IMPELLER

.1 Impeller to be centrifugal, non-clogging of one piece construction from grey cast iron ASTM A48 Class 35B.

.2 Must be capable of handling solids of a minimum 75 mm, fibres, sludge, and other materials commonly found in wastewater.

.3 Back vanes shall be provided to minimize axial loads and to propel solids away from the seal area.

.4 One piece casted, smooth, well finished, free from blowholes and imperfections and dynamically balanced.

.5 Securely fitted to the shaft to ensure it does not loosen or become detached if the pump operated in the wrong direction by reversed flow or reversed motor connections.

2.10 WEAR RINGS

.1 Nitronic 50/60 or duplex stainless steel.

.2 Impeller and casing wear ring to have 50 Brinell Hardness (BHN) difference with casing ring to be harder.

2.11 PUMP SHAFT

.1 Pump shaft to be an extension of the motor shaft. Couplings are not acceptable. Each shaft shall be of 420 stainless steel material and adequately designed to meet the maximum torque required at any normal start-up condition or operating point in the system.

.2 Each pump shaft shall have a polished finish and have accurately machined shoulder to accommodate bearings, seals and impeller. Carbon steel or chrome plated shafts shall not be considered adequate or equal.

.3 No reduction in size through the seal area.

2.12 BEARINGS

.1 provide bearings of the heavy duty anti-friction type with B-10 bearing life rating of 100,000 hours, permanently grease lubricated.

2.13 MOTOR

.1 Refer to electrical drawings and specifications.

.2 600 V, 3 phase, 60 Hz with 1.15 service factor

.3 Wye resistance grounded and capable of operating at 10% voltage deviation.

.4 High efficiency squirrel cage induction type, statically and dynamically balanced.

.5 Provide thermistors embedded in motor winding with wiring terminating in a common junction box. This is supplemental to external motor overload protection.

.6 Max temperature rise of 80°C above an ambient of 40°C with continuous operation at rated load.

.7 Guarantee minimum efficiency at full load of 90%.

.8 Guarantee minimum full load power factor of 0.85.

.9 Motor to be sized to achieve minimum of 85% maximum motor power at the duty point and 90% maximum elsewhere on operating range.

.10 Starter winding to have copper conductors with ends brought to terminal box.

.11 Rotor to indicate direction of rotation on non-driving end. Painted arrows not acceptable.

.12 Rated for continuous operation and capable of a minimum of 10 starts per hour.

.13 Motor stator with minimum class H insulation rated for 180°C

.14 Minimum of IP68

.15 Suitable for use in Class 1 Division 1 atmospheres.

.16 Provide removal lifting lugs.

2.14 AUXILIARIES

.1 provide the following for each pump:

.1 Special tools for servicing the pump.

2.15 MOUNTING AND SUPPORT SYSTEM

.1 Power Cable Support

.1 A 316L stainless steel power cable support shall be provided with each pump and be permanently attached to the pump on one end and the upper guide bracket. The power cable shall be attached to the support cable using sway clamps at a minimum of 1 m intervals.

.2 Lifting Cable

.1 A 316L stainless steel lifting cables shall be provided, length as required. A cable cleat shall be provided to store the cable when needed. A lifting cable with a hook that must grab onto a lifting bail attached to the pump before the pump can be raised or lowered will not be considered acceptable or equal.

.3 Mounting System

.1 A mounting system shall be supplied by the pump manufacturer and used to mount the pump and guide it during installation and removal without entering the wet well.

.2 The assembly shall consist of a guide rail, upper, intermediate, and lower bracket of 316L stainless steel. A 316L stainless steel mast shall be used to guide, securely hold the pump in place and be designed to withstand the maximum loads produced by the pump. The mast shall interface with the guide brackets to guide the pump securely into position. Guide tubes and mounting systems other than the one described above will not be considered acceptable or equal.

.3 To ensure the integrity of the mounting system the pump manufacturer shall supply the support guide brackets. The square mast shall be 316L SS and shall be provided by the pump manufacturer.

.4 Provide DN 100 discharge pipe supports coordinated with support guide brackets.

3 PART 3 – EXECUTION

3.1 QUALITY CONTROL

.1 Provide factory test certificates for all pumps delivered to site.

.2 Provide certificate of declaration from pump manufacturer that the pumps were installed inspected and passed all tests to the satisfaction of the pump manufacturer.

3.2 INSTALLATION

.1 Refer to “Section 11050 – Equipment – General Clauses”, the suppliers’ or manufacturers’ instructions, and 3.2.

3.3 TESTING

.1 Prior to start-up, inspect all equipment for alignment, quiet operation, proper connections, and satisfactory performance, and test in the presence of the Engineer.

.2 Check for excessive vibration, correct operation of control systems and equipment, motor power input, noise, speed and direction of rotation.

.3 Test to demonstrate that the equipment and work is not defective electrically, mechanically, or otherwise, and is in a safe and satisfactory operating condition.

END OF SECTION

SECTION 11311
ODOUR CONTROL UNIT

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SECTION 11311
ODOUR CONTROL UNIT

1 PART 1 – GENERAL

1.1 SCOPE

.1 Design, supply, install, and satisfactorily operate a complete odour control system to the full intent of the Drawings and Specification.

.2 Refer to Division 16 - Electrical for all material specification (i.e. conduit, wiring, boxes, etc.), 120 V and 600 V power wiring and connections and for electrical installation/workmanship requirements.

.3 All electrical equipment must be CSA approved and compliant for NFPA Class 1 Div. 2

1.2 RELATED SECTIONS

.1 Submittals Section 01300

.2 Basic Mechanical Requirements Section 15050

1.3 SHOP DRAWINGS

.1 General: Administrative, shop drawings, samples, quality control, and contract closeout submittals shall conform to the requirements of Section 01330, SUBMITTALS.

.2 Submit unit performance data including: capacity, nominal and operating performance.

.3 Submit chemical media data sheets, current MSDS information and original samples are to be provided.

.4 Submit Mechanical Specifications for unit and accessories describing construction, components and options.

.5 Submit shop drawings indicating overall dimensions as well as installation, operation and servicing clearances. Indicate lift points recommendations and centre of gravity. Indicate unit shipping, installation and operating weights including dimensions.

.6 Submit data on electrical requirements and connection points. Include recommended wire and fuse sizes or MCA, sequence of operation, safety and start-up instructions.

.7 Furnish the following information:

.1 Detailed structural, mechanical and electrical drawings showing the equipment fabrications and interface with other items.

.1 Include dimensions, size and locations of connections to other work.

.2 Include information on weights of all major equipment.

.3 Installation procedures.

.2 Manufacturer's catalog information, descriptive literature, specifications, and identification of materials of construction. This information is required for carbon active filter, blowers, motors, silencers, flexible couplings, inlet isolation damper, shaft couplings, vibration isolators, electrical panels, instrumentation and control devices and other accessories

.3 System layout, installation and placing drawings for equipment, drivers, and bases.

.4 Functional description of internal and external instrumentation and controls to be supplied including list of parameters monitored, controlled, or alarmed.

.5 Control panel scaled external/internal layout drawings showing construction and placement of operator interface devices, electrical and other elements.

.6 Power and control wiring diagrams, including terminals and numbers.

.7 Bill of materials for Equipment, Components, Control Panel and Instruments.

.8 Information Submittals:

.1 Certificate of Proper Equipment Application: With the initial shop drawing submittal or substitution request, provide a signed letter from the

.2 Equipment Manufacturer stating that the Equipment being supplied is suitable for the intended application. In addition, Equipment Manufacturer to submit a calculation demonstrating that the fan selected has sufficient static to provide the design airflow. Submittal review will not be conducted without this completed certificate.

.9 Quality Control Submittals:

.1 Conform to the requirements of Section 01330, SUBMITTALS.

.10 Operation and Maintenance Manual and Maintenance Summary:

.1 Provide an Operation and Maintenance Manual and Maintenance Summary in conformance with the requirements of Section 01780, Closeout Submittals.

1.4 REGULATIONS

.1 Conform to all codes, by-laws, etc. of Provincial and Municipal authorities having jurisdiction. No additional compensation will be awarded for carrying out any conditions embodied in such regulations.

.2 When the work as shown and as specified exceeds the minimum requirements of such regulations, the Drawings and/or Specifications shall govern.

.3 Provide all permits, inspections, and certificates required for this Section.

1.5 GENERAL ARRANGEMENT

.1 Co-ordinate the work under this Section with all other trades, in particular the structural work and make all necessary changes or additions to the runs to accommodate structural conditions, piping, ductwork, mechanical equipment, etc.

.2 Install the systems and apparatus in a practical and first-class manner and guarantee all work and apparatus against defects of workmanship and material and repair or replace any and all defective equipment/defects that may develop to the satisfaction of the Engineer.

1.6 WORKING DRAWINGS AND EQUIPMENT MANUALS

.1 Submit working Drawings for review for all items included in this Section.

.2 Submit all manuals required under this section.

1.7 APPURTENANCES, FITTINGS, CONNECTING PIPING AND DUCTING AND ACCESSORIES

.1 Supply and install all appurtenances, fittings, ductwork and accessories necessary for the proper functioning of the system or reasonably inferable from the Drawings with the equipment, whether indicated on the Drawings or specified herein, or not.

2 PART 2 - PRODUCTS

2.1 DESIGN

.1 The manufacturer shall have a minimum of 5 years of history in design, fabrication, and testing of similar air purification systems. The system shall provide a minimum airflow capacity as outlined in the specification parameters.

.2 The air purification system shall include prefilters, dual chemical media beds, final filters, a blower section, and other items specified in this Section.

.3 The system shall be configured in a draw thru configuration.

.4 The manufacturer shall guarantee a minimum life expectancy for the system according to the inlet and outlet contaminant levels for this application. Media shall have a minimum life expectancy of two years.

.5 Discharge contaminant levels shall not exceed defined parameters at any time before media expiry.

.6 In house production and analysis of corrosion coupons shall be provided by the equipment manufacturer.

.7 The chemical media shall have the capability of being unloaded by a vacuum unloader at the bottom side of each media section. The hinged unloading door shall incorporate features to avoid media spill. Bulk loading shall be accomplished through the removable hatch on top of the unit.

.8 All media beds shall be designed to have a means of obtaining a media and air sample.

.9 The unit casing shall be minimum 14 AWG 316L stainless steel welded construction with similar metals. Any dissimilar metals shall be fastened together by mechanical fasteners.

.10 All access doors and hatches shall use closed cell neoprene gasketing to prevent any air leakage. Separate hatches shall be provided for each media.

.11 Service doors and all unit access shall be oriented to suit field conditions or requirements.

.12 Hinges shall be of continuous piano type pin and constructed of 316 L SS. Doors shall be held closed with quick release, snap acting type, positive pressure latches.

2.2 ACTIVATED CARBON FILTER

.1 Design Criteria:

.1 The odour control system shall be designed to treat 2,966 md/h (1750 CFM) of odorous air from the wet well and sanitary storage tank. The odorous air will pass through a Mist Eliminator System, prior to entry into the carbon filter.

.2 The following operating conditions, design requirements, and performance guarantees shall apply to the odour control system:

.2 Design conditions:

.1 Average value of H2S = 4.53 ppm

.2 Average value of VOC = 14.0 ppm

.3 Performance of the system:

.4 The system must provide a minimum 2-year odor control removal with:

.1 H2 S Removal 99%

.2 VOC 99%

.3 All other odours 90%

.5 Calculations and test data proving capacity removal shall be submitted during shop drawing submission.

.6 All system should be supplied as a Package including all items described in this section.

.7 Approved manufacturers:

.1 UNISORB

.2 PURAFIL

.3 ADVANCED AIR SOLUTIONS LTD.

.4 ENDURO

.3 General Description

.1 This specification describes a carbon odour control systems that shall be designed to treat a maximum of 2,966 m'/h (1750 CFM) of odorous air at HC062.

.4 Scope of Work

.1 Shall include, but is not limited to the following:

.1 Enclosure

.2 Demister

.3 Media filter

.4 Media Bed Monitor

.5 Blower

.6 Silencer

.7 Acoustic Enclosure for the Blower

.8 Control Panel

.9 Instrumentation

.5 Enclosure:

.1 Provide 316L SS enclosure.

.2 The unit base shall be 100mm epoxy coated steel applied as manufacturer's recommended practice for high corrosion

.3 Enclosure is to be anchored to 150mm concrete pad, to be provided by the Contractor.

.6 Demister:

.1 A 3-stage side access, mist and grease eliminator shall be provided within the entering air stream plenum, to remove grease and mists.

.2 One spare pad shall be shipped with the unit.

.3 The mist and grease eliminator must be the permanent washable type and retain a 99.95% removal rate for 2-micron sized mists after cleaning.

.4 The filter is to be serviced through an access door complete with heavy weight '/4 turn stainless steel lockable compression latches with gasket seals. Bolted access panels are not acceptable.

.5 A magnehelic differential pressure gauge shall be provided to monitor the pressure drop across the mist and grease eliminator. Pressure gauge shall be suitable for environment and shall have a guaranteed accuracy within 2%.

.7 Media Filter:

.1 Provide dual media system to treat H2S and VOC efficiently.

.2 Provide sample ports in middle and end zone of any consecutive media packages.

.3 Provide fabric test for the media with a performance of 99% in removing H2S and 99% for VOC.

.4 Provide a minimum media bed depth as required for first and second media to provide a 2-year media life under the conditions specified above with maximum face velocity of 0.381 m/s (75 FPM) media bed face velocity. Media 1 will have a minimum 0.2g/cc ASTM D6642 H2S capacity.

.5 Media should be easy to remove and replace avoiding mixture with other materials or media.

.6 Media must be Non-Hazardous before and after it is spent.

.7 The media shall be warranted to last a minimum of 2 years from the date the filter is placed in service. The odour control system supplier shall supervise the installation of the media.

.8 Provide media bed monitor. This system shall measure the penetration of corrosive H2S gases into the media bed along the line of air flow. The system shall have +/- 25mm accuracy on spent media.

.8 Blower:

.1 Draw through fan is to be spark proof corrosion resistant and motors are to be TEXP for Class 1 Div. 1 airstream application and selected to provide continuous reliable operation 24 hours a day, 365 days a year in a sewage airstream environment.

.2 Blow thru configuration will not be accepted.

.3 Shaft seal, and shaft guard on belt drive fans shall be provided.

.4 The odor control equipment manufacturer shall provide the appropriate fan enclosure and integral stainless steel veil lined discharge silencer with conical diffuser to ensure a 45 dba sound level at 5 metre distance.

.5 A minimum of 30 inch (762mm) are required for service clearance at blower assembly

.6 The following operating conditions and design requirements shall apply to the odour control system fan:

.7 Service condition: odour control system supply fan.

.8 Normal air flow: HC062: 2,966 m3/h. (1750 CFM)

.9 Manufacturer:

.1 New York Blower

.2 Chicago

.3 Daltec

.10 Arrangement: As indicated on drawings.

.11 Fan motor type: Explosion proof, 600V, 3 phase.

.12 Motor efficiency: premium.

.13 Fans

.9 Materials of Construction:

.1 Blower shall be constructed in 316 Stainless Steel. All nuts, bolts and fasteners in contact with the gas stream shall be type 316 SS.

.2 Fan ratings shall be based on tests made in accordance with AMCA Standard 210 and licensed to bear the AMCA Certified Ratings Seal for Air Performance. Fans not licensed to bear the AMCA Seal for performance shall not be permitted.

.3 Fan shall have a sharply rising pressure characteristic extending from minimum air flow throughout the normal operating range specified to assure quiet and stable operation.

.4 Bearings are to be grease lubricated, precision anti-friction ball or spherical roller, self-aligning, pillow block design. Bearings shall be designed for a minimum L-10 life of 40,000 hours (200,000 hours L-50 life) when rated at the fan maximum cataloged operating speed. Fan bearings shall be accessible for inspection and maintenance. Bearings enclosed within the fan housing where they can be exposed to the corrosive gas stream are not acceptable.

.5 Fans shall come complete with starters and shall be single speed.

.10 Accessories:

.1 Fan shall be provided with the following accessories:

.2 Flanged and drilled inlet and outlet

.3 Lubricated double tip Teflon shaft seals

.4 Belt, shaft and bearing guards

.5 Fixed pitch V-belt drive

.6 Housing drain

.7 Unitary base

.8 Vibration Isolation springs

.9 Acoustically lined cover for noise reduction

.11 Blower shall be located downstream of the odour control system.

.12 Air Handling

.1 All connections and ducting shall be supplied by the Contractor.

.2 Exhaust pipe should be vertical and ensure rain protection.

.3 A stainless steel silencer shall be provided on the exhaust pipe

.13 Odour Control Panel

.1 The Supplier shall provide control panels to house main disconnect switch, circuit breaker type combination starter for single speed blower. The panel is to control the fan, demister system pressure, Media Bed Monitor and associated control wiring. Locate panel as shown on the drawings.

.2 Panel will be NEMA 4X

.3 Provide disconnect switch, conduit and wiring for all associated equipment.

.4 Provide the following indicating lights on the panel:

.1 Fan Running

.2 Low Current (Fan belt failure)

.1 Current transducer and current alarm relay to indicate low current.

.3 Demister Trouble

.5 Provide contacts for SCADA monitoring:

.1 Odour Control System Inlet Damper Opened Status

.2 Odour Control System Fan Low Current (Belt Break)

.3 Odour Control System Running Status

.4 Odour Control System General Fault

.5 Odour Control System Overload

.14 Instrumentation

.1 Differential Pressure: A gage shall be included with the scrubber to permit local read-out of pressure drop through the mist eliminator.

.2 Instruments shall be either ULC or CSA approved.

.3 All supplied instrumentation shall be of a proven design for each application and shall be selected to suit their applicable operating process and environmental requirements.

.4 Instrumentation parts subject to wear, corrosion, or other deterioration, or requiring adjustment, inspection or repair, shall be accessible and capable of convenient field maintenance.

.5 The Supplier shall provide pressure gauges for measurement of air pressure in ductwork at the blower inlet and discharge.

3 PART 3 - EXECUTION

3.1 INSTALLATION

.1 Installation by the Contractor of each equipment item shall be in strict accordance with the respective Manufacturer's and Engineer's instructions and recommendations in the locations shown on the drawings. All cost for the installation shall be borne by the Contractor.

.2 Take all necessary field dimensions to ensure accurate and proper fitting of the work and equipment supplied into the building. Make up or break down equipment into sections sized for easy transportation into and through the building to final location without alteration or damage to the building.

3.2 INSPECTION, START-UP, AND OPERATOR TRAINING

.1 Activated Carbon Filter

.1 Provide service of competent servicemen, mechanics and or other trained personnel of the Suppliers or Start-up manufacturers to check the complete installation and be present for start-up of the equipment. A written report signed by the equipment manufacturer's representative shall be submitted to the Consultant stating the following:

.1 That a satisfactory installation of equipment Start-up has been performed and outlining any modifications that have been made as a result of the commissioning or testing of the equipment at no additional cost to the Contract.

.2 That the equipment is now ready for permanent operation.

.3 That the operation, lubrication and maintenance instructions for the equipment have been presented to the Consultant.

.4 That the equipment has been properly lubricated with the correct lubricants.

.2 The equipment manufacturer's representative shall fully instruct the permanent operator of the equipment in the proper operation and maintenance of all equipment at no additional cost to the Contract.

.3 A minimum period of three (3) days on site for skilled supervision and instruction and a minimum of three (3) trips to the site should be assumed by the equipment supplier. Provide as many trips and days on site as required to complete the installation and put the equipment into satisfactory operation.

.4 The odour unit supplier is responsible for providing enough media to top up the loading hoppers after the media has settled. The equipment supplier shall check the system six months after Start-up.

3.3 TESTING

.1 Activated Carbon Filter

.1 Final acceptance of the equipment requires field tests for handling design flow conditions.

.2 The Contractor shall provide all necessary equipment and accessories to facilitate the testing of equipment.

.3 Conduct a performance test in coordination with the Consultant and Owner of the carbon filter within three (3) months after commissioning has been completed.

.4 Submit a performance test protocol to the Consultant for approval. If odour panel testing is deemed to be required, this is at the expense of the owner.

.5 Collect sufficient data on the inlet and outlet to verify the VOC and hydrogen sulphide removal efficiency or the maximum guaranteed outlet levels specified in this document.

.6 Submit a performance test report with results and verification of performance.

END OF SECTION

DIVISION 14
CONVEYING SYSTEMS

14600 Bridge Crane and Hoist Systems

SECTION 14600
BRIDGE CRANE AND HOIST SYSTEMS

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SECTION 14600
BRIDGE CRANE AND HOIST SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION

.1 SCOPE

.1 This section specifies bridge cranes and hoisting equipment.

.2 Runway beams and rail are part of the building steel package and are not included in this section.

.2 CRANE SUMMARY

Item	Specification
Crane #1 location	
Span	4 m
Capacity	2000 kg
Crane type	top running, under running, single girder, double girder
Classification	Crane shall be designed and constructed to CMAA Specification # 70 or #74, as applicable, for Class “C” service requirements. Class 9048 01-CRANES AND HOIST (for hazardous location) Ex de IIC T4 (Class I, Zone 1)
Crane speed	25/6.2 m/minute, 2 speed
Crane drive	Dual motor drive
Trolley speed	25/6.2 m/minute, 2 speed
Trolley drive	Motorized
Hoist speeds	7.5/1.2 m/minute, 2 speed
Hoist type	Electric wire rope
Hoist lift required	8.5 m
Control	Pendant from independent track on bridge

.3 WORK INCLUDES THE FOLLOWING:

.1 Detailed design of completed crane system, including bridge, end trucks, trolley, hoists, cabling, controls, and all appurtenances specified hereinafter.

.2 Shop drawings.

.3 Fabrication of a complete crane.

.4 Inspection and shop testing.

.5 Documentation and schedules.

1.2 REFERENCES

Equipment furnished under this section shall, except as otherwise noted, comply in all respects with the requirements of the following standards:

.1 CAN/CSA-C22.2 No. 14-95: Industrial Control Equipment

.2 CSA Std C22.2 No. 33-M1984: Construction and Test of Electric Cranes and Hoists

.3 CSA Std C22.2 No.213-M1987: Non-Incendive Electrical Equipment for Use in Class I, Division 2 Hazardous Locations

.4 CAN/CSA-E60079-0-04: Electrical apparatus for explosive gas atmospheres - General Requirements

. 5 CAN/CSA-E60079-1-04: Electrical apparatus for explosive gas atmospheres - Construction and Verification test of flameproof enclosures of electrical apparatus

. 6 CAN/CSA-E60079-7-04: Electrical apparatus for explosive gas atmospheres Increased safety

.7 CAN/CSA C22-2 No. 100-95: Motors and Generators

.8 IEC 60529 1989-11: Degrees of protection provided by enclosures (IP code)

1.3 SUBMITTALS

.1 SHOP DRAWINGS AND EQUIPMENT DATA

.1 Manufacturer’s catalog data for hoist.

.2 Dimensional drawings and details for bridge crane system.

.3 Wiring schematics. – ship with crane

.2 OPERATIONS AND MAINTENANCE MANUALS (one set of Owner’s manuals in paper and on DVD)

.1 Equipment function, normal operating characteristics, and limiting conditions

.2 Assembly, installation, alignment, and maintenance instructions

.3 Lubrication and maintenance instructions

.4 Guide to “troubleshooting”

.5 Parts list

.6 As-built drawing

.7 Test results

1.4 APPLICABLE STANDARDS

.1 Contractor shall adhere to CSA B167 as applicable.

.2 Long lead items [hoist, end trucks, drives and controls] will be ordered by contractor upon receipt of approved drawings. Steel will not be ordered until shop drawings and submittals have been approved by the customer.

.3 All electric equipment shall be CSA labeled.

1.5 WARRANTIES

.1 Provide one-year equipment warranty.

PART 2 - PRODUCTS

2.1 APPROVED MANUFACTURERS

.1 Konecranes

.2 Richards-Wilcox

.3 Zelus Material Handling

.4 Or other approved equal

2.2 MATERIALS

Components	Material
Bridge beams	Steel, ASTM A36 or A992
End trucks	Steel, ASTM A36 (or equal)
Trolley	Steel, ASTM A36 (or equal)
Wheels	Cast iron or steel (Brass wheels for Spark Resistant Design)
Hooks	Forged steel (Bronze coated for Spark Resistant Design)

2.3 EQUIPMENT

.1 HOIST AND TROLLEY

.1 Top-running single girder cranes shall utilize a hazardous area wire rope hoist. Hoist & Trolley to be CSA Approved for use in specified hazardous area.

.2 The hoist shall be equipped with an electro-mechanical load-limiting device that shall prevent lifting more than 110% of the rated load.

.3 Hoisting motor(s) shall be two-speed/two winding squirrel cage type with a speed ratio of 6:1.

.4 Hoisting motor(s) shall be use sliding rotor brake motor with two hoisting speeds. Long service life of the adjustable, asbestos-free brake.

.5 Motor and brake are flameproof enclosed (Ex d) and have PTC thermistor temperature control.

.6 Trolley motor(s) shall be a sliding rotor brake motor with two hoisting speeds. Long service life of the adjustable, asbestos-free brake. Contactor control with main contactor and transformer.

.7 Rotary cam type limit switch equipped with 4 micro-switches shall be provided. Limit switch shall provide upper and lower limit of hoist travel, hoist slow down prior to reaching upper limit and phase sequence supervision at upper limit. An additional block operated limit shall be included.

.8 Hoist motor brake shall be DC disc type with adequate torque to stop and hold over **125%** of the hoist rated load.

.9 The hoist nameplate is to carry a CSA approval.

.10 Two-step SWH 5ex rocker-type control pendant with EMERGENCY STOP button.

.11 All trolleys with buffers.

.12 The rope drum shall be equipped with a rope guide to help keep the rope aligned in the grooves of the drum.

.13 Wire rope shall be constructed from galvanized steel having a minimum safety factor of 5.

.14 Hooks shall be made of forged alloy steel (34CrMo4QT or 34CrNiMo6QT) and shall be fitted with a spring-loaded flipper-type safety latch.

.15 Hoist shall have a duty rating suitable for the load class and load cycles of the application.

.16 Trolleys shall have safety drop lugs and energy absorbing bumpers.

2.4 BRIDGE GIRDER

.1 Bridge girders shall be constructed from welded box girders or Structural beams, Steel, ASTM A36 or A992, as required.

2.5 END TRUCKS AND BRIDGE DRIVE

.1 End trucks shall be designed in accordance with CMAA specifications as applicable.

.2 End trucks shall be bolted to bridge girder.

.3 Bridge drive shall be dual-motor (A-4 arrangement per CMAA).

.4 Bridge drive shall be designed to stop the bridge within CMAA specifications.

.5 End trucks shall be equipped with rail sweeps and energy-absorbing rubber bumpers.

.6 Bridge shall be furnished with a 2 speed motor suitable for the hazardous area specified.

.7 Bridge motor(s) shall be use sliding rotor brake motor with two hoisting speeds. Long service life of the adjustable, asbestos-free brake. Contactor control with main contactor and transformer.

.8 Motor and brake are flameproof enclosed (Ex d) and have PTC thermistor temperature control.

2.6 POWER SUPPLY

- Power supply for the hoist shall be 600 V, 3 ph., 60 Hz. All power required for the operation of the hoist, trolley, and end trucks shall be developed from this source.

.1 Runway electrification shall be festooned conductors or Cable reel to meet the Hazardous rating of the room. Wall mounted disconnect switch and power to runway conductors provided by Electrical Contractor.

.2 Cross bridge electrification shall be festooned conductors or Cable reel to meet the Hazardous rating of the room. Cables are to be hardwired, plug connectors are not acceptable.

2.7 CONTROLS

.1 The following controls shall be used as applicable:

.1 Six-way operation, plug-in pushbutton pendant suspended from independent festoon track. Radio control may be quoted as an option.

.2 Pendant shall include Start (momentary) button and Emergency Stop (push to maintain, turn to release) that controls a mainline contactor in the bridge control panel.

.3 Pushbutton shall be clearly marked with hoist, trolley and bridge travel directions.

.4 Hoist shall be 2 speed magnetic reversing type and the trolley and bridge controls shall be 2 speed.

.5 Electrical control enclosures and pendant shall be suitable for the Hazardous area specified.

2.8 LABELING

.1 Hoist and bridge beam shall be labeled with load rating.

.2 A corrosion-resistant nameplate shall be fixed to the bridge with the following information:

.1 Name of manufacturer

.2 Manufacturer’s model number and serial number

.3 Capacity

.4 Date of manufacture (month and year)

2.9 PAINTING

.1 Hoist and trolley shall be factory painted per manufacturer’s standards.

.2 Bridge shall be shop cleaned, primed, and painted per manufacturer’s standards.

.3 The following items shall not be painted:

.1 Rail surfaces in contact with wheels

.2 Wheel running surfaces

.3 Hoist wire rope

.4 Conductor bar, festoon cables and supports

PART 3 - EXECUTION

3.1 DELIVERY, RECEIVING AND STORAGE OF EQUIPMENT

.1 Arrange with suppliers for delivery of all items of equipment to the site of the work at the appropriate dates on the Contractor's construction schedule.

.2 Arrange for delivery of all anchor bolts, templates, embedded metals, etc., required during the concreting and other construction.

.3 Receive equipment at the site, unload and examine it upon arrival for damage or deficiency and be responsible for its safekeeping, storage and installation. Immediately notify the Engineer and the Supplier of any damages or deficiency in the equipment delivered.

.4 For the purpose of this Contract, equipment storage, safekeeping and relocation of equipment from one area of the site to another, for whatever reason, shall be the sole responsibility of the Contractor from the time of initial off-loading at the site until the date of completion and take-over by the Owner.

3.2 INSTALLATION

.1 Arrange with suppliers for delivery of all items of equipment to the site of the work at the appropriate dates on the Contractor's construction schedule.

.2 Be fully responsible for work of unloading, storing as necessary, erecting, assembling, adjusting and testing of the materials and equipment specified. Supply shims as required.

.3 If intended to use the crane system to assist in the initial installation of equipment, provide certification from the equipment supplier that the equipment has not been damaged in any way and that the full warranty is still in place.

.4 Provide the services of manufacturer's representatives to supervise the unloading, handling, erecting, assembly and testing of the crane, and to instruct operating personnel in its proper operation and maintenance.

.5 Provide all necessary labour, equipment, tools, anchor bolts, etc., as required for the complete installation of all equipment specified under this Division.

.6 Install all equipment in accordance with the supplier's drawings, instructions and/or under the direction of the manufacturer's or supplier's qualified technical representative as specified in the individual sections of this Division. Furnish a letter from each manufacturer or supplier certifying that his qualified

representative has checked the installed equipment and found the equipment to be satisfactorily installed, in proper working order, and in accordance with all applicable Safety Specifications (in accordance with Section 01351).

.7 Provide and install all lubricants and liquids, necessary for initial operation of the equipment in accordance with the manufacturer's instructions, unless otherwise specified.

3.3 LOAD 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 requirement.

.2 The testing procedure shall be approved by the Engineer prior to commencement of the test, and in all cases where the equipment does not meet the specifications, it is to be revised, replaced or readjusted to the satisfaction of the Engineer and until it does meet the specifications.

.3 Provision shall be made for the equipment manufacturer's representative to check the complete installation prior to start-up and to instruct the operating personnel regarding operation and maintenance.

.4 A written test report shall be included in the Maintenance Manual, as per Division 01730.

.5 Running Test - After erection has been completed, and before being placed into service, the machinery shall be operated by power and tests carried out to prove the following:

.1 All clearances and alignments are in order; gearing is sufficiently quiet and lubrication is adequate.

.2 Operation of each controller switch, contactor relay and other control devices is satisfactory; all limit switches operate correctly under the most unfavourable conditions.

.3 All circuits, inter-locks and sequence of operation are correct.

.4 All protective devices operate satisfactorily.

.5 Each motion of the crane operates satisfactorily.

.6 Load Test - Test each motion with the hook carrying (loads to be provided by Contractor):

.1 25% Overload: During this test the specified speeds need not be attained, but the system shall show itself capable of dealing with the overload without difficulty.

.2 Rated Load: During these tests the specified speeds are to be attained, provided that the current supply to the crane is correctly maintained.

.7 Brake Test:

.1 All brakes shall be tested under full load conditions, from maximum speed to rest, three times in quick succession without overheating.

.2 Any work not meeting the requirements of this Specification shall be rectified to the satisfaction of the Engineer and all costs for such work shall be at this Section's expense.

3.4 OPERATION AND MAINTENANCE INSTRUCTIONS

.1 Provide the services of a technical representative of the equipment supplier to provide two (2) days' worth of instruction to the Owner's staff as outlined in Section 01820, 1.3.4. This instruction to be given during a separate visit from the commissioning visit.

.2 Provide complete operation and maintenance manuals for all equipment in this Section.

END OF SECTION

DIVISION 15
MECHANICAL

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15070	Station Piping and Valves
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15410	Plumbing Piping
15411	Gas Piping Systems
15430	Plumbing Specialties
15440	Fibreglass Reinforced Plastic Duct
15518	Plumbing and HVAC Valves
15830	Split Cooling Systems
15852	Indoor Direct Fired Make-Up
15854	Direct Fired Make-Up Air Units
15855	Monoxivent FRP Corrosion Ductwork
15860	Fans
15890	Low Pressure Ductwork
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SECTION 15050
BASIC MECHANICAL MATERIALS AND METHODS

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SECTION 15050
BASIC MECHANICAL MATERIALS AND METHODS

1 PART 1 – GENERAL

1.1 DESCRIPTION

.1 This Section specifies requirements, products, characteristics, and methods and executions that are common to one or more sections, and it is intended as a supplement to each section and is to be read in conjunction with the Drawings.

.2 The Drawings indicate the general location and route to be followed by the piping and ductwork. Where details are not shown on the Drawings or only shown diagrammatically, the equipment shall be installed in such a way as to conserve headroom and interfere as little as possible with the free use of space through which they pass.

.3 Related Work Specified in other sections:

.1 Motors, starters, and accessories, Divisions 11 and 16.

.2 Electrical power wiring connections to power and control panels supplied with equipment or part of the mechanical work, Division 16

.3 Finish Painting of exposed mechanical work in Section 09900

.4 Excavation and backfill of mechanical work in Section 02220

1.2 GENERAL

.1 Supply the equipment complete in all respects including all other accessories and auxiliaries necessary to provide for a satisfactory installation.

.2 Where equipment is supplied with larger or smaller power requirements than that shown, coordinate with the electrical requirements (Division 16) to ensure compatibility with electrical and control components so that a complete working system is in place without extra cost to the Owner.

.3 The exact location and routing of mechanical and electrical services are to be properly planned, coordinated and established with all affected trades prior to installation such that the services will clear each other as well as any obstruction. Generally, give the right of way to piping requiring uniform pitch and locate and arrange other services to suit.

.4 Check dimensions associated with existing structures, equipment and piping in the field before fabrication and installation are started.

.5 All shutoff valves, balancing devices, air vent, and similar products, must be located for easy access for servicing. Products, which do not meet this location requirement, are to be relocated at no cost.

.6 All mechanical piping system work including equipment, must comply in all respects with requirements of the TSSA and CSA. Where required, fittings, valves, equipment etc. must bear a CRN Number.

.7 All Codes and Standards referred to in the specifications are the latest edition at the time of tendering. All electrical items associated with mechanical equipment are to be CSA certified, or ESA approved.

1.3 SHOP DRAWINGS

.1 Submit shop drawings for review for all items including electrical and control wiring specified in this Section.

.2 Refer to Division 1, regarding requirements for submission of shop drawings, equipment manuals, etc.

.3 Shop drawings shall include:

.1 Materials and equipment by manufacturer and model number clearly indicating the equipment being proposed. Cross out non-applicable material.

.2 Include dimensional and technical data sufficient to check if equipment meets the specifications.

.4 Do not order equipment until shop drawings have been approved.

1.4 RECORD DRAWINGS

.1 Drawings shall show all inverts and size of all pipes, all buried pipes and ductwork, and the exact routing of the pipes and ductwork.

1.5 APPURTENANCES AND ACCESSORIES

.1 Provide all jointing, couplings, fittings, gaskets, insulation, wrapping, flanges, bolts and nuts, wall pieces, blocking, all pipe supports (including steel pipe racks), and all other necessary materials. Include all couplings, gaskets and bolts and nuts for valves, meters, and connections to equipment, whether indicated on the Drawings or specified herein, or not.

1.6 MATERIALS HANDLING AND STORAGE

.1 Provide all necessary equipment materials and labour to off-load equipment at the site and provide for any additional transportation necessary for storage or installation on site. The methods employed for off-loading and handling must be to the satisfaction of the equipment supplier and Engineer.

.2 Before taking delivery examine the equipment for any damage. Rectify damage to equipment. Ensure that the equipment supplier first approves any repairs such that guarantees are not invalidated.

.3 If not required for immediate use, adequately store and protect all equipment against weather, damage and theft. Take particular care with corrodible and electrical equipment. Store mechanical equipment in an area heated to a minimum of 10 degrees C. If extended storage time is required, perform periodic maintenance in accordance with manufacturers' instructions.

.4 Immediately upon delivery or unpacking, turn over all spare parts, in working condition, to the Owner for safe storage. Notify and coordinate with the Owner before delivery.

1.7 CONCRETE EQUIPMENT BASES

.1 Where equipment is to be set on a concrete base, anchor the base itself to the floor slab as shown on the Drawing. Provide concrete and grout for bases under Section 03300 Cast-In-Place Concrete.

.2 Unless otherwise shown on the Drawings, finally set equipment on 25 mm of non-shrink grout, chamfered at the edges.

.3 Include in the tender price any equipment bases, supports and/or housekeeping pads that may be required in addition to those specified or indicated on the Drawings.

1.8 ANCHOR BOLTS

.1 Provide anchor bolts of galvanized steel in pumping station spaces, except for reservoir access room.

.2 Provide anchor bolts of 316L stainless steel in reservoir access room and all spaces within reservoir.

1.9 EXPEDITING DELIVERY

.1 Take full responsibility for expediting the delivery, installing and putting all equipment into specified working operation.

.2 Develop a construction schedule based on the information available from the Equipment Suppliers at the time of tendering.

.3 Failure or delay in delivery of equipment does not relieve the Contractor of his responsibility to complete the Contract in the time stated in the Form of Tender.

1.10 ACQUAINTANCE WITH WORK

.1 Be fully acquainted with all work involved in the complete installation of all equipment. At no time make any claim that any misunderstanding existed in regard to the nature or amount of work to be done.

.2 Obtain from Equipment Suppliers the details, dimensions and other information pertinent to the work of this Contract.

1.11 MATERIAL AND WORKMANSHIP

.1 Material and equipment to conform to the latest edition of applicable standards in force at the time of tendering. In the case of conflict of these Specifications with any standards, the more stringent of the two applies.

.2 Provide materials and equipment:

.1 First class in every respect

.2 Constructed and finished in a workmanlike manner

.3 Suitable for the service intended

.4 Selected and fabricated to best engineering practice

.3 Furnish safety devices including shear pins, flexible coupling guards, belt guards and other pertinent items with the equipment.

.4 Design machinery such that working parts are readily accessible for inspection and repair, and each part is suitable for the service required.

.5 Carefully pack and crate equipment for shipment. Protect polished and machined metal surfaces from corrosion and damage during shipment. Specially pack electrical equipment to prevent damage by moisture. Cover equipment having exposed bearings and glands to exclude foreign matter.

.6 Design equipment to have adequate strength, power and capacity for both continuous and intermittent service. Motors and other parts to be capable of starting and operating under any conditions of loading likely to occur under normal plant operating conditions.

.7 Design the general mechanical and electrical equipment and particularly bearings, contacts and other wearing parts to satisfy the need for long periods of operation without frequent maintenance or attention.

.8 Provide adequate and, as far as practicable, automatic means of lubrication for working parts. Arrange lubrication grease nipples, grease boxes and other lubrication devices so that they are readily accessible for greasing.

.9 Indicate on the working drawings submitted, the type of lubricants to be used (readily available in Canada). Use grease nipples of a consistent type.

.10 Make lubrication points readily accessible using grease nipples and Type 316L stainless steel extensions where required. Secure the nipples and tubing to the equipment at appropriate locations.

.11 Design equipment installed outdoors for service under climatic conditions typical for the area. Give particular attention to winter operating conditions.

2 PART 2 – PRODUCTS

2.1 WATERPROOFING AND SEAL MATERIALS

.1 Modular, mechanical seal assemblies consisting of interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe and the pipe sleeve or wall opening, assembled with stainless steel bolts and pressure plates and designed so the when the bolts are tightened the links expand to seal the opening watertight, the seal assemblies are to be selected to suit the pipe size and the sleeve size or wall opening size.

.2 Acceptable manufactures:

.1 Thunderline Corp “Link Seal” model S

.2 Metraflex “MetraSeal Type ES

.3 Approved Equal

2.2 PIPE ESCUTCHEON PLATES

.1 One-piece chrome plated brass or stainless steel plates with screws, each sized to cover the pipe sleeve or wall or slab opening and to fit tightly around the pipe or insulation.

2.3 PIPE, FITTINGS AND VALVES

.1 All piping materials, fittings and standard valves to be in accordance with the Specifications within this Division.

2.4 MECHANICAL COUPLINGS

.1 Mechanical couplings shall conform to AWWA C219-06, epoxy coated with stainless steel straps, nuts and bolts.

.2 As an alternate to flanged joints, couplings manufactured of materials conforming to ASTM A47 Grade 32510 or 35108 and design conforming to CSA B242 for grooved and shoulder type mechanical piping couplings may be used on ductile cast iron, steel and stainless steel piping systems. Groove pipe ends according to manufacturer's recommendations and standards to make connections rigid. Differentiate the Rigid Joint from the flexible joint by colour code identification.

.3 For connecting ductile iron pipe to flanged valves, fittings and equipment use the Victaulic Company Vic-flange Style 341, Romac FCA501 or Approved Equal. For connecting steel or stainless steel pipe to flanged valves, fittings and equipment use the Victaulic Company Vic-flange Style 741, Romac FC400 or Approved Equal. Groove pipe ends to make these connections rigid.

.4 Prepare pipe ends to fit the type of coupling to be used. The outer surface of the pipe ends will be free from surface defects and have the longitudinal or spiral welds ground to surface for a sufficient distance from the ends to permit the pipe to make a watertight joint with the coupling.

2.5 DRAIN AND AIR VENT VALVES

.1 Locate drain valves at low points and section isolating valves as indicated in Contract Drawings.

.2 Drain valves to be minimum 20 mm size unless otherwise specified: straight pattern bronze with hose end male thread and complete with cap, chain and vacuum breaker.

.3 Provide air vent valves at high points together with means for "blowing out" lines piped to floor drain as indicated on Contract Drawings.

2.6 VIBRATION ISOLATION

.1 Elastomeric Pads

.1 Neoprene waffle or ribbed, 9 mm minimum thickness, 50 durometer, maximum loading 350 kPa.

.2 Rubber waffle or ribbed, 9 mm minimum thickness, 30 durometer natural rubber, maximum loading 415 kPa.

.3 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.

.4 Rubber-steel-rubber, 9 mm thick rubber bonded to 1.71 mm steel plate, 30 durometer natural rubber, waffle or ribbed, holes sleeved with isolation washers.

.2 Spring Hangers

.1 Colour coded springs, rust resistant, painted, box type hangers. Swivel arrangement to permit hanger box or rod to move through a 20* arc without metal-to-metal contact, stable spring, elastomeric element.

.2 Performance: to be determined by equipment supplier.

.3 Acceptable product: Korfund, Masdom VM or Vibron.

.4 Acoustic Barriers for Anchors and Guides:

.1 Acoustic barriers: between pipe and support, consisting of 25 mm minimum thick heavy duty duck and neoprene isolation material.

.2 Acceptable product: Masdom VM, Vibron, Vibro-Acoustics.

.3 Horizontal Thrust Restraint:

.1 Spring and elastomeric element housed in box frame, assembly complete with rods and angle brackets for equipment and ductwork attachment, provision for adjustment to limit maximum start and stop movement to 9 mm.

.2 Restraints arranged symmetrically on either side of unit and attached at centerline of thrust.

.3 Acceptable product: Korfund, Masdom, VM, Vibron, Vibro-Acoustic.

2.7 DRIVES, GUARDS AND LUBRICATION ACCESSORIES

.1 Sheaves

.1 Select variable and adjustable pitch sheaves unless otherwise specified.

.2 Provide motor driven equipment using 2 or more belts with fixed sheaves.

.3 Fit reinforced belts in sheave matched to drive. Multiple belts on unit to be matched set.

.4 Use cast iron or steel sheaves secured to shafts with removable keys.

.5 Standard adjustable pitch drive sheaves having + 10% range to be used on motors from 0.25 kW to 7.5 kW. Use mid-position of range for specified RPM.

.2 Drive Rating

.1 Minimum drive rating to be 1.5 times nameplate rating of motor. Keep overhung loads within manufacturer's design requirements on prime mover shafts.

.3 Adjustment

.1 Motor slide rail adjustment plates to allow for centerline adjustment.

.4 Guards

.1 Provide guards for exposed drives.

.2 Guards for drives to have:

.1 Expanded metal screen welded to 25 mm steel angle frame.

.2 18 Ga. galvanized sheet metal tops and bottoms.

.3 Removable sides for servicing.

.4 40 mm diameter holes on both shaft centres for insertion of a tachometer.

.3 Secure guards to driven machine, foundations or floors with heavy angle supports and anchor bolts.

.4 Do not short circuit vibration isolators.

.5 Provide means to permit lubrication, use of speed counters, or other maintenance and testing operations, with the guard in place.

.6 Install belt guards to permit movement of motors for adjusting belt tension.

.7 For flexible couplings, provide removable "U" shaped guards fabricated from 12 Ga. galvanized steel frame with 18 Ga. expanded mesh face.

.8 Provide protective screen on both inlet and outlet of exposed fan blades. Screen to be fabricated from 20 mm mesh minimum galvanized expanded

metal such that the net free area of openings is not less than 80% of the original opening.

.9 Provide oil gauges, grease cups, oil cups or grease gun fittings at all points requiring lubrication. Extend all fittings as required to be fully accessible without requiring any disassembly or removal of guards.

2.8 VALVE EXTENSION STEM AND GUIDES

.1 Where indicated, provide extension stems with the following features:

.1 Naval bronze or hardened Type 410 stainless steel.

.2 Cast iron stem guides with bronze bushings and stainless steel bolts, nuts and washers to support extension stems.

.3 A 50 mm square operating nuts in floor boxes equipped with threaded bronze covers having slotted, flush heads.

.4 A 914 mm long steel valve key for each valve.

2.9 FINISHES

.1 Finish piping and mechanical equipment to the 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 Stainless steel pipe free of steel wire rope marks.

.5 Materials, piping and equipment free of dents.

.6 Machined surfaces finished to specified tolerances.

2.10 EQUIPMENT AND PIPE PROTECTION

.1 Where specified in the respective Sections, prepare surface, shop prime and factory finish equipment in accordance with the requirements of Section 09900, colour ANSI/ASA #61 grey.

.2 Where in the respective Sections exposed surfaces of equipment and piping, including fittings, metal pipe supports and valves, are not specified to be painted, prepare surfaces, and prime paint in accordance with Section 09900 - Painting.

.3 Field painting is to be done after pipes, valves and equipment have been installed and tested.

2.11 PRESSURE GAUGES

.1 Provide pressure gauges as indicated in the drawings, and as required and specified herein. All gauges are to be bottom mounted unless otherwise specified or bottom mounted would prevent reading of the gauge.

.2 Measurement: Gauge Pressure.

.3 Display: Analogue dual scales in psi and bar, liquid filled case.

.4 Accuracy: ASME B40.1 Grade 2A or better, with Permissible Error +/- 0.5% of span.

.5 All stainless steel construction.

.6 Range: 0 to 11 bar (0 to 160 psi)

.7 Dial: 75 mm (3”) to 100 mm (4"). All station gauges to be fitted with same sized dials unless otherwise specified.

.8 Operating Temperature: 10°C-30°C

.9 Provide syphon for steam service.

.10 Provide snubber for pulsating operation, including at all pumps.

.11 Provide block and bleed valve, and ball valve at all pressure gauges.

.12 Provide diaphragm for corrosive service.

.13 Acceptable manufactures:

.1 Omega

.2 Wika

.3 Approved Equal

3 PART 3 – EXECUTION

3.1 STANDARDS

.1 Do work in accordance with, but not limited to, the following codes and standards deemed to be part of this specification.

.1 Ontario Building Code.

.2 Plumbing and Drainage Regulations of the Province of Ontario.

.3 Canadian Standards Association (CSA)

.4 The American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE)

.5 The American National Standards Institute (ANSI)

.6 The American Society for Testing and Materials (ASTM)

.7 Sheet Metal and Air Conditioning Contractor's National Association (SMACNA)

.8 Ministry of Environment of the Province of Ontario.

.9 Air-Conditioning and Refrigeration Institute (ARI)

.10 National Fire Protection Association (NFPA)

.11 American Water Works Association (AWWA)

.12 Air Movement and Control Association (AMCA)

3.2 EXAMINATION

.1 Examine areas where work is to be performed for:

.1 Anything that affects execution and quality of work.

.2 Piping clearances.

3.3 PIPING INSTALLATION

.1 General

.1 Conform to requirements of ANSI B31 code for pressure piping and CSA/CAN3 Z138.

.2 Install straight, parallel and close to walls and ceilings, with specified pitch. Use standard fittings for direction changes.

.3 Determine exact location of each pipe/duct in the field with respect to adjacent and interconnecting piping and equipment. Install groups of piping parallel to each other, spaced to permit application of insulation, identification, and service access, on trapeze hangers.

.4 Install eccentric reducers in horizontal piping to permit drainage and eliminate air pockets.

.5 Where pipe sizes differ from connection sizes of equipment, install reducing fittings close to equipment. Reducing bushings are not permitted.

.6 Install flanged or welded nozzles, branch connections, welding outlets, adapters and taps, true and faced at right angles to the axis of the pipe. Do not extend connection inside of pipe.

.7 Make pipe ends round and true, suitable for weld connection.

.8 Prepare pipe ends in accordance with ANSI B16.25 for butt welding.

.9 Ream ends of pipe and tubes before being made up.

.10 Use non-corrosive lubricant or teflon tape applied to male thread only.

.11 Groove pipe ends, cut square, seating surface clean and free from indent and score marks.

.12 Install dielectric fittings wherever piping of dissimilar metals are joined.

.13 Install flanges or unions to permit removal of equipment without disturbing piping systems, as required by piping standard.

.14 Clean all ducts, pipe and fittings prior to installation, temporarily cap or plug ends of pipe, ducts and equipment that are open and exposed during construction. Install piping and ductwork that are to be insulated so that they have sufficient clearance to permit insulation to be applied continuously and unbroken around the pipe or duct, except at fire barriers.

.15 Clean ends of pipes or tubing and recesses of fittings to be brazed or soldered. Assemble joints without binding.

.16 Support piping during construction to prevent abnormal stresses on the pipe works.

.17 Install pipe supports and hangers as required.

.18 For piping, all supports and hangers, etc. to be Type 316L stainless steel.

.19 Provide a minimum of two pipe diameters of straight pipe length between fittings.

.2 Bolted Connections

.1 Clean pipe ends and gaskets.

.2 Lubricate gaskets with soapy water and bolts with thread lubricant.

.3 Tighten bolts progressively by crossover method and not in rotation around the joint.

.4 Tighten bolts to the torque recommended by the manufacturer.

.5 Use properly sized wrenches for bolt tightening to prevent rounding of nut and bolt heads.

3.4 PIPING EXPANSION AND FLEXIBILITY

.1 Install piping to permit free movement of piping caused by thermal expansion and contraction except where it is anchored.

.1 Provide for expansion and contraction by installing suitable expansion pieces or flexible connectors as is necessary or where indicated.

.2 Use only expansion pieces or flexible connectors having ratings equivalent to the test pressures specified for the particular piping system and wetted surfaces of material similar to that of the piping systems.

.3 Design expansion pieces or flexible connectors for the lengths of straight runs shown and the temperature differentials specified.

.4 Construct expansion pieces to limit turbulence and pressure drop. Where necessary, provide liners of materials compatible with the process fluid to prevent erosion and corrosion. In any case, provide liners for services when the process fluid is dirty or contains solids.

.5 Provide anchors, supports and guides where necessary to direct expansion into the expansion pieces or flexible connectors and to limit movements to those directions and magnitudes permitted for the specific joint or flexible connector selected.

.6 Install expansion pieces and flexible connectors in accordance with the standards of the Expansion Joint Manufacturer's Association, Inc.

3.5 INSTALLATION

.1 Storage of Valves

.1 Store valves in cool and clean location, away from moving vehicles or other objects.

.2 Prevent dirt and debris entering the valve internals.

.3 Protect the valve seats against painting.

.4 Store valves with their hand wheels, operator shafts and operators in an upright position.

.2 Handling Valves

.1 Do not place chains, cables and ropes through valve ports or make attachment to operators or hand wheels.

.2 Use sling either around valve body or with bolts or rods through the flange holes.

.3 Installation of Valves

.1 Installation of valves to be by competent personnel and in strict accordance with manufacturer's instructions.

.2 Inspect and remove all foreign debris or objects that may prevent closing of valves prior to the installation of any valves.

3.6 VENT PIPES

.1 Where vent pipes are indicated, route to outside preferably through the roof and discharge vertically upwards.

.2 Design, provide and install vent and relief pipes in accordance with ANSI B31.1, .2, .3, CAN1-B105, and the Ontario Building Code.

3.7 PIPE HANGERS

.1 Hanger Spacing

.1 Spacing and middle attachment rod diameter as specified in paragraphs below or as in table below, whichever is the more stringent.

.1 Plumbing piping: most stringent requirements of the Plumbing Code for the Province of Ontario or authority having jurisdiction.

.2 Fire protection: to applicable fire code.

.3 Flexible joint roll groove pipe: in accordance with table below, but not less than one hanger at joints.

.4 Within 300 mm of each horizontal elbow, tee or fitting.

.2 Spacing of vertical clamp supports for vertical pipes shall not exceed 1.5 metres.

3.8 PROTECTION OF OPENINGS

.1 Protect equipment and system openings from dirt, dust and other foreign materials.

.2 Thoroughly clean piping, ducts and equipment of dirt, cuttings, and other foreign substances prior to being put into operation.

3.9 EQUIPMENT PIPING CONNECTIONS

.1 Where equipment connections are a different size from the piping serving it, all associated isolating valves and fittings to be the larger pipe size unless specifically indicated otherwise on the drawings. This rule to also apply in the case of control valves.

3.10 EQUIPMENT LUBRICATION

.1 All equipment placed in operation prior to the completion of the Contract to be maintained and adequately lubricated in accordance with the manufacturer's instructions.

.2 All equipment to be lubricated in accordance with the manufacturer's instructions prior to acceptance of any system.

.3 Oil level gauges, grease cups and grease fittings for all machinery bearings, etc., to be provided as recommended by the manufacturer. Locate oil level gauges for easy viewing.

.4 All bearings to be flushed out and refilled with new change of oil prior to final acceptance.

.5 Protect bearings and shafts during installation. Grease shafts and sheaves to prevent corrosion.

3.11 SLEEVES

.1 Provide individual metal sleeves for all pipes, tubes or ducts penetrating all walls and floor slabs. Grout tightly in place for full depth of wall or slab.

.2 Standard sleeves to be standard weight galvanized steel or epoxy coated steel pipe.

.3 Use cast iron or steel pipe sleeve with annular fin continuously welded at midpoint:

.1 Through foundation walls.

.2 Where sleeve extends above finished floor.

.4 Sizes

.1 Refer to mechanical drawings for details.

.2 Provide 6 mm minimum clearance all around, between sleeves and pipe or between sleeve and insulation.

.5 Terminate sleeves flush with vertical surfaces of concrete and masonry and 100 mm above floors.

.6 For pipes passing through roofs, use cast iron sleeves with caulking recess and flashing clamp device. Anchor sleeves in roof construction; caulk between sleeve recess and pipe; fasten roof flashing to clamp device; make water-tight, durable joint.

.7 Voids Around Pipes

.1 Caulk between sleeve and pipe in foundation walls and below grade floors with grout or synthetic caulking compound between sleeve and pipe.

.2 Where sleeves pass through walls or floors, caulk space between sleeve and insulation or between sleeve and pipe with grout or synthetic caulking compound. Seal space at each end of sleeve with waterproof, fire retardant, non-hardening mastic.

.3 Ensure no contact between copper tube or pipe and ferrous sleeve.

.4 Coat exposed exterior surfaces of ferrous sleeves with heavy application of zinc rich paint.

.8 Where pipes and ducts pass through walls and floors having a fire separation rating, pack the space with approved caulking material and seal in accordance with CGSB 19-GP-9.

3.12 ESCUTCHEONS AND PLATES

.1 Install on pipes passing through finished walls, floors and ceilings.

.2 Use chrome or nickel plated brass, solid type with set screws for ceiling or wall mount.

.3 Inside diameter to fit around finished pipe. Outside diameter to cover opening or sleeve.

.4 Where sleeve extends above finished floor, escutcheons or plates to clear sleeve extension.

.5 Secure to pipe or finished surface but not to insulation.

3.13 VIBRATION ISOLATION

.1 Installation

.1 Install vibration isolation equipment in accordance with manufacturer's instructions and adjust mounting to level equipment.

.2 Ensure piping, ducting and electrical connections to isolated equipment do not reduce system flexibility and that piping 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 minimum static deflection as follows:

.1 Up to 100 mm size: first 3 points of support; 150 mm to 200 mm size: first 4 points of support; 250 mm size and larger: first 6 points of support.

.2 First point of support to have static deflection of twice deflection of isolated equipment, but not more than 50 mm.

.4 Where isolation is bolted to the floor avoid short circuiting of sound pads by using vibration isolation washers.

.5 Block and shim level all 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.

3.14 CUTTING AND PATCHING

.1 Minimize cutting and patching required. Set sleeves and mark openings in concrete forms and masonry structure prior to the placement of concrete or masonry.

END OF SECTION

SECTION 15060
PIPING SUPPORT SYSTEMS

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SECTION 15060
PIPING SUPPORT SYSTEMS

1. PART 1 - GENERAL

1.1 SUMMARY

.1 Comply with Division 1 – General Requirements.

1.2 WORK OF THIS SECTION

.1 The work of this section cover the design, sizing, locating, supplying and installing piping support, including piping expansion joints, throughout the facility for all pipes 750 mm and smaller. Provide all materials and labor to install all pipe support systems.

.2 Related specification Sections:

.1 Section 15200-Process Piping

.2 Section 15205-Process Piping Specialties

1.3 REFERENCES

.1 The following is a list of standards which may be referenced in this section. Where referenced guidelines conflict, the more stringent will be applied.

.1 CSA G164, Standard Specification for Hot Dip Galvanizing.

.2 AWWA C220, Stainless Steel Piping

.3 AWWA C226 Stainless Steel Fittings

.4 Ontario Building Code (OBC).

1.4 SUBMITTALS

.1 Shop Drawings:

.1 Complete drawings of piping support systems, locating each support, brace, hanger, guide, component and anchor. Identify support, hanger, guide, and anchor type by catalog number and shop drawing detail number.

.2 Revisions to support systems resulting from changes in related piping system layout or addition of flexible joints.

.3 Calculated loads on each support to confirm safety factor of 5 based upon yield strength of materials is being conformed to or exceeded.

1.5 DESIGN REQUIREMENTS

.1 General:

.1 Provide pipe supports as shown on the Drawings.

.2 Supports shall account for all loads including but not limited to gravity, lateral thrust, temperature and all the other loads encountered by support system during its life span.

.3 Seismic Load: Seismic performance category forces with seismic loads in accordance with local codes and National Building Code of Canada.

.4 Design, size, and locate piping support systems throughout facility for the pipes, whether shown or specified. Provide a minimum safety factor of 5 based upon loads and yield strength of materials.

.5 Supports are shown only where specific types and locations are required. Provide additional pipe supports as required. Where pipe supports are shown on the Drawings consider this as a minimum requirement.

.6 Meet requirements of Manufacturers' Standardization Society (MSS), or as modified by this Section

.1 SP 58, Pipe Hangers and Supports - Materials, Design and Manufacture.

.2 SP 69, Pipe Hangers and Supports - Selection and Application.

.3 SP 89, Pipe Hangers and Supports - Fabrication and Installation Practices.

.2 Pipe Support Systems:

.1 Support Load: Dead loads imposed by weight of pipes filled with water, except air and gas pipes, plus insulation.

.2 Maximum Support Spacing and Minimum Rod Size:

.1 Stainless Steel Piping:

SST Pipe Size (mm)	Maximum Support/Hanger Spacing	Minimum Rod Size Single Rod Hangers
25ø & smaller	1.8 m	6 mm
32ø through 100ø	2.4 m	6 mm
150ø	2.4 m	9 mm
200ø through 300ø	3.0 m	13 mm
350ø & 400ø	3.6 m	16 mm
450ø & 500ø	4.2 m	19 mm
600ø	4.2 m	22 mm
Larger than 600ø	As recommended by manufacturer	

.3 Plastic and FRP piping:

.1 Maximum support spacing: As recommended by manufacturer for flow temperature in pipe.

.2 Minimum Hanger Rod Sizing: Same as listed for steel pipe.

.4 Framing Support System:

.1 Beams: Size such that beam strength with a safety factor of 5 based upon loads and material yield strength and maximum deflection does not exceed 1/240 of span.

.2 Column Members: Size in accordance with manufacturer's recommended method.

.3 Support Loads: Calculate using weight of pipes filled with water.

.4 Maximum Spans:

.1 Steel and Ductile Iron Pipe, 75 mm Diameter and Larger: 3 m centers, unless otherwise shown.

.2 Other Pipelines and Special Situations: May require supplementary hangers and supports.

.5 Anchoring Devices: Size and space support anchoring devices, including anchor bolts, inserts, and other devices used to anchor support, to withstand shear, pullout loads and all other applicable loads imposed by loading and spacing on each particular support.

.6 Vertical Sway Bracing: 3 m maximum centers, or as shown.

2. PART 2 - PRODUCTS

2.1 GENERAL

.1 When specified items are not available, fabricate pipe supports of correct material and to general configuration indicated by catalogs.

.2 Special support and hanger details are shown for cases where standard catalog supports are inapplicable.

.3 Materials: In accordance with Tables 1 and 2, attached as supplements to this section.

2.2 HANGERS

.1 Clevis Type: MSS SP 58 and SP 69, Type 1 or 6.

.1 Anvil; Figure 104 or 260, sizes 15 mm through 750 mm.

.2 B-Line; Figure B3198 or B3100, sizes 10 mm through 750 mm.

.3 Approved Equal

.2 Hinged Split-Ring Pipe Clamp: MSS SP 58 and SP 69, Type 6 or 12.

.1 Anvil; Figure 104, sizes 20 mm through 200 mm

.2 B-Line; Figure B3198H, sizes 10 mm through 750 mm.

.3 Approved Equal

.3 Offset Hanger for PVC Pipe:

.1 Anvil Figure 188

.2 B-Line Figure B3184

.3 Approved Equal

.4 Hanger Rods, Clevises, Nuts, Sockets, and Turnbuckles: In accordance with MSS SP 58.

.5 Attachments:

.1 I-Beam Clamp: Concentric loading type, MSS SP 58 and SP 69, Type 21, 28, 29, or 30, which engage both sides of flange.

.2 Concrete Insert: MSS SP 58 and SP 69, Type 18, continuous channel insert with load rating not less than that of hanger rod it supports.

2.3 WALL BRACKETS

.1 Welded Steel Bracket: MSS SP 58 and SP 69, Type 33 (heavy-duty).

.1 Anvil; Figure 199.

.2 B-Line; Figure B3067.

.3 Approved Equal

.2 One-Hole Clamp: Anvil; Figure 126.

.3 Channel Type:

.1 Unistrut.

.2 Anvil; Power-Strut.

.3 B-Line; Strut System.

.4 Aickinstrut (FRP).

2.4 PIPE CLAMPS

.1 Riser Clamp: MSS SP 58 and SP 69, Type 8.

.1 Anvil; Figure 261.

.2 B-Line; Figure B3373.

.3 Approved Equal

2.5 EXPANSION JOINTS

.1 Flexicraft Model EP rated at 150 and 300 psi or approved equal.

2.6 CHANNEL TYPE SUPPORT SYSTEMS

.1 Channel Size: 12-gauge, 41 mm wide minimum stainless steel; 38 mm wide, minimum FRP.

.2 Members and Connections: Design for all loads with safety factor of 5.

.3 Manufacturers:

.1 B-Line; Strut System.

.2 Unistrut.

.3 Anvil; Power-Strut.

.4 Aickinstrut (FRP System).

2.7 ACCESSORIES

.1 Insulation Shields:

.1 Type: Galvanized steel or stainless steel, MSS SP 58 and SP 69, Type 40.

.2 Manufacturers and Products:

.1 Anvil; Figure 167.

.2 B-Line; Figure B3151.

.3 Approved Equal

.2 Welding Insulation Saddles:

.1 Type: MSS SP 58 and SP 69, Type 39.

.2 Manufacturers and Products:

.1 Anvil; Figure Series 160.

.2 B-Line; Figure Series B3160.

.3 Approved Equal

.3 Vibration Isolation Pads:

.1 Type: Neoprene Waffle.

.2 Manufacturers and Products:

.1 Mason Industries; Type W.

.2 Korfund; Korpad 40.

.3 Approved Equal

.4 Flush Type Insert Channels: As specified in Section 05500, Metal Fabrications (Structural).

2.8 INTERMEDIATE PIPE GUIDES

.1 Piping 150 mm and Smaller:

.1 Type: Pipe clamp with oversized pipe sleeve to provide minimum 3 mm clearance.

.2 Manufacturers and Products:

.1 B-Line; B3148 or B3180.

.2 Anvil; Figure 103.

.3 Approved Equal

.2 Piping 200 mm and Larger:

.1 Type: Specially formed U-bolts with double nuts to provide 6 mm minimum clearance around pipe.

.2 U-Bolt Stock Size:

.1 200 mm Pipe: 16 mm.

.2 250 mm Pipe: 19 mm.

.3 300 mm Through 400 mm Pipe: 22 mm.

.4 450 mm Through 750 mm Pipe: 25 mm.

2.9 PIPE ALIGNMENT GUIDES

.1 Type:

.1 Piping 200 mm and Smaller: Spider or sleeve type.

.2 Piping 250 mm and Larger: Roller type.

.2 Manufacturers:

.1 Flexonics.

.2 Anvil.

.3 B-Line.

2.10 PIPE ANCHORS

.1 Type: Anchor chair with U-bolt strap.

.2 Manufacturers and Products:

.1 Anvil; Figure 198.

.2 B-Line; Figure B3147A or B3147B.

.3 Approved Equal

3. PART 3 - EXECUTION

3.1 INSTALLATION

.1 General:

.1 Install support systems in accordance with MSS SP 69 and MSS SP 89, unless shown or specified otherwise.

.2 Support piping connections to equipment by pipe support and not by equipment.

.3 Support large or heavy valves, fittings, and appurtenances independently of connected piping.

.4 Support pipe at changes in direction or in elevation, adjacent to flexible joints and couplings, and where shown.

.5 Brace hanging pipes against horizontal movement by both longitudinal and lateral sway bracing to reduce movement during startup.

.6 Install lateral supports for seismic loads at all changes in direction.

.7 Install pipe anchors where required to withstand expansion thrust loads and to direct and control thermal expansion.

.8 Repair mounting surfaces to original condition after attachments are made.

.9 Provide and select pipe support system that does not block valves and other parts that require removal for maintenance purpose.

.10 Provide pipe support system that does not block door or window. Pipe support system shall not obstruct movement or access to maintenance work.

.2 Standard Pipe Supports:

.1 Horizontal Suspended Piping:

.1 Single Pipes: Adjustable swivel-ring, split-ring, or clevis hangers.

.2 Grouped Pipes: Trapeze hanger systems.

.3 Furnish galvanized steel protection shield and oversized hangers for insulated pipe.

.4 Furnish precut sections of rigid insulation with vapor barrier at hangers for insulated pipe.

.2 Horizontal Piping Supported From Walls:

.1 Single Pipes: Wall brackets or wall clips attached to wall with anchors. Clips attached to wall mounted framing also acceptable.

.2 Stacked Piping:

.1 Wall mounted framing system and clips acceptable for piping smaller than 75 mm nominal diameter.

.2 Piping clamps that resist axial movement of pipe through support not acceptable.

.3 Wall mounted piping clips not acceptable for insulated piping.

.3 Horizontal Piping Supported From Floors:

.1 Stanchion Type:

.1 Pedestal type; adjustable with stanchion, saddle, and anchoring flange.

.2 Use yoked saddles for piping whose centerline elevation is 450 mm or greater above floor and for exterior installations.

.3 Provide neoprene waffle isolation pad under anchoring flanges, adjacent to equipment or where otherwise required to provide vibration isolation.

.2 Floor Mounted Channel Supports:

.1 Use for piping smaller than 75 mm nominal diameter running along floors and in trenches at piping elevations

lower than can be accommodated using pedestal pipe supports.

.2 Attach channel framing to floors with anchor bolts.

.3 Attach pipe to channel with clips or pipe clamps.

.3 Concrete Cradles: Use for piping larger than 75 mm along floor and in trenches at piping elevations lower than can be accommodated using stanchion type.

.4 Vertical Pipe: Support with wall brackets and base elbow or riser clamps on floor penetrations.

.3 Intermediate and Pipe Alignment Guides:

.1 Provide pipe alignment guides (or pipe supports that provide same function) at expansion joints and loops.

.2 Guide piping on each side of expansion joint or loop at 4- and 14-pipe diameters from each joint or loop.

.3 Install intermediate guides on metal framing support systems not carrying pipe anchor or alignment guide.

.4 Accessories:

.1 Insulation Shield: Install on insulated non-steel piping. Oversize rollers and supports.

.2 Vibration Isolation Pad: Install under base flange of pedestal type pipe supports adjacent to equipment, and where required to isolate vibration.

.3 Dielectric Barrier:

.1 Install between carbon steel members and copper or stainless steel pipe.

.2 Install between stainless steel supports and non-stainless steel ferrous metal piping.

.4 Electrical Isolation: Install 6 mm by 75 mm neoprene rubber wrap between submerged metal pipe and oversized clamps.

3.2 HANGER AND SUPPORT LOCATION

.1 Locate hangers and supports as near as possible to concentrated loads such as valve, flanges, etc. Locate hangers, supports and accessories within the maximum

span lengths specified on drawings to support continuous pipeline runs unaffected by concentrated loads.

.2 Provide hangers and/or base supports within one (1) m of each change in direction on each leg, on one side of each valve, and on the first spool piece or fitting extending from a piece of equipment.

.3 Locate hangers and supports to ensure that connections to equipment, etc. are substantially free from loads transmitted by the piping.

.4 Ensure that where piping is connected to equipment, a valve, piping assembly, etc. that will require removal for maintenance, the piping will be supported in such a manner that temporary supports will not be necessary for this procedure.

.5 Support piping so that no pockets will be formed in the span due to sagging of the pipe between supports caused by the weight of the pipe, medium in the pipe, insulation, valves and fittings.

.6 Install spring hangers where required to offset expansion in horizontal runs which follow long vertical risers.

3.3 ADJUSTMENT OF HANGERS AND SUPPORTS

.1 Adjust hangers and supports to obtain required pipe slope and elevation. Use shims made of material that is compatible with the piping material. Adjust stanchions prior to grouting of base plates.

3.4 FIELD FINISHING

.1 Paint atmospheric exposed surfaces hot-dip galvanized steel components as specified in Section 09900, Painting.

END OF SECTION

SECTION 15070
STATION PIPING AND VALVES

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SECTION 15070
STATION PIPING AND VALVES

1 PART 1 – GENERAL

1.1 INTENT

.1 The Contractor shall furnish and install all piping systems shown and specified, in accordance with the requirements of the Contract Documents. Each system shall be complete with all necessary fittings, hangers, supports, anchors, seismic restraints, expansion joints, flexible connectors, valves, accessories, heat tracing, insulation, lining and coating, testing, disinfection, excavation, backfill and encasement, to provide a functional installation.

.2 The piping shown in the Drawings is intended to define the general layout, configuration, routing, method of support, pipe size, and pipe type. The Drawings are not pipe construction or fabrication drawings. It is the Contractor's responsibility to develop the details necessary to construct all mechanical piping systems, to accommodate the specific equipment provided, and to provide and install all spools, spacers, adapters, connectors, supports, and other appurtenances for a complete and functional system.

.3 Carry out cutting and patching, drilling and fitting under this Section, as required for these piping systems.

1.2 PIPING SYSTEM

.1 All welding procedures used to fabricate pipe shall be prequalified under the provisions of ANSI/AWS D1.1. Welding procedures shall be required for, but not necessarily limited to, longitudinal and girth or spiral welds for pipe cylinders, spigot and bell ring attachments, reinforcing plates and ring flange welds, and plates for lug connections.

.2 All welding shall be done by skilled welders, welding operators, and tackers who have had adequate experience in the methods and materials to be used. Welders shall be qualified under the provisions of ANSI/AWS D1.1 by an independent local, approved testing agency not more than 6 months prior to commencing Work on the pipeline. Machines and electrodes similar to those used in the Work shall be used in qualification tests. The Contractor shall furnish all material and bear the expense of qualifying welders at no increased cost to the Owner.

1.3 MISCELLANEOUS

.1 Refer to the Section 15050 – Basic Mechanical Materials and Methods.

.1 Working Drawings and Equipment Manuals

.2 Special Tools and Accessories

.3 Pipe and Duct Identification

.4 Equipment Guarantee

.5 Material and Workmanship

.6 Installation

.7 Equivalents

.2 Submit complete shop drawings and certificates, test reports, affidavits of compliance, of all piping systems for review by the Engineer in accordance with the requirements in Section 01330 – Submittal Procedures, and as indicated in the individual piping sections. The shop drawings shall include dimensions and details on pipe joints, fittings, fitting specials, harnessed joints, valves, and appurtenances, and shall include design calculations and material lists. The submittals shall include detailed layout, spool, or fabrication drawings which show all pipe spools, spacers, adapters, connectors, fittings, and pipe supports and seismic restraints necessary to accommodate the equipment and valves provided in a complete and functional system based on field measurement as necessary.

.3 Provide six (6) sets of Operation and Maintenance Manuals including equipment descriptions, operating instructions, drawings, troubleshooting techniques, recommended maintenance schedule and recommended lubricants.

.4 Where the assistance of a manufacturer's service representative is advisable in order to obtain perfect pipe joints, supports, or special connections, the Contractor shall furnish such assistance at no additional cost to the Owner.

.5 All piping materials, fittings, valves, and accessories shall be delivered in a clean and undamaged condition and shall be stored off the ground to provide protection against oxidation caused by ground contact. All defective or damaged materials shall be replaced with new materials.

.6 After completion of the Work, all remaining pipe cuttings, joining and wrapping materials, and other scattered debris, shall be removed from the site by the Contractor. The entire piping system shall be handed over to the Owner in a clean and functional condition.

1.4 REFERENCES

.1 Where referenced guidelines conflict, the more stringent will be applied:

.1 AWWA C219 “Bolted Sleeve-Type Couplings on Plain end Pipe”

.2 AWWA C220 “Stainless Steel Piping”

.3 AWWA C226 “Stainless Steel Fittings”

.4 AWWA C2BB “Stainless Steel Flanges”

.5 AWWA C550 “Protective Interior Coatings for Valves and Hydrants”

.6 AWWA C509 “Resilient Seated Gate Valves for Water Supply Service”

.7 NSF/ANSI 61 “Drinking Water System Components – Health Effects”

.8 Manufacturers Standardization Society (MSS) MSS-SP81, Stainless-Steel or Stainless-Steel-Lined, Bonnetless, Knife Gate Valves with Flanged Ends

.9 American National Standards Institute (ANSI) B16.5, 2-24" (50-600mm) Flanges and Flanged Fittings, ANSI 150

2 PART 2 – PRODUCTS

2.1 STAINLESS STEEL (SS) PIPE AND FITTINGS

.1 All stainless steel piping and appurtenances inside pumping station to be 316L stainless steel Schedule 40s unless otherwise noted on the drawings.

.2 All smooth flow fittings fabricated to AWWA C208.

.3 Full face neoprene rubber gaskets.

.4 Factory chemical passivation of all surfaces to ASTM A380

.5 Acid pickling of all external surfaces on completion

.6 Welding to ASME Boiler and Pressure Vessel Code, Section 8 – Unfired Pressure Vessels Section 9 – Welding Qualifications. All welds to have full penetration. Welding to be by the MIG or TIG process.

.7 Submerged Service:

.1 Prevent contact of carbon steel with stainless steel.

.2 All pipe hangers or supports in contact with the stainless steel constructed of stainless steel.

.3 Clean all pipe and fittings with pickling solution prior to being put into service.

2.2 PVC PIPE AND FITTINGS

.1 Solvent welded PVC Piping and fittings, schedule 80 conforming to CSA B137.3.

.2 Socket end type fittings to ASTM D-2467.3.0 Provide sufficient unions to enable easy dismantling of the pipework, particularly where pipes pass thru walls or other physical barriers.

.3 PVC pipe and fitting joints to be socket weld type or flanged.

2.3 PIPE JOINTS

.1 Flanged: Gaskets: Rubber, cloth inserted, 3 mm thick. Nuts and Bolts – ANSI B18.2. Hot-dip galvanized for submerged service.

.2 Welded: In conformance with ASME Boiler and Pressure Vessel Code, Sections 8 and 9. Welders to be registered and certified by the Ministry of Consumer and Commercial Relations or approved by the Canadian Welding Bureau under the requirements of CSA W-47.

.3 Mechanical Coupling: refer to Section 15050 – Basic Mechanical Materials and Methods

2.4 SAMPLING AND CHEMICAL FEED PIPING

.1 20 mm diameter flexible fibre reinforced PVC, HDPE or polypropylene tubing.

2.5 VALVES

.1 Furnish valves complying with the requirements of ASME and ANSI codes with respect to dimensions, materials and service. Clearly mark on the outside of each valve body the manufacturer's name and the valve pressure rating.

.2 Unless otherwise noted, provide valves of cast iron with bronze trim and flanged ends. The bronze material in bronze valves shall conform to ASTM B62; and the cast iron material in iron valves to ASTM A126 (Class B or C).

2.6 CHECK VALVE

.1 Tilted Disc metal seated, full body type capable of accepting optional bottom or top mounted oil dashpots to AWWA C508.

.2 The valve shall be certified to NSF/ANSI 61.

.3 Check valve to be provided with flanges in accordance with ANSI/ASME B16.1

.4 All valves shall be hydrostatically tested and seat tested to demonstrate zero leakage.

.5 The disc must be “pinnable” or lockable in the open position such that the valve can be left open indefinitely, regardless of back pressure.

.6 The exterior and interior of the valve shall be coated with an NSF/ANSI 61 approved fusion bonded epoxy coating.

.7 Manufacturers and Products:

.1 Val-Matic

.2 Apco

.3 Approved Equal

2.7 DUCKBILL CHECK VALVE

.1 Flow of water in one direction only.

.2 Constructed to withstand backpressure with retaining a minimal head loss when fluid flows in the desired direction thru valve.

.3 Made of NSF 61 compliant elastomers.

.4 316 stainless steel clamp(s) or expansion clamp.

.5 Manufacturers for duckbill check valve:

.1 Tideflex TF-1

.2 J & S Valve HedFlex

.3 Or approved equal

2.8 INLINE CHECK VALVE

.1 When line pressure exceeds the backpressure, the line pressure forces the valve membrane open, allowing flow to pass. When the backpressure exceeds the line pressure, or in the absence of any upstream or downstream pressure, the valve membrane is forced closed, preventing backflow.

.2 Inline check valve membrane shall be fully closed and sealed in the normal state when no flow of water/liquid occurs through the pipe.

.3 The membrane shall withstand abrasives such as sand, detritus and normal chemicals found in waste water and shall be made of reinforced rubber.

.4 Each inline check valve shall be labelled with flow direction and unique serial number.

.5 Inline check valves shall allow for installation at an inlet using flanged connections.

.6 Inline check valve membrane shall be:

.1 mounted in a housing that, during installation, is to be inserted as-is on site into an existing pipe

.2 inherently resistant to microbiological attack over long periods

.3 resistant to oxygen, ozone and UV light

.7 Manufacturers for inline check valve:

.1 Red Valve Tideflex - Checkmate

.2 Wapro – WaStop

.3 Proco – ProFlex Style 790

.4 Or approved equal

2.9 BUTTERFLY VALVE

.1 Butterfly valves shall be in accordance with AWWA C504, Class 150B, short body design.

.2 Class 150B rubber-seated, short body design, flanged to ANSI B16.1 Class 125 for sizes greater than 300 mm diameter and lug-type wafer style for smaller diameters to AWWA C504.

.3 Cast iron body and disc, 316L stainless steel stem, EPDM seat. Cast iron or ductile iron are acceptable for body and disc material for butterfly valves.

.4 Interior coatings must be compliant with NSF 61, AWWA C550 and AWWA C509. Butterfly valves to be internally and externally coated with fusion bonded epoxy coating.

.5 Fully enclosed geared operators where shown and as required to limit hand wheel pulls to a maximum of 350 N under the full differential pressure rating and oriented to facilitate ease of operation: hand wheel actuators on all manually operated valves and electric actuators where indicated on the drawings.

.6 Manufacturers:

.1 Clow Canada

.2 Watts

.3 Val-Matic

2.10 BALL VALVE

.1 Ball valves to be manufactured in accordance with AWWA C507 and certified to NSF61 and NSF372 Lead Free Standards. Ball valves to be constructed with cast iron or ductile iron bodies and ball and stainless steel body seat to match specified pressure rating.

.2 ANSI Class 1,035 kPa valve with flanged ends, Type 317 stainless steel body, ASTM A351, Grade CG8M.

.3 317 stainless steel heat treated nickel overlay, ASTM A351, Grade CG8M ball.

.4 Splined-type 17-4 PH stainless steel shafts, reinforced PTFE flow-ring seal, reinforced PTFE with stainless steel or Hastelloy sleeve bearings, and PTFE V-ring packing.

.5 Valve to have 300:1 range-ability and equal percentage characteristic.

.6 Valves shall seal tightly at rated pressure and be capable of operation after long periods of inactivity. Valves to include blow-out proof shaft protection, high flow capacity, splined ball-to-shaft connection for ease of maintenance and zero backlash.

.7 Nominal size, pressure rating, year of manufacture and manufacturer's name or mark shall be cast onto the valve body or be permanently attached on a nameplate.

.8 Valve must be constructed for potable water service certified NSF 61 or certified NSF 372, and AWWA C550. Ball valves to be both internally and externally coated with an NSF 61 epoxy.

.9 All seals and gaskets in contact with water must be NSF 61 certified.

.10 Actuation to be provided as shown on the drawings.

.1 Provide totally enclosed and sealed worm gear actuator with position indicator. The worm segment gear and worm shaft shall be ductile iron with precision bore and keyway for connection to the valve shaft.

.2 All gear actuators shall be designed to withstand a rim pull of 200 lb. on the hand wheel and input torque of 300 ft-lbs for nuts.

.3 Electric Actuators to be provided as recommended by the manufacturer by as supplied by:

.1 Rotork

.2 Auma

.11 Manufacturers

.1 DeZURIK Canada Inc.

.2 GA Industries, Inc. (Golden Anderson).

.3 Approved Equivalent

2.11 PLUG VALVE

.1 Plug Valves shall be quarter-turn, non-lubricated with resilient encapsulated plug.

.2 Valves are flanged and shall have flanges with drilling to ANSIB16.1, Class 125.

.3 Valve bodies and covers shall be constructed of ASTM A126 Class B cast iron for working pressures up to 175 psig

.4 Valve shall have a valve seat applied directly to the body on a pre-machined, cast seating surface and machined to a smooth finish.

.5 Valve plugs shall be of one-piece construction and made of ASTM A126 Class B cast iron or ASTM A536 Grade 65-45-12 ductile iron and fully encapsulated with resilient facing per ASTM D2000-BG.

.6 Both the packing and bearings in the upper and lower journals shall be protected by a Grit-Guard™ “drip tight” Buna-N shaft seal located on the valve shaft to minimize the entrance of grit into the bearing journal and shaft seal areas.

.7 Permanently lubricated, radial shaft bearings shall be supplied in the upper and lower bearing journals. Thrust Bearings shall be provided in the upper and lower journal areas.

.8 Plug Valve will be supplied with extension stem to surface, connected to pedestal with an Electric Actuator mounted on top to operate the Plug Valve.

.9 Electric Actuator will be used in a modulating application. Electric Actuator shall be sized based on torque required to open and close the valve under the full pressure rating of the valve taking into consideration the stem length.

.10 A safety factor of 2 times the torque required to operate the valve when exposed to pressures equaling the full rated pressure of the valve accounting for the stem extension.

.11 Manufacturers

.1 Val-Matic

.2 DeZURIK Canada Inc.

.3 Approved equal

.12 Actuation to be provided as shown on the drawings.

.1 Unit to be 575 V, 60 Hz, 3 Ph

.2 Electric Actuator shall be suitable for outdoor service.

.3 Controls with local & remote capability to be included.

.4 Manual Handwheel override to be included.

.5 Electric Actuators to be provided as recommended by the manufacturer by as supplied by:

.1 Limitorque

.2 Auma

.3 Rotork

.4 Approved equal

2.12 GATE VALVE

.1 Resilient seated gate valve, cast iron body and disc, flanged to ANSI B16.1 Class 125, to AWWA C509, painted finish to AWWA standards.

.2 Interior & exterior, NSF 61 electrostatically applied fusion bonded epoxy coated and to AWWA C509.

.3 Full size waterway to allow for tapping use w/ no cavities /depressions in the seat area.

.4 Shaft spindle with resilient “O” rings.

.5 Valves to open in counter clockwise direction.

.6 Stainless Steel Nuts, bolts and bolt studs.

.7 Bronze pint top adjustment not permitted.

.8 Operator: waterproof type for continuous submergence, greased packed and enclosed gear type.

.9 Manufacturers:

.1 Clow Canada

.2 Mueller

.3 AVK

.4 Approved equal

2.13 KNIFE GATE VALVES

.1 Resilient neoprene or Viton seat, outside stem and yoke, rated for 1035 kPa cold water, ANSI B16.1 150 lb flanged ends, self cleaning, nonclogging, with round port, drip tight shutoff, non-rising extended stem suitable for bi-directional service.

.2 Complete with hand wheel up to 300 mm, 350 mm and larger with gear.

.3 Provide 2 limit switches for each valve: Open Status (DI) and Closed Status (DI).

.4 Body and stem, Type 316 stainless steel, yoke sleeve bronze, gate finish ground both sides with a sharp knife edge.

.5 Packing system leak tight seal around the gate, VITON O-rings, valve superstructure and yoke designed for full peripheral access to gland bolts when valve is equipped with manual or power actuator.

.6 In compliance with MSS SP 81.

.7 Manufacturers:

.1 Trueline Valve Corporation

.2 Orbinox Valves International

.3 Stafsjo Valves AB (Part of Broer Group Company)

.8 Actuation to be provided as shown on the drawings.

.1 Unit to be 575 V, 60 Hz, 3 Ph

.2 Controls with local & remote capability to be included.

.3 Manual Handwheel override to be included.

.4 Electric Actuators to be provided as recommended by the manufacturer by as supplied by:

.1 Limitorque

.2 Auma

.3 Rotork

.4 Approved equal

2.14 SMALL VALVES

.1 All valves to be permanently marked with chemical resistant labels.

.2 Full ported, full blocking, PVC ball valves, threaded, true union configuration, materials selected for intended duty, by:

.1 Chemline

.2 Plastomatic

.3 GF Piping Systems.

.3 True union, threaded PVC back-pressure valve with integral check function, designed for pulsation dosing applications, by:

.1 Chemline

.2 Plastomatic

.3 GF Piping Systems

.4 True union, full port, PVC ball check valves by:

.1 Plastomatic

.2 Chemline

.3 GF Piping Systems

.5 True union back pressure/ relief valves PVC, EPDM static seals, schedule 80

.1 Plastomatic

.2 Chemline

.3 GF Piping Systems

.6 Stainless steel isolation ball valves on all instrument sensing lines. Full port, stainless steel complete with Type 316 S.S. ball and stem. Packing, reinforced PTFE Durafill or TFM 1600 seats. 304 S.S. lockable handle, NPT ends.

.1 Watts Canada S-FBV-1

.2 Dwyer Series BV2M

.3 Mueller Co.

.4 Approved Equal

2.15 VALVE OPERATORS

.1 General:

.1 Operator force not to exceed 18 kg under any operating condition, including initial breakaway. Gear reduction operator when force exceeds 18 kg.

.2 Operator self-locking type or equipped with self-locking device.

.3 Position indicator on quarter-turn valves.

.4 Worm and gear operators one-piece design worm-gears of gear bronze material. Worm hardened alloy steel with thread ground and polished. Traveling nut type operators threaded steel reach rods with internally threaded bronze or ductile iron nut.

.2 Exposed or Submerged Operator:

.1 Galvanized and painted handwheels.

.2 Cranks on gear type operators.

.3 Chain wheel operator with tiebacks, extension stem, floor stands, and other accessories to permit operation from normal operation level.

.4 Valve handles to take a padlock, and wheels a chain and padlock.

2.16 AIR RELEASE VALVE

.1 Valves shall be manufactured and tested in accordance with AWWA C512, and certified to NSF/ANSI 61.

.2 The cover shall be bolted to the valve body and sealed with a flat gasket. Resilient seats shall be replaceable and provide drop tight shut off to the full valve pressure rating.

.3 Valves 3 in. (76mm) and smaller shall be threaded with NPT inlets and outlets. The body inlet connection shall be hexagonal for a wrench connection. Larger valves shall have ANSI Class 125 flanged inlets.

.4 Floats shall be unconditionally guaranteed against failure including pressure surges. Mechanical linkage shall provide sufficient mechanical advantage so that the valve will open under full operating pressure. Simple lever designs shall consist of a single pivot arm and a resilient orifice button. Compound lever designs shall consist of two levers and an adjustable threaded resilient orifice button.

.5 The valve body and cover shall be constructed of ASTM A126 Class B cast iron for working pressures up to 300 psig. Higher pressure rated valves shall be constructed of ASTM A536 Grade 65-45-12 ductile iron.

.6 The orifice, float and linkage mechanism shall be constructed of Type 316 stainless steel. The orifice button shall be Viton for simple lever valves and Buna-N for compound lever designs.

.7 Valve interiors and exteriors shall be coated with an NSF/ANSI 61 certified fusion bonded epoxy in accordance with AWWA C550 when specified.

.8 Sizes as specified on drawings.

.9 Manufacturers:

.1 Val-Matic

.2 Apco

.3 Approved Equal

2.17 AIR VACUUM VALVE

.1 Valves shall be manufactured and tested in accordance with AWWA C512, and certified to NSF/ANSI 61.

.2 A bolted cover with alloy screws and flat gasket shall be provided to allow for maintenance and repair.

.3 Valve sizes 3 in. (76 mm) and smaller shall have full size NPT inlets and outlets equal to the nominal valve size. The body inlet connection shall be hexagonal for a wrench connection. Valve sizes 4 in. (100 mm) and larger shall have bolted flange inlets with threaded or plain outlets and protective hoods. Flanges shall be in accordance with ANSI B16.1 for Class 125 or Class 250 iron flanges and ANSI B16.5 for Class 150 or Class 300 steel flanges.

.4 Floats shall be unconditionally guaranteed against failure including pressure surges. The float shall have a hexagonal guide shaft supported in the body by circular bushings to prevent binding from debris. The float shall be protected against direct water impact by an internal baffle.

.5 The resilient seat shall provide drop tight shut off to the full valve pressure rating. The seat shall be a minimum of .5 in. (12 mm) thick and secured in such a manner as to prevent distortion. Valves with working pressures above 400 psig (2760 kPa) shall have metal seats with synthetic seals.

.6 On valve sizes 4 in. (100 mm) and larger, the cover shall be fitted to the valve body by means of a machined register to maintain concentricity between the top and

bottom guide bushings at all times. The float shall be double guided with a guide shaft extending through the float to prevent any contact with the body. A resilient bumper shall be provided to cushion the float during sudden opening conditions.

.7 The valve body, cover, and baffle shall be constructed of ASTM A126 Class B cast iron for Class 125 and Class 250 valves. Class 300 ductile iron valves shall be constructed of ASTM A536 Grade 65-45-12 ductile iron. Class 300 steel valves shall be constructed of ASTM A216 Grade WCB cast steel.

.8 The float, guide shafts, and bushings shall be constructed of Type 316 stainless steel. Resilient seats shall be Buna-N. Class 300 steel valves shall have a 316 stainless steel Seat with Buna- N seal to provide an initial contact to Buna-N with final metal to metal contact to prevent over compression of the resilient seal.

.9 Valve interiors and exteriors shall be coated with an NSF/ANSI 61 certified fusion bonded epoxy in accordance with AWWA C550 when specified.

.10 Sizes as specified on drawings.

2.18 SURGE RELIEF VALVE

.1 Valves must be pressure relief valves designed with rate-of-rise pressure differential pilots and with staggered set-points to be determined.

.2 Single seat hydraulically operated pilot valve diaphragm type globe valve, isolating ball valve on pilot system and limit switch mounted on the valve stem.

.3 Valves must be angle style and must be able to discharge to atmosphere (drain line).

.4 The valve will open rapidly on an over-pressure caused by surges in the pipeline.

.5 The valve must anticipate a surge by sensing a rapid increasing in pressure as the surge wave returns and opens fully with no stroke limiters on the valve opening.

.6 The valve must begin slowly closing when the system pressure falls below the high pressure set-point of the valve piloting until it fully closes regardless of static pressure in the pipeline.

.7 The valve shall have a protective fusion bonded epoxy coating internally and externally that conforms to the most current editions of ANSI/AWWA C116/A21.16 and NSF 61.

.8 Pilots shall be bronze ASTM B62 with a spring range of 20 to 200 psi. Pilot should also be field adjustable without the use of any special tools.

.9 Sizes as specified on drawings.

.10 Manufacturers:

.1 Singer

.2 Golden Anderson

.3 Cla-Val

3 PART 3 – EXECUTION

3.1 PIPE JOINTS – GENERAL

.1 Flanges

.1 Unless otherwise specified, supply full faced one piece gaskets for all flanged joints. Provide gaskets of 3 mm thick rubber with cloth insertion.

.2 For raised face flanges, provide gaskets of the one piece, soft, flat ring type, tangent to the bolt circle. Gaskets to ANSI B16.21 on ANSI B16.20.

.3 Unless otherwise specified, provide bolts and nuts of the Coarse Thread Series (UNC), and conforming to ANSI B18.2. For sizes 29 mm diameter and below, provide the conventional type with material conforming to ASTM A-307 (Grade B). For bolts and studs, 32 mm diameter and above, provide material conforming to ASTM A-193 (Grade B-7) or to ASTM A-325 (SAE Grade 5). Provide nuts conforming to ASTM A-194 Grade 2H. Furnish bolts having hexagonal heads and held with hexagonal semi-finished nuts. Provide bolt lengths that will not project beyond the nut more than 12 mm or less than 6 mm. Provide no bolt less than the diameter of the hole in which it fits by more than 3 mm.

.4 Utilize bolts for all flanged joints. Studs or “stud bolts” may be used for certain special connections only when permitted by the Engineer.

.5 Unless otherwise specified, provide large diameter bolts and nuts which are hot-dip galvanized in damp areas such as valve chambers, and submerged areas.

.2 Mechanical Groove Couplings

.1 Provide mechanical groove couplings designed for the same Design and Field Test pressure ratings as their respective pipelines. Carefully clean and coat all surfaces at joints with an approved soap solution before placing. Construct joints with care and accuracy after the ends have been properly set to receive them. Tighten all nuts evenly around the joint and ensure bolt pads are metal to metal. Separate ends of adjacent pipe to be connected with a mechanical-groove coupling to the proper dimension.

.2 Provide hot-dip galvanized bolts and nuts unless otherwise specified. Provide gaskets suitable for the intended service throughout.

.3 Prepare pipe ends to fit the type of coupling to be used. The outer surface of the pipe ends will be free from surface defects and have the longitudinal or spiral welds ground to surface for a sufficient distance from the ends to permit the pipe to make a watertight joint with the coupling.

.3 Field Welding

.1 Welding to conform to the ASME Boiler and Pressure Vessel Code, Section 8 – Unfired Pressure Vessels, and Section 9 – Welding Qualifications. Carry out welding with the services of a fabricator fully certified and approved by the Ministry of Consumer and Commercial Relations or by the Canadian Welding Bureau, under the requirements of CSA W47.

.2 Provide field welding conforming to the general requirements of AWWA C-206 “Field Welding of Steel Water Pipe Joints”.

.3 Cut pipes in the field for closing pieces and other field joints with an approved cutting torch to a smooth uniform level.

.4 Provide smooth edges, not serrated, and grind them smooth if they are rough after cutting. Do not smooth rough edges by hammering.

3.2 PIPES THROUGH WALLS, ETC.

.1 Unless otherwise specified, set pipes through walls, floors and roofs of concrete or similar material in suitable openings for grouting in place under the Concrete Section - 03300. Provide suitable pipe connections on both sides of the opening to permit ready dismantling of the pipelines.

.2 For pipes passing through concrete block walls, place a 6 mm thick strip of non-bituminous type joint filler between the pipe and the grout to provide for pipe expansion. Provide joint filler of sponge rubber equal to ASTM D1752, Type 1.

.3 For pipes passing through double walls use the same joint filler as specified above. Ensure that the joint sealer and its application conform to Type ‘C’ joint sealer as specified in the Concrete Accessories Section.

.4 Where required for anchoring steel pipe, furnish thrust rings in the number and thickness required to absorb the full thrust imposed by the Field Test Pressure. Provide thrust rings of steel plate not less than 6 mm thick; reference AWWA M11.

.5 Provide all openings necessary for the installation of the piping. See the Concrete Section - 03300 for details of the concrete work associated with pipe openings.

3.3 SUPPORTS

.1 Carefully align and support all pipe fittings before the joints are securely bolted in order to prevent excessive stresses in the pipes. Take special care to see that the pipe is not moved thereafter. Unless otherwise shown or specified, provide a distance between supports, for metallic pipe, of not greater than 2.5 m. For steel pipe racks, space as shown on the Drawings and, in any case, not greater than 3 m.

.2 Install concrete supporting piers for pipes placed near the floor level, and approved thrust anchors at all points of change in pipe direction. Securely support piping by brackets or hangers well fastened to inserts in walls and ceilings. Support vertical pipes by lateral struts secured to adjacent walls.

.3 Supply hangers of the clevis type equal to “Anvil” manufacture, and arrange to suit the direction of thermal expansion and contraction. Perforated hangers are not permitted. Furnish brackets of heavy steel construction, equal to “Anvil”. Provide special supports as shown. Provide galvanized hanger rods.

.4 Supply concrete fasteners for pipe supports equal to HILTI or “Phillips Redhead” cinch anchors and of ample capacity for the loading envisaged.

.5 Furnish field welded structural steel pipe racks of the general design shown on the Drawings. Fabricate them of structural steel members having ample size for all conditions of loading.

.6 Otherwise, provide supports as follows:

.1 25 mm diameter and less; 2 m centres maximum;

.2 Greater than 25 mm diameter; 2.5 m centres maximum.

3.4 PIPE COATING

.1 Shop coat pipe, fittings and related appurtenances, unless otherwise specified. Remove all mill scale, rust and foreign matter prior to coating.

.1 Steel Piping: Primer Exterior Surfaces: Painting in accordance with Section 09900.

.2 Mechanical Groove, Sleeve Couplings, and other Pipe Couplings; same treatment as associated pipes.

.3 Bolts and nuts used underground or submerged couplings; coat with an approved varnish or bitumastic solution after connection.

.2 Wrap all fabricated steel piping buried in earth with Denso Wrap (primer, mastic and tape) from Denso North America, PetroWrap (primer, mastic and tape), Trenton No. 1 Wax Tape (primer, mastic and tape) or Approved Equal.

.3 Touch-up interior and exterior coatings damaged from field welding or other causes to the satisfaction of the Engineer.

3.5 TESTING AND CLEANING PRIOR TO SETTING

.1 Before setting into place and while suspended, inspect the pipe or fittings for defects and ring with a light hammer to detect cracks. Reject any defective, damaged or unsound pipe. Remove all lumps, blisters and excess coating from flanged ends. Ensure pipe is clean and dry and free from oil and grease before setting.

3.6 INSTALLATION

.1 Install all pipes and fittings according to the lines, elevations and dimensions shown. Install all definitely dimensioned pipes and fittings before fitting make-up pieces. Join the piping so that no stress or strain is created in the lines and associated equipment due to forcing parts into position.

.2 The piping shown on the Drawings and specified herein indicates general arrangement only. Complete the piping in all respects and in accordance with best practice in the field. Co-ordinate the work under this Section with other trades, in particular the structural work. Make necessary adjustments to the runs to accommodate structural conditions, plant piping, plumbing, process equipment and so forth.

.3 Install all pipe runs straight, true and parallel, and run at a proper slope to drain.

.4 Install piping to clear and provide service for future equipment.

.5 Make ample allowance for expansion and contraction in all pipes, by means of offsets, elbows, bends etc., expansion joints and so forth. In addition, provide suitable flexible joints in all piping crossing structural expansion joints.

.6 For dismantling purposes, install mechanical-groove couplings or unions where shown and where required by good practice. For piping 60 mm diameters and larger use mechanical-groove couplings. For piping 50 mm diameter and smaller, use unions as follows:

.1 Copper Tubing: Cast Bronze Solder Type

.2 Steel: Forged Steel Bronze Seat

.7 Do not use close right and left hand nipples. Provide nipples of such length that the correct size of pipe wrench can be used on them when in place.

.8 Use dielectric fittings, fitted as required to resist galvanizing action between ferrous and copper elements of the various systems. In particular, fit copper branch lines

off steel or cast iron headers with a screwed steel nipple, screwed gate valve, screwed dielectric coupling and copper tubing.

.9 Where required and where shown, furnish prefabricated steel piping connecting two fixed points with a loose steel slip-on flange suitable for field welding after exact fitting-up. Touch up the interior finish to the satisfaction of the Engineer.

.10 Provide temporary bracing and supports to adequately support the pipe during its installation and take care in placing piping to prevent damage to the pipe or pipe coating or to adjacent structures or equipment. Ensure that all supporting piers and blocking are in place before temporary supports and bracing are removed.

.11 On completing the installation, carefully clean the inside of the pipe of tools, scrap, dirt and debris. Fully flush out the lines with water and air prior to inspection by the Engineer.

.12 Where required and where shown, make temporary connections and subsequently permanent connections.

3.7 TESTING

.1 Give 48 hour written notice of date of tests.

.2 Insulate and/or conceal work only after testing is satisfactorily completed.

.3 Conduct all tests in the presence of the Engineer.

.4 Bear all costs of testing including retesting and making good.

.5 Maintain test pressures for at least 4 hours unless otherwise specified.

.6 Working pressure of piping to be 1035 kPa. Piping to be tested to 1035 kPa water pressure. 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 Test equipment as specified in the relevant sections and as a minimum, demonstrate that each piece of equipment operates as specified.

.9 Prior to tests, isolate all equipment or other parts that are not designed to withstand test pressures.

3.8 FLUSHING AND DISINFECTION

.1 After cleaning and prior to placing process piping into service, fill the piping with a minimum 50 mg/L chlorine solution and maintain in place for 24 hours. If the concentration falls to less than 25 mg/L after 24 hours repeat the process.

.2 Dispose of the disinfecting solution by flushing with potable water and discharging to waste using an approved neutralizing agent to ensure that chlorine residual concentrations are less than 0.5 mg/L and within regulatory limits.

.3 The disinfection water shall be disposed of in a manner which will not adversely affect the area of discharge. The watermain is then recharged and samples shall be taken and sent to the department of Health Laboratory for testing, test results obtained and clearance given by the local Health Unit.

.4 Take a minimum of 2 samples for bacteriological testing in accordance with Region standard procedures and submit for testing. Testing will be carried out by the Region at its cost.

.5 If the tests are un-successful repeat the disinfection procedures and pay for all subsequent bacteriological testing.

3.9 CERTIFICATION

.1 On completion of installation and testing of all equipment, submit the manufacturer’s certification of the correctness of the installation to the Engineer.

END OF SECTION

SECTION 15130
THERMOMETERS AND PRESSURE GAUGES

PART 1 - GENERAL

1.1 WORK INCLUDED

.1 Provide all thermometers and pressure gauges, complete with all necessary accessories.

1.2 SUBMITTALS

.1 Submit shop drawings and product data for the following:

.1 Thermometers.

.2 Pressure gauges.

.3 Stop cocks.

.4 Syphons.

.5 Wells

.2 Provide a schematic drawing of each piping system indicating the position and range of each thermometer and pressure gauge.

.3 Provide samples of each type of thermometer, pressure gauge and all accessories.

.4 Provide maintenance data for incorporation into Operating and Maintenance Manuals.

PART 2 - PRODUCTS

2.1 GENERAL

.1 Provide thermometers and pressure gauges to operate at mid-point of scale or range.

2.2 DIRECT READING THERMOMETERS

.1 Provide industrial, variable angle type, liquid filled, 230 mm (9") scale length to CGSB

standards.

2.3 REMOTE READING THERMOMETERS

.1 Provide remote reading thermometers, 100 mm (4") mercury activated dial type, stainless steel bourdon type, brass movement, stainless steel capillary, stainless steel spiral armour, stainless steel bulb and stainless steel case for wall mounting.

2.4 THERMOMETER WELLS

.1 Provide copper or bronze thermometer wells for copper pipe. For steel pipe, use stainless steel.

2.5 PRESSURE GAUGES

.1 Provide 100 mm (4") dial type pressure gauges to CGSB standards, having 1/2 of 1% accuracy unless otherwise specified.

.2 Provide bronze stop cock and:

.1 Syphon for steam service.

.2 Snubber for pulsating operation, including at all pumps.

.3 Diaphragm for corrosive service.

PART 3 - EXECUTION

3.1 INSTALLATION

.1 Install thermometers and gauges such that they can be easily read from floor or platform. If this cannot be accomplished, install remote reading thermometers and gauges.

3.2 THERMOMETERS

.1 Install in wells on all piping.

.2 Install in locations as indicated and on inlet and outlet of:

.1 Heat exchangers.

.2 Water heating and cooling coils on air handling units.

.3 Water boilers.

.4 Chillers.

.5 Cooling towers.

.6 Domestic hot water tanks.

.3 Use extensions where thermometers are installed through insulation.

3.3 PRESSURE GAUGES

.1 Install in following locations:

.1 Suction and discharge of pumps.

.2 Upstream and downstream of pressure reducing valves.

.3 Inlet and outlet of heat exchangers.

.2 Provide pressure taps on the inlet and outlet side of air handling unit coils.

.3 Use extensions where pressure gauges are installed through insulation.

END OF SECTION

SECTION 15190
MECHANICAL IDENTIFICATION

PART 1 - GENERAL

1.1 WORK INCLUDED

.1 Provide a complete system of identification.

1.2 EQUIPMENT

.1 Manufacturer's Nameplates

.1 Provide metal nameplates on each piece of equipment, mechanically fastened with raised or recessed letters.

.2 Provide Underwriters' Laboratories and CSA registration plates, as required by respective agency.

.3 Manufacturer's nameplate to indicate size, equipment model, manufacturer's name, serial number, voltage, cycle, phase and power of motors.

.4 Locate nameplates so that they are easily read. Do not insulate or paint over plates.

.2 System Nameplates

.1 Provide laminated plastic plates with black face and white centre of minimum size 90 X 40 X 2.5 mm (3-1/2" X 1-1/2" X 1/8") nominal thickness, engraved with 6 mm (1/4") high lettering. Use 25 mm (1") lettering for major equipment.

.2 Fasten nameplates securely in conspicuous place. Where nameplates cannot be mounted on cool surface, provide standoffs.

.3 Identify equipment designation and number.

.4 Submit list of nameplates for review prior to engraving.

1.3 PIPING

.1 Identify medium in piping with markers showing name and service, including temperature, pressure and directional flow arrows in accordance with CGSB 24-GP-3a.

.2 Conform to CGSB 1-GP-12c+Amdt-Dec-84. Colour Coding System Schedule for new buildings.

.3 Primary colour paint to conform to CGSB 1-GP-60M.

.4 Manufactured pipe markers and colour bands:

.1 Plastic coated cloth material with protective overcoating and waterproof contact adhesive undercoating, suitable for continuous operating temperature of 150°C (302°F) and intermittent temperature of 200°C (392°F). Apply to prepared surfaces.

.2 50 mm (2") wide tape single wrap around pipe or pipe covering with ends overlapping one pipe diameter but not less than 25 mm (1") for colour bands.

.3 Block capital letters 50 mm (2") high for pipes of 75 mm (3") nominal and larger outside diameter (including insulation) and not less than 20 mm (3/4") high for smaller diameters.

.4 Direction arrows 150 mm (6") long by 50 mm (2") wide for piping of 75 mm (3") nominal or larger outside diameter including insulation, and 100 mm (4") long by 20 mm (3/4") wide for smaller diameters. Use double headed arrows where direction of flow is reversible.

.5 Waterproof and heat resistant plastic marker tags for pipes and tubing 20 mm (3/4") nominal and smaller.

.6 Black pipe marker letters and direction arrows, white on red background for fire protection markers.

.5 Identify piping with full description of medium using only abbreviations indicated in the Legend on the Drawings.

.6 Location

.1 Locate markers and classifying colours on piping systems so they can be seen from floor or platform.

.2 On each piping run at least once in each room.

.3 Maximum 15 m (50') between identifications in open areas.

.4 Both sides where piping passes through walls, partitions and floors.

.5 At point of entry and leaving, where piping is concealed in pipe chase or other confined space, and at each access opening.

.6 At start and end points of runs and at each piece of equipment.

.7 At major manual and automatic valves immediately upstream of valves.

.8 Identify branch, equipment or building served after valve.

1.4 DUCTWORK

.1 Use 50 mm (2") high black stencilled letters (eg. "Supply Air", "Return Air", "Sanitary Exhaust", "General Exhaust") with directional flow arrow.

.2 Maintain maximum 15 m (50') distance between markings.

.3 Identify ducts each side of dividing walls or partitions and beside each access door.

.4 Stencil over final finish only.

1.5 VALVES AND CONTROLLERS

.1 Provide brass tags with 12 mm (1/2") stamped code lettering and numbers filled with black paint, secured with non-ferrous chains or "S" hooks for valves and operating controllers except at plumbing fixtures and radiation and except in plain sight of equipment they serve.

.2 Provide Consultant with six identification flow diagrams of approved size for each system. Include tag schedule, designating number, service, function, and location of each tagged item and normal operating position of valves.

.3 Install where directed one copy of flow diagram and valve schedule mounted in glazed frame. Provide one copy in each operating and maintenance manual.

.4 Consecutively number valves in systems.

END OF SECTION

SECTION 15230
ELECTRIC HEATING

PART 1 - GENERAL

1.1 WORK INCLUDED

.a Provide electric heaters where indicated on the Drawings.

.b Refer to Schedules for types, electrical characteristics, control requirements and finish.

.c Refer to the Drawings for location and heating capacity.

.d Unless otherwise indicated, power supply shall be provided by Division 16. This Division shall install heaters and provide all necessary control wiring including wiring to line voltage thermostats.

1.2 SUBMITTALS

.a Submit shop drawings for each type of electric heating in accordance with Section 15010 and including the following:

.i Schedule of heaters indicating type, location, voltage, phase, heating capacity, control and finish.

.ii Control schematics.

.iii Catalogue data sheets for all control devices including thermostats, low voltage relays, etc.

.b Provide data for inclusion in the Operating and Maintenance Manuals in accordance with Section 15010.

PART 2 - PRODUCTS

2.1 GENERAL

.a All electric heaters shall be CSA approved for the application indicated.

.b Heating capacities shown on the drawings are net output at the specified voltage and phase.

2.2 DUCT HEATERS

.a Provide open coil electric duct heaters with grounded metal mesh screens.

.b Rigid steel mounting framework to permit coil removal without dismantling ductwork of equipment. Provide mounting flanges as required.

.c Protection

.i Linear thermal high limit control with automatic reset.

.ii Secondary linear thermal high limit control with manual reset.

.iii Pressure differential switch to shutdown power to coil upon loss of air flow.

.d Provide complete temperature control package as indicated in the Schedules including:

.i Control panel attached to heater.

.ii Disconnect switch.

.iii Control transformer.

.iv Contactors for each step of control.

.v Fuse protection as required.

.vi SCR or step controllers where specified.

2.3 BASEBOARD HEATERS

.a Unless otherwise indicated, baseboard heaters shall be standard watt density.

.b Baseboard heaters shall be prefinished with baked enamel paint. Unless otherwise indicated, provide manufacturer's standard colour.

.c Heating elements shall be locked to cabinet and supported with non-metallic bushings to allow for expansion.

.d Provide full length thermal cut-out with automatic reset.

.e Where baseboard heaters are specified with continuous enclosure, provide inside and outside corners, blank sections, splice plates and end caps as necessary. All enclosure pieces shall be fully enclosed to allow branch circuit wiring.

.f Provide temperature control components as specified in the Schedules.

2.4 FAN FORCED HEATERS

.a Provide fan forced heaters as specified in the Schedules for fully recessed, semi-recessed or surface mounted. Provide all accessories required for type of mounting indicated.

.b Provide 16 gauge steel cabinet with punched grilles. Finish cabinet with prime coat paint finish suitable for site painting.

.c Provide forward curved fans with permanent split capacitor motor with integral overload protection.

.d Provide automatic reset thermal cut-out.

.e Provide temperature control components as specified in the Schedules.

2.5 UNIT HEATERS

.a Provide vertical or horizontal electric unit heaters designed suspension from building structure.

.b Units shall be constructed of heavy gauge galvanized steel with brackets to accept mounting rods. Heaters shall be prefinished with baked enamel paint in manufacturer's standard colour.

.c Provide propeller type fans with permanent split capacitor motor with integral overload protection. Motors shall be permanently lubricated.

.d Provide adjustable directional discharge air louvres on horizontal unit heaters and fixed pattern diffusers for vertical unit heaters.

.e Provide automatic reset thermostat for remote mounting. Provide transformer, contractor and integral continuous fan switch.

PART 3 - EXECUTION

3.1 INSTALLATION

.a Install electric heaters in accordance with manufacturer's installation instructions.

.b Locate thermostats where shown on the drawings and provide all wiring between

thermostats and heaters.

.c Mount electric baseboard heaters 25 mm (1") above finished floor or as detailed on the Drawings.

.d Site measure enclosures for baseboard heaters where continuous enclosure is specified.

.e Test all electric heaters to verify operation of heating elements and all controls.

END OF SECTION

SECTION 15240
SOUND ATTENUATION

PART 1 - GENERAL

1.1 WORK INCLUDED

.1 Provide sound attenuation and accessories to achieve the following sound levels:

.1	Offices:	NC 35.
.2	Retail Spaces:	NC 40.
.3	Atrium:	NC 40.
.4	Residential Corridors:	NC 40.
.5	Residential Suites:	NC 35.

.2 Provide silencers where shown on the Drawings and as listed in the Schedules. Data in the Schedules is for reference only. Provide silencers selected to achieve the sound levels above based on the sound generation of the actual air moving equipment supplied for the project.

.3 Provide acoustic plenums where noted on the Drawings.

1.2 REFERENCE STANDARDS

.1 Provide sound attenuation in accordance with ASTM E477-80, ASTM E90-81 and ASTM C423-81a, except where specified otherwise.

1.3 SHOP DRAWINGS

.1 Submit shop drawings in accordance with Section 15010.

.2 Provide separate shop drawings for each piece of attenuation equipment.

.3 Submit calculations for each silencer indicating that sound levels specified are achieved. Indicate sound levels of actual air moving equipment supplied for the project. Indicate all assumptions regarding duct system and room effect.

1.4 PERFORMANCE RATING DATA

.1 Provide performance rating data on silencers and acoustic plenums, certified by a professional engineer and supported by calculations and verified by test results in accordance with referenced standards. Provide insertion loss, pressure drop, generated noise level for all silencers.

PART 2 - PRODUCTS

2.1 SILENCERS

.1 Factory manufactured of galvanized steel, compatible with ductwork specified elsewhere and to ASHRAE and SMACNA standards.

.2 Completely prefabricate all silencers using noncombustible materials. Silencers shall have rounded inlets and tapered diffuser outlets. Equip circular silencers with centre bodies with spun aluminum hoses and tapered diffuser outlets. Select silencers to attain the specified values of maximum allowable air pressure drop, and minimum allowable duct to reverberant room insertion loss.

.3 Acoustic media shall be inorganic, inert and rot proof. Density of media shall be 40 kg/m^3 (2.5 lb/$ft.^3$) packed under 10% compression and protected from air erosion by 0.89 mm (20 gauge) perforated galvanized metal. In addition, media in silencers with internal air velocities above 23 m/s (4500 fpm) shall be protected with glass fibre cloth.

.4 Factory paint Class II circular silencers with anti-rust primer coat.

.5 Equip circular silencers 600 mm (24")φ and larger with lifting lugs.

.6 Rectangular silencers, type RLC shall be constructed according to either of the following classes. Silencers over 1200 mm (48") in any one cross sectional dimension shall be constructed in modules not exceeding 1200 mm (48").

.1 Class I: Outer shell shall be minimum 0.89 mm (16 gauge) galvanized steel with airtight mastic filled seams, and 50 mm (2") slip connections each end.

.2 Class II: Outer shell shall be minimum 1.61 mm (16 gauge) galvanized steel with spot welded and caulked seams.

.3 Class III: The outer casing shall be a minimum of 1.61 mm (16 gauge) hot rolled

steel with all seams continuously welded and steel angle flanges.

2.2 ACOUSTIC PLENUMS

.1 Construct galvanized acoustic plenums using prefabricated acoustic panels, and steel supports, joiner sections, floor channels, opening frames and sealing materials. Provide 1.31 mm (18 gauge) minimum channel stiffeners at not greater than 800 mm (32") centres.

.2 Connect corners and butt joints with 1.61 mm (16 gauge) galvanized sections. Seal all joints with rubber mastic. Use angle joints to attach panel edges to walls.

.3 Entire acoustic plenum shall resist deflection and seal sufficiently to avoid air leakage when subjected to a pressure differential between inside and outside of 2500 Pa (10 in. WG).

.4 Doors in acoustic plenums shall have a transmission loss equal to acoustic panels.

.5 Provide 100 mm (4") thick acoustic panels having an absorption coefficient of 0.90 at 250 HZ. Cover inner surface with minimum 0.89 mm (20 gauge) perforated galvanized metal.

.6 Acoustic media shall be inorganic, inert and rot proof. Density of media shall be 40 kg/m^3 (2.5 lb/$ft.^3$) packed under at least 10% compression.

.7 Minimum Certified Performance

Octave Band		125	250	500	1000	2000	4000
Panel TL	(dB)	21	28	39	50	53	56
Absorption		0.7	0.9	0.98	0.99	0.9	0.9

PART 3 - EXECUTION

3.1 INSTALLATION

.1 Install sound attenuation equipment in accordance with manufacturer's instructions.

3.2 SITE VISIT

.1 Arrange for supplier of equipment to visit site to ensure installation is in accordance with

manufacturer's instructions and make adjustments and corrections in accordance with written report.

3.3 TESTING

.1 An experienced and competent sound and vibration testing professional engineer acceptable to the Consultant shall take sound measurements for HVAC system(s) after start up and final corrections and balancing of systems.

.2 Sound measurements to extend over full audio frequency range and to be taken in areas adjacent to mechanical equipment rooms, duct and pipe shafts and in other critical locations as listed below:

.1 Top level office area.

.2 Office area adjacent to duct shafts.

.3 Provide Consultant with notice 24 hours in advance of commencement of tests.

.4 Submit complete report of test results, including sound curves. Report should establish adequacy of equipment isolation and acceptability of noise levels in occupied areas and, where appropriate, remedial recommendations.

END OF SECTION

SECTION 15241
VIBRATION ISOLATION

PART 1 - GENERAL

1.1 WORK INCLUDED

.1 Provide vibration isolation and accessories to achieve the following sound levels:

.1 Offices: NC 35.

.2 Refer to Vibration Isolation Schedule for specific requirements of mechanical equipment.

.3 Provide spring hangers for piping as specified herein.

1.2 SHOP DRAWINGS

.1 Submit shop drawings in accordance with Section 15010.

.2 Provide separate shop drawings for each isolated system complete with performance and product data.

PART 2 - PRODUCTS

2.1 ELASTOMERIC PADS

.1 Type P1 - neoprene waffle or ribbed; 9 mm (3/8") minimum thickness; 50 durometer; maximum loading 350 kPa (50 psi).

.2 Type P2 - rubber waffle or ribbed; 9 mm (3/8") minimum thickness; 30 durometer natural rubber; maximum loading 415 kPa (60 psi).

.3 Type P3 - neoprene-steel-neoprene; 9 mm (3/8") minimum thickness neoprene bonded to 1.71 mm (14 gauge) steel plate; 50 durometer neoprene, waffle or ribbed; holes sleeved with isolation washers; maximum loading 350 kPa (50 psi).

.4 Type P4 - rubber-steel-rubber; 9 mm (3/8") minimum thickness rubber bonded to 1.71 mm (14 gauge) steel plate; 30 durometer natural rubber, waffle or ribbed; holes sleeved with isolation washers; maximum loading 415 kPa (60 psi).

2.2 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.

2.3 ISOLATOR 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 shall be complete with levelling devices.

.2 Ratio of height when loaded to diameter of spring to be between 0.8 and 1.0.

.3 Cadmium plated for all installations.

.4 Colour code springs.

2.4 SPRING MOUNT

.1 Zinc or cadmium plated hardware; housings coated with rust resistant paint.

.2 Type M2 - stable open spring; support on bonded 6 mm (1/4") minimum thick ribbed neoprene or rubber friction and acoustic pad.

.3 Type M3 - stable open spring; 6 mm (1/4") 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 (1/4") minimum thick ribbed neoprene or rubber friction and acoustic pad; built-in resilient limit stops, removable spacer plates.

.5 Type M5 - enclosed spring mounts with snubbers for isolation up to 950 kg (430 lbs) maximum.

.6 Performance as indicated.

2.5 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 as indicated.

2.6 ACOUSTIC BARRIERS FOR ANCHORS AND GUIDES

.1 Acoustic barriers: between pipe and support, consisting of 25 mm (1") minimum thickness heavy duty duck and neoprene isolation material.

2.7 HORIZONTAL THRUST RESTRAINT

.1 Spring and elastomeric element housed in box frame; assembly complete with rods and angle brackets for equipment and ductwork attachment; provision for adjustment to limit maximum start and stop movement to 9 mm (3/8").

.2 Arrange restraints symmetrically on either side of unit and attach at centre line of thrust.

2.8 STRUCTURAL BASES

.1 Type B1 - prefabricated steel base: integrally welded on sizes up to 2400 mm (8'-0") on smallest dimension, split for field welding on sizes over 2400 mm (8'-0") on smallest dimension and reinforced for drive and driven alignment, 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.

.2 Type B2 - steel rail base: structural steel, positioned for drive and driven alignment; without supplementary hold down devices; complete with isolation element attached to base brackets to minimize height; and pre-drilled holes to receive equipment anchor bolts.

.3 Bases to clear housekeeping pads by 25 mm (1") minimum.

2.9 INERTIA BASE FORMS

.1 Type B3 - full depth perimeter structural or formed channels, frames: welded in place reinforcing rods running in both directions; spring mounted units carried by gussetted height-saving brackets welded to frame; and clear housekeeping pads by 50 mm (2") minimum.

.2 Bases: "T" shaped, where applicable, to provide support for pump elbows.

.3 Concrete shall be installed to the requirements of Division 3.

2.10 ROOF CURB ISOLATION RAILS

.1 General: complete factory assembled (without need for sub-base).

.2 Lower member: continuous (rectangular steel tube) (or) (extruded aluminum channel).

.3 Upper member: continuous (rectangular steel tub) (or) (extruded aluminum channel) to provide continuous support for equipment, complete with all-directional neoprene snubber bushings (6) mm thick to resist wind (and seismic) forces.

.4 Springs: steel, adjustable, removeable, selected for (25) mm maximum static deflection plus 50% additional travel to solid, cadmium plated, sized and positioned to ensure uniform deflection.

.5 High frequency isolation: 6 mm minimum thick (continuous gasket on top and bottom of complete assembly) (or) pads on top and bottom of each spring). Material: closed cell neoprene.

.6 Weatherproofing: continuous flexible counterflashing to curb and providing access to

springs. Material: (aluminum) (neoprene).

PART 3 - EXECUTION

3.1 INSTALLATION

.1 Install vibration isolation equipment in accordance with manufacturer's 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 and ducting passage through walls and floors does 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.

.2 NPS 5 to NPS 8: first 4 points of support.

.3 NPS 10 and over: first 6 points of support.

.4 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, avoid short circuiting of sound pads by using vibration isolation rubber washers.

.5 Block and shim level all 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 Arrange for manufacturer's representative to visit site to ensure installation is in accordance with manufacturer's instructions and make adjustments and corrections in accordance with written report.

.2 Provide Consultant with 24 hours notice in advance of manufacturer's representative's visit.

3.3 TESTING

.1 An experienced and competent sound and vibration testing professional engineer shall take vibration measurements for HVAC systems after start-up and final corrections and balancing of systems.

.2 Vibration measurements shall be taken for the following equipment:

.1 Chillers.

.2 Cooling towers.

.3 Air handling units.

.4 Pumps.

.5 Compressors.

.3 Provide Consultant with 24 hours advance notice of commencement of tests.

.4 Submit complete report of test results including sound curves. Report should establish adequacy of equipment isolation and acceptability of noise levels in occupied areas and, where appropriate, remedial recommendations.

3.4

END OF SECTION

SECTION 15260
PIPING INSULATION

PART 1 - GENERAL

1.1 WORK INCLUDED

.1 Provide all thermal insulation and accessories for piping.

.2 Refer to the Insulation Schedule Section 15300 for piping to be insulated, insulation type and thickness.

.3 Insulate all associated fittings and valves.

1.2 REFERENCE STANDARDS

.1 Meet NFPA 90A. Maximum flame spread rating of 25 and maximum smoke developed rating of 50 in accordance with NFPA 255 and CAN4-S102-M83 for all components of insulation system. Materials tested in accordance with ASTM C411.

1.3 SAMPLES

.1 Submit for approval a complete assembly of each type of insulation system, insulation coating and adhesive proposed. Mount samples on minimum 12 mm (1/2") plywood board. Label each sample indicating type.

1.4 DEFINITIONS

.1 For purposes of this section:

.1 "CONCEALED" shall mean insulated mechanical services and equipment in suspended ceilings and non-accessible chases and furred spaces.

.2 "EXPOSED" shall mean "not concealed" as defined herein.

PART 2 - PRODUCTS

2.1 P-1 FORMED MINERAL FIBRE TO 200°C (392 °F)

.1 Material:

.1 CGSB 51-GP-9M, rigid mineral fibre sleeving for piping.

2.2 P-2 FORMED MINERAL FIBRE WITH VAPOUR BARRIER TO 85°C (185 °F)

.1 Material:

.1 CGSB 51-GP-9M, rigid mineral fibre sleeving for piping and CGSB 51-GP-52M, vapour barrier jacket and facing material.

2.3 P-3 FLEXIBLE MINERAL FIBRE WITH VAPOUR BARRIER TO 85°C (185 °F)

.1 Material:

.1 CGSB 51-GP-11M+Amdt, mineral fibre blanket for piping and CGSB 51-GP-52M vapour barrier jacket and facing material.

2.4 P-4 FLEXIBLE ELASTOMERIC -40°C TO 100°C (-40 °F TO 212 °F)

.1 Material:

.1 CAN2-51.40-M80+Amdt, flexible elastomeric unicellular sheet and pipe covering.

2.5 FIRE RATED THERMAL PIPE INSULATION

.1 Equal to "Instant Firestop Inc." type "PI".

.2 ULC listed as a component of a fire stop system complete with vapour barrier jacket.

2.6 FASTENINGS

.1 For insulation systems P-1, P-2, P-3:

.1 Tape: self-adhesive.

.2 Lap seal adhesive: quick-setting for joints and lap sealing of vapour barriers.

.2 For insulation system P-4 and underside of roof drain body:

.1 Contact adhesive: quick-setting for seams and joints.

.2 Tape: self-adhesive PVC.

.3 For canvas:

.1 Washable adhesive for cementing canvas lagging cloth to piping insulation.

2.7 INSULATION CEMENT

.1 To CGSB 51-GP-6M.

2.8 JACKETS

.1 Canvas:

.1 Material: ULC listed plain weave, cotton fabric at 220 g/sq. m (6.5 oz./sq. yd).

.2 On concealed valves and fittings: ULC listed plain weave cotton fabric at 120 g/sq. m (4 oz./sq. ft).

.2 Aluminum Alloy:

.1 Apply in accordance with CSA HA Series.

.1 Crimped or embossed jacketting 0.4 mm (28 gauge) thick with longitudinal slip joints and 50 mm (2") end laps with factory attached protective liner on interior surface. Aluminum alloy butt straps with mechanical fasteners.

.2 On fittings: 0.4 mm (28 gauge) thick, die shaped components with factory attached protective liner on interior surface.

.3 Stainless Steel 302

.1 Apply in accordance with ASTM 167-84a.

.1 Jacket preformed of smoot austenitic stainless steel, one quarter hard, 0.3mm (30 gauge) thick to fit outside diameter of insulation with preformed interlocking “Z” longitudinal joint and 50mm (2”) end laps.

.2 Closure bands for circumferential butt joints austenitic stainless steel 0.3mm (30 gauge) thick, precut and preformed to fit outside diameter of insulation jacket. Closure bands shall be furnished with factory installed, high temperature non-setting sealing compound in each exterior lip of its inside surface to provide water seal when installed on metal jacket.

.3 Fittings, jackets and factory fabricated components to match above.

.4 PVC

.1 Apply in accordance with CGSB 51-GP-53M in outdoor areas only when specified.

.1 0.38 mm (28 gauge) thick minimum.

.2 Fitting covers, one piece premoulded to match.

.3 Fastenings standard to manufacturer.

PART 3 - EXECUTION

3.1 APPLICATION

.1 Apply insulation after required tests have been completed and approved by Consultant. Insulation and surfaces shall be clean and dry when installed and during application of any finish. Apply insulation materials, accessories and finishes in accordance with manufacturer's recommendations and as specified.

.2 Insulation on roof drain body shall be held in place with 100% coverage of adhesive.

.3 On piping with insulation and vapour barrier, install high density insulation under hanger shield. Maintain integrity of vapour barrier over full length of pipe without interruption at sleeves, fittings and supports.

.4 On piping with insulation and vapour barrier that passes through a fire separation (wall, floor slab, etc.), provide fire rated thermal insulation to maintain continuity of vapour barrier and insulation without violating the integrity of the fire separation. Fire rated insulation shall be

installed as part of a ULC listed fire stop system to provide the same rating as the fire separation.

SPEC NOTE: USE .5 & .6 ONLY FOR RENOVATIONS TO EXISTING BUILDINGS:

.5 Where new piping is to connect to existing piping, remove existing piping insulation as required and re-insulate existing piping after connection to new piping.

.6 Where existing piping is required to be electrically heat traced, remove existing pipe insulation to allow for installation of heat tracing cables. Re-insulate piping after cable installation is complete.

.7 Apply PVC jacket to all exposed piping insulation located indoors unless otherwise indicated.

.8 Apply aluminum or PVC jacket to all exposed piping insulation located outdoors.

3.2 INSTALLATION

.1 Preformed: sectional up to NPS 12, sectional or curved segmented above NPS 12.

.2 Multi-layered:, staggered butt joint construction.

.3 Vertical pipe over NPS 3: insulation supports welded or bolted to pipe directly above lowest pipe fitting. Thereafter, locate on 4.5 m (15') centres.

.4 Expansion joints: terminate single layer and each layer of multiple layers in straight cut. Leave space of 25 mm (1") between terminations. Pack void tightly with mineral fibre. Protect joints with stainless steel or aluminum sleeves.

.5 Terminate insulation with insulation cement.

.6 Bevel away for studs and nuts to permit their removal without damage to insulation, and seal with insulating cement.

.7 Insulation is not required for chrome plated piping, valves and fittings.

.8 Provide removable sections of insulation for fittings or devices requiring routine maintenance such as strainers.

3.3 FASTENINGS

.1 Secure pipe insulation by tape at each end and centre of section, but not greater than 900 mm (36") on centres.

END OF SECTION

SECTION 15290
DUCTWORK INSULATION

PART 1 - GENERAL

1.1 WORK INCLUDED

.1 Provide all thermal insulation and accessories for ducting of the types and thicknesses indicated in the Insulation Schedule Section 15300.

1.2 REFERENCE STANDARDS

.1 Meet NFPA 90A. Maximum flame spread rating of 25 and maximum smoke developed rating of 50 in accordance with NFPA 255 and CAN4-S102-M83 for all components of insulation system. Materials shall be tested in accordance with ASTM C411.

1.3 SAMPLES SUBMITTALS

.1 Submit for approval a complete assembly of each type of insulation system, insulation, coating and adhesive proposed. Mount samples on 12 mm (1/2") plywood board. Label each sample indicating type.

1.4 DEFINITIONS

.1 For purposes of this Section:

.1 "CONCEALED" shall mean insulated mechanical services and equipment in suspended ceilings and non-accessible chases and furred spaces.

.2 "EXPOSED" shall mean "not concealed" as defined herein.

PART 2 - PRODUCTS

2.1 D-1 MINERAL FIBRE BLANKET 20°C TO 65°C (68 °F TO 150 °F)

.1 Material:

.1 CGSB 51-GP-11M+Amd mineral fibre blanket.

2.2 D-2 MINERAL FIBRE BLANKET WITH VAPOUR BARRIER -40°C TO 65°C (-40 °F TO 150 °F)

.1 Material:

.1 CGSB 51-GP-11M+Amdt mineral fibre blanket: CGSB 51-GP-52M for vapour barrier.

2.3 D-3 MINERAL FIBRE RIGID 20°C TO 65°C (68 °F TO 150 °F)

.1 Material:

.1 CGSB 51-GP-10M, rigid mineral fibre board.

2.4 D-4 MINERAL FIBRE RIGID WITH VAPOUR BARRIER TO 65°C (150 °F)

.1 Material:

.1 CGSB 51-GP-10M, rigid mineral fibre board: CGSB 51-GP-52M vapour barrier jacket and facing material.

2.5 FASTENINGS

.1 Tape: self-adhesive, 100 mm (4") wide.

.2 Contact adhesive: quick-setting.

.3 Lap seal adhesive: quick-setting for joints and lap sealing of vapour barriers.

.4 For canvas:

.1 Washable adhesive for cementing canvas lagging cloth to duct insulation.

.5 Pins:

.1 Weld pins 4 mm (1/8") in diameter, with 35 mm (1.5") diameter head for installation through the insulation. Length to suit thickness of insulation.

.2 Weld pins 2 mm (1/16") in diameter, for installation prior to applying insulation. Length to suit thickness of insulation. Nylon retaining clips 32 mm (1.5") square.

2.6 JACKETS

.1 Canvas:

.1 Apply in exposed areas: ULC listed plain weave, cotton fabric at 220 g/sq. m (6.5 oz./sq. yd).

PART 3 - EXECUTION

3.1 APPLICATION

.1 Apply insulation after required tests have been completed and approved by Consultant. Insulation and surfaces shall be clean and dry when installed and during application of any finish. Apply insulation materials, accessories and finishes to manufacturer's recommendations and as specified.

.2 Vapour barriers and insulation to be unbroken over full length of duct or surface, without penetration for hangers, standing duct seams and without interruption at sleeves.

.3 Use stand-offs for all duct-mounted control accessories.

.4 Apply 1.0 mm (18 gauge) thick galvanized sheet metal corners to all ductwork in mechanical rooms.

.5 Where new ductwork is to connected to existing ductwork, remove existing duct insulation as required and re-insulate existing ductwork after connection to new ductwork.

3.2 INSTALLATION

.1 General

.1 Adhere and seal vapour barrier using vapour seal adhesives.

.2 Stagger longitudinal and horizontal joints on multi-layered insulation.

.2 Mechanical Fastenings

.1 On rectangular ducts, use 50% coverage of insulating cement and weld pins at not more than 200 mm (8") centres, but not less than two (2) rows per side and bottom.

.3 Apply jacket in all exposed areas.

END OF SECTION

SECTION 15300
INSULATION SCHEDULE

PART 1 - GENERAL

1.1 WORK INCLUDED

1 Provide all thermal insulation and accessories for ducting, piping, and equipment of the types and thicknesses indicated in the following Insulation Schedule.

.2 Refer to Specification Sections 15260, 15280 and 15290 for additional details.

.3 Increase thickness of piping insulation to 50 mm (2") where piping over 50 mm (2") is electrically traced.

INSULATION SCHEDULE

ITEM	TYPE	THICKNESS	COMMENTS
Domestic Cold Water	P-2	25 (1)	
Domestic Hot Water Supply and Recirc. (2"Ø and Below)	P-1	25 (1)	
Domestic Hot Water Supply and Recirc. (Above 2"Ø)	P-1	40 (1-1/2)	
Horizontal Unburied Sanitary Drainage	P-2	25 (1)	All exposed piping (rigid insulation)
Horizontal Unburied Sanitary Drainage	P-3	25 (1)	All concealed piping (flexible insulation)
Storm Drainage	P-2	25 (1)	Horizontal exposed piping
Storm Drainage	P-3	25 (1)	Horizontal concealed piping
Cast Iron Storm Drainage Fittings	P-2	25 (1)	For asbestos cement piping on storm drainage systems

INSULATION SCHEDULE			
ITEM	**TYPE**	**THICKNESS**	**COMMENTS**
Condenser Supply and Return Water (indoor)	P-3	25 (1)	
Condenser Supply and Return water (outdoor)	P-2	50 (2)	Aluminium Jacket.
Chilled Water Supply and Return	P-2	40 (1-1/2)	
Heating Water Supply and Return	P-1	40 (1-1/2)	
Glycol Heating Supply and Return	P-1	40 (1-1/2)	
Steam (2"Ø and Below)	P-1	40 (1-1/2)	15 PSI Maximum
Steam (Above 2"Ø)	P-1	50 (2)	15 PSI Maximum
Condensate from Steam Systems	P-1	25 (1)	
Condensate Drains from Cooling Coils	P-2	25 (1)	
Refrigerant Piping	P-4	19 (3/4)	Suction and liquid lines
Dry Sprinkler System Drum Drips	P-2	50 (2)	In unheated areas only
Fire Standpipe	P-2	50 (2)	In unheated areas only.
Wet Sprinkler	P-2	50 (2)	In unheated areas only.

INSULATION SCHEDULE			
ITEM	**TYPE**	**THICKNESS**	**COMMENTS**
Hot Water Storage Tanks	E-1	50 (2)	
Heat Exchangers and Convertors	E-1	25 (1)	
Flash Tanks	E-1	25 (1)	
Cold Water Storage Tanks	E-3	25 (1)	
Chillers	E-5	20 (3/4)	
Domestic Hot Water Tanks	E-1	25 (1)	
Chilled Water Expansion Tanks	E-3	25 (1)	
Water Meter	E-3	25 (1)	
Chilled Water Pumps	E-7	25 (1)	
Domestic Water Pumps	E-7	25 (1)	
Heated Cooling Tower Sump	E-5	40 (1-1/2)	
Diesel Generator Exhaust	E-6	50 (2)	
Condenser Water Pumps	E-7	25 (1)	
Supply Air Duct - Round	D-2	25 (1)	All ductwork within concealed ceiling spaces and shafts

INSULATION SCHEDULE			
ITEM	**TYPE**	**THICKNESS**	**COMMENTS**
Supply Air Duct - Rectangular	D-4	25 (1)	All ductwork within concealed ceiling spaces and shafts
Supply Air Duct – Rectangular	D-4	25 (1)	All ductwork located in Mechanical Rooms and Service Rooms
Outdoor Air Duct - Round	D-2	40 (1-1/2)	From outdoor air louvre to Air Handling Unit.
Outdoor Air Duct - Rectangular	D-4	40 (1-1/2)	From outdoor air louvre to Air Handling Unit.
Exhaust or Relief Duct	D-4	50 (2)	From louvre to 2 m (7 ft.) upstream of exterior wall or roof
Supply Air Duct - Round, Located Outdoors	D-2	50 (2)	Aluminium Jacket.
Supply Air Duct - Rectangular, Located Outdoors	D-4	50 (2)	Aluminium Jacket.
Exhaust Duct - Round, Located Outdoors	D-4	50 (2)	Aluminium Jacket.
Exhaust Duct - Rectangular, Located Outdoors	D-4	50 (2)	Aluminium Jacket.
Supply Air Duct – Located Outdoors	Internal Acoustic Duct Lining	50 (2)	Silicone seal all duct joints. Paint ductwork with weather resistant paint.
Exhaust Air Duct Located Outdoors	Internal Acoustic Duct Lining	50 (2)	Silicone seal all duct joints. Paint ductwork with weather resistant paint.
Return Air Duct Located Outdoors	Internal Acoustic Duct Lining	50 (2)	Silicone seal all duct joints. Paint ductwork with weather resistant paint.
Plenums	D-4	40 (1-1/2)	Or use equivalent acoustic lining with Neoprene coating.

INSULATION SCHEDULE			
ITEM	**TYPE**	**THICKNESS**	**COMMENTS**
Apparatus Casings	D-4	40 (1-1/2)	Increase to 50 mm (2") above 2425 mm (96").
Under Coil Sections	D-4	40 (1-1/2)	

END OF SECTION

SECTION 15305
PORTABLE FIRE EXTINGUISHERS

PART 1 - GENERAL

1.1 WORK INCLUDED

.1 NFPA 10, Portable Fire Extinguishers.

.2 CAN4-S508-M83, Rating and Fire Testing of Fire Extinguishers.

1.2 SHOP DRAWINGS AND PRODUCT DATA

.1 Submit shop drawings and product data in accordance with Section 01340 - Shop Drawings, Product Data, Samples and Mock-ups.

1.3 MAINTENANCE DATA

.1 Provide maintenance data for incorporation into manual specified in Section 01730 - Operation and Maintenance Manual

PART 2 - PRODUCTS

2.1 MULTI-PURPOSE DRY CHEMICAL EXTINGUISHERS

.1 Stored pressure rechargeable type with shut-off nozzle, ULC labeled for A, B and C class protection. Size 2.25 kg or as noted on Drawings.

2.2 EXTINGUISHER BRACKETS

.1 Type recommended by extinguisher manufacturer.

2.3 EXTINGUISHER CABINETS

.1 Fully recessed cabinets for 5-inch (125mm) deep wall with hinged door and glass front. Standard colour, obtain final colour selection from Architect.

2.4 IDENTIFICATION

.1 Identify extinguishers in accordance with recommendations of ANSI NFPA 10 CAN4-S508.

.2 Attach tag or label to extinguishers, indicating month and year of installation. Provide space for service dates.

PART 3 - EXECUTION

3.1 INSTALLATION

.1 Install or mount extinguishers on brackets or in cabinets as indicated on the drawings.

.2 Install where shown on the Drawings and as required by the Ontario Fire Code.

END OF SECTION

SECTION 15410
PLUMBING PIPING

PART 1 - GENERAL

1.1 WORK INCLUDED

.1 Provide complete plumbing and drainage systems, including all necessary labour, services, products, materials and equipment as shown on the Drawings, listed in the Schedules as specified herein. Products, materials and equipment shall include, but not necessarily be limited to, the following:

.1 Piping and fittings.

.2 Valves.

.3 Meters.

.2 **[**Apply to the City of _____ for the street connections for the project on behalf of the Owner. A cash allowance is included to cover costs for providing water, sanitary and storm services to the project. Refer to Section 01020.**]**

1.2 REFERENCE STANDARDS

.1 Provide all Work in accordance with the latest edition of the Ontario Plumbing Code and all local authorities having jurisdiction, including all applicable by-laws.

1.3 SUBMITTALS

.1 Submit shop drawings for each type of valve in accordance with Section 15010.

.2 Submit shop drawings for grooved mechanical couplings and fittings in accordance with Section 15010.

.3 Provide valve charts for inclusion in Operating and Maintenance Manuals in accordance with Section 15010.

PART 2 - PRODUCTS

2.1 PLUMBING PIPING AND FITTINGS

.1 Provide pipe and fittings of good quality consistent with respective manufacturer and devoid of any defects and compatible with required system working pressure.

.1 Domestic Water Piping

.1 Above Ground - 100 mm (4") and smaller.

.1 Type `L' hard copper pipe with wrought copper fittings and silver solder joints.

SPEC. NOTE: Use .2 and .3 where approved only

.2 Above Ground – Domestic Cold Water 25 mm (1”) and smaller.

.1 PE/AL/PE composite pipe and fittings (Kitec Green).

.3 Above Ground – Domestic Hot Water 25 mm (1”) and smaller.
.1 PEX/AL/PEX composite pipe and fittings (Kitec Orange).

.2 Below Ground - 100 mm (4") and smaller.

.1 Type `K' soft copper pipe with wrought copper fittings and silver solder joints.

.2 Sanitary Drain and Vent Piping.

.1 Above Ground - 65 mm (2-1/2") and smaller.

.1 DWV copper with drainage fittings and 60/40 lead/tin solder joints.

.2 Above Ground - 75 mm (3") and larger.

.1 CSA class 4000 cast iron soil piping and drainage fittings.

.3 Below Ground - 65 mm (2-1/2") and smaller.

.1 Type `L' copper with 60/40 lead/tin solder joints.

.4 Below Ground - 75 mm (3") and larger.

.1 CSA class 4000 cast iron soil piping and drainage fittings.

.5 Below Ground - 100 mm (4") and larger.

.1 ICSA class 4000 cast iron soil pipe and fittings with mechanical joints and stainless steel couplings **OR**

.2 PVC DR 35 gravity sewer pipe and fitting in accordance with ASTM Specification D3034 and CSA Standard B182.1-M1983 and B182.2-1983.

.3 Storm Drainage

.1 Above Ground

.1 DWV copper pipe with drainage fittings and 60/40 lead/tin solder joints.

.2 Above Ground - 75 mm (3") and larger.

.1 CSA class 400 cast iron soil pipe and drainage fittings

OR

.2 Asbestos – cement pipe and fittings in accordance with CAN/CGSB-34.22 and CSA B127.1.

.3 Below Ground - 100 mm (4") and larger.

.1 CSA class 4000 cast iron soil pipe and drainage fittings. **OR**

.2 PRV DR 35 gravity sewer pipe and fitting in accordance with ASTM Specification D3034 and CSA Standard B182.1-M1983 and B182.2-1983.

OR

.3 Asbestos – cement pipe and fittings in accordance with CAN/CGSB-34.9, CAN/CGSB-34.23 and CSA B127.2.

.4 Sump Pump Discharge Piping.

.1 75 mm (3") and smaller.

.1 Type `L' hard copper with wrought copper fittings and 60/40 lead/tin solder joints.

.2 100 mm (4") and larger.

.1 Schedule 40 galvanized steel pipe to ASTM Standards with galvanized malleable iron fittings.

.4 Sanitary and Storm Drainage Fittings

.1 Mechanical Joints, neoprene or butyl rubber compression fittings and stainless steel clamps.

OR

.2 Heavyweight Couplings: Furnish and install hubless soil pipe couplings designated as Heavyweight, constructed of extra wide 4 to 5 band corrugated type 304 stainless steel bands, with heavy duty worm drive clamps tightened to 80 in lbs torque. Flanged gasket to be made of neoprene rubber, meeting ASTM C 564 – and unit to meet CISPI 310 and ASTM C1640-02 standards, as manufactured by Mission Rubber Company.

2.2 VALVES

.1 Provide valves that are compatible with the piping and service required.

.2 Valves of each type shall be the product of one manufacturer.

.3 Refer to Schedules for details.

2.3 WATER METER

.1 Provide domestic water meter complete with three-valve bypass to local authority standards.

2.4 AIR CHAMBERS

.1 Provide air chambers minimum 600 mm (24") long on supplies at each fixture, same size as supply pipe to the fixture. Air chambers are not required where mechanical shock stops are specified.

PART 3 - EXECUTION

3.1 INSTALLATION

.1 Piping and Fittings

.1 Install piping such that uniform grade is maintained. Install piping with ends aligned and carefully abutted. Install pipe joints in accordance with the recommendation of the respective manufacturer.

.2 Ensure that the piping is protected at all times from movement, etc. Ensure piping is kept clean at all times and cap ends during periods when work is stopped.

.3 Install piping to conform to building planes. Run parallel to walls and structural components. Conserve headroom at all times and co-ordinate the piping installation with the Work of other Trades and Divisions.

.4 Install flanges or unions to isolate each piece of equipment.

.5 Provide the necessary chemicals, equipment and labour to clean and disinfect the system to the requirements of all authorities having jurisdiction.

.2 Valves

.1 Install valves at each piece of equipment, plumbing fixture, at the base of each riser and at any main branch of the piping system.

.3 Meters

.1 Install water meters complete with accessories and trim. Where meters are provided and installed by the Municipality or Regulating Authority, the cost of same shall be carried by this Division.

.4 Air Chambers

.1 Install air chambers concealed inside partitions.

END OF SECTION

SECTION 15411
GAS PIPING SYSTEMS

PART 1 - GENERAL

1.1 WORK INCLUDED

.1 Provide complete gas piping systems, including all necessary labour, services, products, materials and equipment as shown on the Drawings, listed in the Schedules as specified herein and as required by authorities having jurisdiction.

.2 Apply to the gas company for the gas service to the project on behalf of the Owner. Co-ordinate the work provided by the gas company to meet the project schedule. Any charges by the gas company relating to the provision of the meter and service shall be paid for under the Cash Allowance for Street Connections.

1.2 REFERENCE STANDARDS

.1 Provide all Work in accordance with the latest edition of the Natural Gas Installation Code, the Gas Company and all local authorities having jurisdiction, including all applicable by-laws.

PART 2 - PRODUCTS

2.1 PIPING AND FITTINGS

.1 Provide pipe and fittings of good quality consistent with respective manufacturer and devoid of any defects.

.2 Gas Piping Below Grade:

.1 Provide Schedule 40 carbon steel to ASTM standards with forged steel welded fittings.

.3 Gas Piping Above Grade:

.1 Provide Schedule 40 carbon steel to ASTM standards with forged steel welded fittings for sizes greater than 50 mm (2"). Piping 50 mm (2") and smaller may be screwed malleable iron with approved thread lubricant.

2.2 VALVES

.1 Provide valves that are compatible with the piping and service required.

.2 Valves shall be of one manufacturer.

.3 Provide plug valves on systems 50 mm (2") and smaller equal to Nordstrom Model 142 complete with semi-steel body and brass trim.

.4 Provide plug valves on systems 65 mm (2-1/2") and larger equal to Nordstrom Model 143 complete with semi-steel body and brass trim.

2.3 GAS METER

.1 Gas meter assembly complete with PRV station shall be provided and installed by the Gas Company.

PART 3 - EXECUTION

3.1 INSTALLATION

.1 Piping and Fittings

.1 Obtain all necessary approvals for the gas piping systems. Provide detailed drawings and specifications as required to the gas company for approval.

.2 Install piping such that uniform grade is maintained. Install piping with ends aligned and carefully abutted. Install pipe joints in accordance with the recommendation of the respective manufacturer.

.3 Ensure that the piping is protected at all times from movement, etc. Ensure piping is kept clean at all times and cap ends during periods when work is stopped.

.4 Install piping to conform to building planes. Run parallel to walls and structural components. Conserve headroom at all times and co-ordinate the piping installation with the Work of other Trades and Divisions.

.5 Install flanges or unions to isolate each piece of equipment.

.6 Cathodic protection for buried steel gas piping shall be provided by a recognized corrosion company.

.7 Where gas piping is buried below floors within the building, pipe shall be enclosed within a continuous duct providing clearances as per the Gas Code. Duct to be ventilated at each end.

.8 Piping colour finish shall be in accordance with the requirements of authorities having jurisdiction.

.2 Valves

.1 Install pressure reducing valves at all equipment requiring a supply of low pressure gas.

.2 Install emergency gas shut-off valves on main gas service before entering the building, on branch piping serving each piece of equipment, outside mechanical rooms which contain gas-fired equipment.

.3 Install vents to atmosphere for all gas regulators.

END OF SECTION

SECTION 15430
PLUMBING SPECIALTIES

PART 1 - GENERAL

1.1 WORK INCLUDED

.1 Provide complete plumbing and drainage systems, including all necessary labour, services, products, materials and equipment as shown on the Drawings, listed in the Schedules and as specified herein. Products, materials and equipment shall include, but not necessarily be limited to, the following:

.1 Floor drains and roof drains;

.2 Cleanouts;

.3 Miscellaneous plumbing specialties.

1.2 REFERENCE STANDARDS

.1 Provide all Work in accordance with the latest edition of the Ontario Plumbing Code and all local authorities having jurisdiction, including all applicable by-laws.

PART 2 - PRODUCTS

2.1 FLOOR AND ROOF DRAINS

.1 Provide all floor and roof drains necessary for a complete installation.

.2 Refer to Schedules for details.

2.2 CLEANOUTS AND MISCELLANEOUS

.1 Provide all cleanouts and miscellaneous items necessary for a complete installation.

.2 Refer to Schedules for details.

2.3 BACK FLOW PREVENTERS

.1 Reduced Pressure Back flow Preventers: Bronze body with bronze and plastic parts and stainless steel springs; two independent spring loaded check valves; diaphragm type differential pressure relief valve; check valve for diaphragm failure; non-threaded vent outlet; assembled with two gate valves, strainer, and four test cocks.

.2 Double Check Valve Assemblies: Bronze body with stainless steel springs; two independent check valves with intermediate atmospheric vent.

PART 3 - EXECUTION

3.1 INSTALLATION

.1 Floor and Roof Drains

.1 Install floor drains as required by codes and as detailed on the Drawings.

.2 Install roof drains as required by codes and as detailed on the Drawings.

.2 Cleanouts and Miscellaneous

.1 Install cleanouts in sanitary and storm drainage piping as required by plumbing codes and all authorities having jurisdiction.

.2 Install cleanouts at the base of all stacks and at each major change of direction on horizontal pipe runs.

.3 Backflow Preventors

.1 Install Backflow Preventors in accordance with manufacturer's recommendations, and as required by plumbing codes, CSA B64.10, local bylaws, and all authorities having jurisdiction.

END OF SECTION

SECTION 15440
FIBREGLASS REINFORCED PLASTIC DUCT

1. PART 1 - GENERAL 1

1.1 INTENT 1
1.2 REFERENCES 1

2. PART 2 - PRODUCTS 2

2.1 PIPE AND FITTINGS 2

3. PART 3 - EXECUTION 2

3.1 INSTALLATION 2

SECTION 15440
FIBREGLASS REINFORCED PLASTIC DUCT

1. PART 1 - GENERAL

1.1 INTENT

.1 The Contractor must furnish and install the Fibreglass Reinforced Plastic duct shown and specified, in accordance with the requirements of the Contract Documents. The duct must be complete with the necessary reducer, coupling, supports, and connectors to provide a functional installation.

The piping shown in the Drawings is intended to define the general layout, configuration, routing, method of support, pipe size, and pipe type. The Drawings are not pipe construction or fabrication drawings. It is the Contractor's responsibility to develop the details necessary to construct all mechanical piping systems, to accommodate the specific equipment provided, and to provide and install all connectors, supports, and other appurtenances for a complete and functional system.

1.2 REFERENCES

.1 Where referenced guidelines conflict, the more stringent will be applied:

.1 NSF/ANSI 14 “Plastics Piping System Components and Related Materials”.

.2 UL 181 “Standard for Factory-Made Air Ducts and Air Connectors”.

.3 NFPA 90A “Standard for the Installation of Air-Conditioning and Ventilating Systems”.

.4 ASTM E84 “Standard Test Method for Surface Burning Characteristics of Building Materials”.

.5 ASTM D2996 “Standard Specification for Filament-Wound ‘Fiberglass’ (Glass-Fiber-Reinforced Thermosetting Resin) Pipe”.

.6 ASTM D2310 “Standard Classification for Machine-Made ‘Fiberglass’ (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe”.

.7 ASTM D3567 “Standard Practice for Determining Dimensions of ‘Fiberglass’ (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe and Fittings”.

.8 ASTM D3982 “Standard Specification for Contact Molded ‘Fiberglass’ (Glass-Fiber-Reinforced Thermosetting-Resin) Ducts”.

.9 ASTM D3839 “Standard Guide for Underground Installation of ‘Fiberglass’ (Glass-Fiber Reinforced Thermosetting-Resin) Pipe”.

.10 ASTM F1668 “Standard Guide for Construction Procedures for Buried Plastic Pipe”.

.11 ASTM F477 “Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe”.

.12 ASTM F913 “Specification for Thermoplastic Elastomeric Seals (Gaskets) for Joining Plastic Pipe”.

2. PART 2 - PRODUCTS

2.1 PIPE AND FITTINGS

.1 Ductwork, including fittings, must be made of Fiberglass Reinforced Plastic (FRP) per industry standards – NSF/ANSI 14, UL 181, ASTM D2996.

.2 Wall thickness shall comply with ASTM D3567 pipe standards. The ductwork shall be furnished with a minimum wall thickness 3.175mm.

.3 Pipe diameters and general arrangement as per Contract Drawings

.4 Duct supports and hangers shall comply with ASTM D3982 duct standards.

3. PART 3 - EXECUTION

3.1 INSTALLATION

.1 All installations are to be completed in accordance with all applicable standards, drawings, specifications and manufacturer recommendations. Where conflicts occur, the most stringent requirement applies.

.2 Where the assistance of a manufacturer's service representative is advisable in order to obtain perfect pipe joints, supports, or special connections, the Contractor must furnish such assistance at no additional cost to the Owner.

.3 All piping materials, fittings, and accessories must be delivered in a clean and undamaged condition. All defective or damaged materials must be replaced with new materials.

.4 The piping system must be handed over to the Owner in a clean and functional condition.

END OF SECTION

PART 1 – GENERAL

1.1 PLUMBING AND HEATING/ COOLING VALVES

.1 Reference Standards

.1 Conform to requirements of ANSI, ASTM, ASME, and applicable MSS standards.

.2 Manufacturer

.1 Provide valves of same manufacturer throughout, where possible.

.2 Provide valves with manufacturer's name and pressure rating clearly marked on body (per MSS-SP-25).

.3 Product shall carry valid CRN (Canadian Registration Number) issued by respective Provinces.

.3 Shop Drawings

.1 Submit shop drawings of manufacturer's literature in accordance with Section 15000.

1.2 GENERAL DESIGN SPECIFICATIONS:

.1 Valve Materials

.1 Bronze: to ASTM B62 or B61 as applicable
.2 Brass: to ASTM B283 C3770
.3 Cast Iron: to ASTM A126, Class B
.4 Forge Steel: to ASTM A105N
.5 Cast Steel: to ASTM A216WCB

.2 Valve Markings

.1 All pressure ratings, manufacturers trademark and size to conform as per MSS-SP-25.

.3 End Connections

.1 Threaded ends to: ASME B1.20.1
.2 Solder ends to: ASME B16.18
.3 Flanged ends to: ASME B16.1 (Class 125)
.4 Face To Face dimensions to: ASME B16.10
.5 Fanged ends to: ASME B16.5
.6 Butt Weld Ends to: ASME 16.25
.7 Socket Weld Ends to: ASME B.16.11

.4 Testing & Design

.1 MSS-SP-80 - Bronze, Gate & Check Valves.
.2 MSS-SP-110 - Ball Valves.
.3 MSS –SP-70, 85, 71 - Cast Iron Gate, Globe & Check Valve.
.4 MSS-SP-72 - American Valve
.5 MSS-SP-67 – Kitz, Apollo, Toyo, Demco & WKM E, Butterfly Valves.
.6 API 602 – Forge Steel Valves (Design)
.7 API 598 – Cast Steel Valves, Forge Steel Valves (Testing)
.8 API 609 – WKM High Performance BFV
.9 API 600 – Cast Steel Valves (Design)

PART 2 – PRODUCTS

2.1 GATE VALVES (ISOLATION SERVICES)

.1 Up to 50mm (2”).

860KPA (125psig) / 200 WOG Rating
Bronze Body to ASTM – B62 Solid Wedge Disc, Bronze Trim

.2 Non- Rising Stem

Soldered: * *Kitz 41*
* *Toyo 281*

Threaded: * *Kitz 40*
* *Toyo 280*

.3 Rising Stem

Soldered: * *Kitz 44*

Threaded: * *Kitz 24*
* *Toyo 293*

2.2 GLOBE VALVES (THROTTLING SERVICE)

.1 Up to 50MM (2”).

860KPA (125psig) / 200WOG Rating
Bronze Body to ASTM B62, Rising Stem,

.2 Bronze Disc

Soldered: *Kitz 12
* Toyo 212A

Threaded: * Kitz 11
* Toyo 211A

2.3 COMPOSITION DISC (TEFLON)

Soldered: *Kitz 10

Threaded: *Kitz 03
*Toyo 220

2.4 CHECK VALVES (BACKFLOW PREVENTION) HORIZONTAL AND VERTICAL SERVICE

.1 Up to 50MM (2”).

860KPA (125psig) / 200 WOG Rating
Bronze Body to ASTM B62, Bronze Trim, and Y Pattern.

Y – Pattern Swing

Soldered: * Kitz 23
* Toyo 237

Threaded: * Kitz 22
* Toyo 236

.2 Spring Loaded Checks (1)

Soldered: *Kitz 26
* Apollo 61-600

Threaded: * MAS 700
* Kitz 36
*Apollo 61-500

**Apollo 61-100*

(1) NOTE: DUE TO RUBBER MATERIAL LIMITATIONS, NOT TO EXCEED 80C .* NOT TO BE USED ON RECIPROCATING PUMP SERVICE. *

2.5 BALL VALVES (ISOLATION & BALANCING)

.1 Up to 50MM (2").

1034 KPA (150psig) / 600WOG Rating
Brass and or Bronze Body, Full Port, TFE Seats, Double O-Ring Design, or Teflon Packing, Chrome Plated Solid Bronze Ball, Lever Handle.

Soldered: * *Kitz 59*
** Toyo 5049A*
** MAS B2F*
** MAS B4*
**Apollo 77C-200 (2)*

Threaded: * *Kitz 58*
**Toyo 5044A*
**MAS B1F*
**MAS B3*
** Apollo 77C-100 (2)*

(2) Note: Heavy Pattern – Bronze Body

2.6 BALL VALVE OPTIONS

,1 Locking Handles:

Soldered: **Kitz 69AMLL*
**Toyo 5049A-LH*
**MAS B-4 LH*
**Apollo 77-200-27*

Threaded: **Kitz 68AMLL*
**Toyo 5044A-LH*
**MAS B-3 LH*
**Apollo 77-100-27*

.2 Stem Extensions:

Soldered: ** Kitz 59SE*
** Toyo 5049SE*
** Apollo 77-200* - 03 Option stem design (1 ¼"), 04 Option Stem design (2 ¼").

Threaded: ** Kitz 58SE*
** Toyo 5044SE*
** Apollo 77-100* - 03 Option stem design (1 ¼"), 04 Option Stem design (2 ¼").

.3 Stainless Steel Ball & Stem.

Soldered: ** Kitz 69AMLL (Note Lever Lock)*
** Apollo 77-240*
** Toyo 5043S-LH*

Threaded: ** Kitz 68AM*
** MAS B3ZSS (Note Lever Lock)*
** Apollo 77-140*
*Toyo 5041S-LH

.4 Balancing (Memory Stop).

Soldered: ** Kitz 59MS*
**Toyo 5049MS*
**Apollo 77-250*

Threaded: **Kitz 58MS*
** Toyo 5049MS*
** Apollo 77-150*

.5 Wing Handles.

Soldered: ** Kitz 59W*
** Toyo 5049W*
** MAS B4W*
**Apollo 77-200-07*

Threaded: **Kitz 58W*
**Toyo 5044W*
**MAS B3W*
*Apollo 77-100-07

.6 Drain Ports.

Soldered: **Kitz 69AD*
**MAS B4D*
**Apollo 95-200*

Threaded: **Kitz 68AD*
MAS B3D
**Apollo 95-100*

.7 Compression End Service.

**MAS B5C*

.8 Pex End (In Floor Heating).

**MAS B-1 PEX*
**MAS B-1D Pex (Drain)*

.9 Cap & Chain.

Soldered: **Kitz 69AC*
**Apollo 78-200*

Threaded: **Kitz 68AC*
**Toyo 5046*
**Apollo 78-100*

.10 Balancing Valves:

To be confirmed at a later date.

2.7 STRAINERS

.1 Up to 50MM (2").

860KPA (125psig) / 200 WOG Rating
Bronze Body, Screwed Cap, Y-Pattern, S.S Screen with 1/32 Perforation

Soldered: ** Mueller 352 ½*
**Kitz 16*

Threaded: **Mueller 351M*
** Kitz 15*
**Toyo 380*

OR

Class 250 / 400 WOG Rating
Cast Iron Body, Screwed Cap, Y Pattern, S.S Screen with 1/32 Perforation.

Threaded: ***Mueller 11M***

PART 3 – EXECUTION

3.1 INSTALLATION

.1 Refer to Sections 15410 & 15510 for installation requirements.

END OF SECTION

SECTION 15830
SPLIT COOLING SYSTEMS

PART 1 - GENERAL

1.1 WORK INCLUDED

.1 Provide split type direct expansion cooling systems where indicated on the Drawings, and of the types and performances as listed in the Schedules.

1.2 SUBMITTALS

.1 Submit shop drawings for each fan coil unit and condensing unit in accordance with Section 15010 including fan performance at the specified external static pressure.

.2 Provide data for inclusion in the Operating and Maintenance Manuals in accordance with Section 15010.

PART 2 - PRODUCTS

2.1 HORIZONTAL FAN COIL UNITS

.1 Coil capacity shall be rated in accordance with ARI Standards as a complete package.

.2 Deliver units to the construction site completely assembled and in one piece. Protect casings from damage and cover all pipe and duct connections.

.3 Provide access to fans, motor and filter to permit removal with units installed.

.4 Insulate entire casing, including return air plenum with minimum 20 mm (3/4") thick glass fibre insulation with neoprene coating.

.5 Provide insulated galvanized steel drain pan under the entire coil section and extending on the connection side sufficiently to permit valves and piping to be mounted above.

.6 Provide belt drive or direct drive fans as indicated in Schedules with forward curved, double width wheels, stable pressure curve and low sound power levels.

.7 Provide 50 mm (2") throw-away filters mounted in return air plenum.

.8 Coils shall be aluminum fin mechanically bonded to copper tubing rated at 1725 kPA (250

psig) working pressure.

.9 Motors shall be high efficiency open drip proof with resilient mounting.

2.2 DUCTLESS FAN COIL UNITS

.1 Wall mounted evaporator unit with 2 speed fan, filters, horizontal and vertical air guide vanes.

.2 Microprocessor control with 24 hour clock, LCD display, self diagnostic indicator, and programmable setpoints.

2.3 CONDENSING UNITS

.1 Casing shall be constructed of heavy gauge galvanized steel, painted with weather resistant powder paint suitable for outdoor application.

.2 Control system to include high and low pressure compressor controls, condenser fan and compressor contactor, factory installed liquid line dryer.

.3 Compressor to have five (5) year warranty, internal over temperature and pressure protection, oil pump, internal vibration isolation.

.4 Condenser coil to be 3/8" O.D. aluminum tube with aluminum fins.

.5 Unit to be complete with refrigerant and defrost controls to permit operation to 0□F ambient temperature.

.6 Provide programmable electronic thermostat with integral seven day, 24 hour clock, programmable temperature setpoints, LCD display of temperature and setpoints.

2.4 REFRIGERANT PIPING

.1 Refrigerant piping shall be Type 'L' nitrogen charged ACR grade copper with forged brass fittings and long radius elbows. Refrigerant valves shall be cast bronze packed globe valves.

.2 Refrigerant lines shall be sized for a maximum 2 psi pressure drop. Provide adequate looping of suction lines to allow oil return to the compressor.

.3 Provide sight glasses for all liquid lines and liquid line strainers ahead of each thermovalve. Provide liquid line driers as required.

PART 3 - EXECUTION

3.1 CONDENSING UNITS

.1 Install condensing units in accordance with manufacturers installation instructions. Install units on wood sleepers when installed on roofs, and on concrete paving stone when installed on grade.

3.2 FAN COIL UNITS

.1 Install fan coil units in accordance with the manufacturer's installation instructions.

.2 Support units from the slab with steel hanger rods and neoprene vibration isolators. Adjust mounts so that drain pan slopes to the condensate drain.

.3 Insulate piping up tight to coils including control valves, and securely fasten insulation to casing.

.4 Do not obstruct access to unit for service or filter replacement.

.5 Direct power connection to fan coil units provided by Division 16 unless otherwise indicated.

.6 Check all units for excessive vibration.

END OF SECTION

SECTION 15852
INDOOR DIRECT FIRED MAKE-UP

PART 1 - GENERAL

1.1 WORK INCLUDED

.1 Provide direct-fired make-up air handling units incorporating fans, burner section, filters, plenums, motors, drives, control cabinet; inlet motorized damper section, direct expansion cooling section, air cooled condensing units.

.2 Deliver units to the construction site completely assembled and in one piece. Protect casings from damage and cover all protruding shafts, pipe and duct connections. Close and lock all access doors.

.3 Provide a service technician to supervise start-up of the equipment and to instruct the Owner's representative on the operation and maintenance of the equipment.

1.2 SUBMITTALS

.1 Submit shop drawings in accordance with Section 15010 and including the following data:

.1 Fan performance for the specified air flow and external static pressure, including outlet velocity, fan speed, brake horsepower, total static pressure, fan curves and sound power levels in each octave band.

.2 Burner assembly with pilot ignition system. Flame surveillance with solid state programmable flame relay rod.

.3 Burner type and specifications, operating and safety controls.

.4 Filter specification and performance at design air flow.

.5 Insulation specification, including flame spread and smoke developed ratings.

.6 Air cooled condensing units, cooling capacities, piping schematics.

.2 Provide data for inclusion in the Operating and Maintenance Manuals in accordance with Section 15010

1.3 MANUFACTURER CERTIFICATION

.1 Provide manufacturer certification of the installation.

.2 Unit shall be built to serve NFPA 820 Class I, Div 2 areas. Unit will have NFPA 820 Class I, Div 2 parts.

PART 2 - PRODUCTS

2.1 GENERAL

.1 Provide direct gas-fired make-up air handling unit for indoor installation and as indicated in the Schedules.

.2 Unit shall be factory assembled, wired, tested and bear the CGA label of approval.

.3 Unit shall have unit-mounted disconnect switch.

.4 Unit shall be horizontally configured.

2.2 CASING AND STRUCTURE

.1 Construct casings of minimum 18 gauge satin-coat galvanized steel and in accordance with ASHRAE and SMACNA Standards.

.2 Reinforce the casings to operate with no vibration or "oil canning" under all conditions.

.3 Seal all joints with a water impervious caulking compound to make the unit air tight.

.4 Provide lift out insulated access panels with cam-lock fasteners for access to each section. Access doors shall fit into frame with full perimeter and continuous neoprene gasket. The access door to the burner and control panel shall be hinged and fastened with similar locking devices.

.5 Apply one factory enamel coat of paint proceeded by a suitable prime coat.

.6 Support casings on structural steel welded base frames extending over the entire length of the casing and designed to support the entire weight of all equipment when suspended from

multiple lifting lugs.

2.3 INSULATION

.1 Insulate internally the entire casing, including the underside of the cabinet, with 1" thick neoprene coated rigid fibreglass thermal insulation.

.2 Insulate the casing such that no part of the casing is exposed to the air stream.

.3 Use insulation, sealants and waterproofing materials in accordance with all applicable Codes and Authorities.

.4 Heating section insulation shall be of sandwich panel design comprising rigid glass fibre insulation between external cabinetry and internal metal lining. Insulating shall be glued and pinned in place.

2.4 FANS

.1 Provide forward curved double width, double inlet belt driven centrifugal fans rated in accordance with AMCA Standard Test Code. Each fan shall carry the AMCA seal.

.2 Fans and drives shall be statically and dynamically balanced in the factory to operate quietly without pulsation or vibration.

.3 Provide ball or roller type self-aligning, grease lubricated bearings designed for 100,000 hour life. Provide extended grease lines terminating adjacent to the fan section access door where grease fittings are not easily accessible.

.4 Provide balanced variable pitch sheaves.

.5 Motors shall be squirrel cage induction type, open drip proof (ODP), 1750 rpm, EEMAC design 'B' with class 'B' insulation, ball bearing, 1.15 service factor.

.6 Mount motors and drives within the fan casing. Provide internal vibration isolation.

.7 Manufacturer shall supply one extra set of drive for field balancing.

2.5 HEATING SECTION

.1 Provide line type gas burner with 15 to 1 turndown ratio.

.2 Provide factory mounted, wired and fire tested gas burner complete with operating and safety controls, including electric pilot valve, appliance regulator, modulating flow ratio valve, fail safe shut off valve and manual shut off valves.

.3 Supply lubricated manual shut-off cock for field mounting.

.4 Gas pressure at inlet valve shall be 7" WC.

2.6 FILTERS

.1 Provide V-bank filter section with 2" replaceable media ULC listed filters in permanent galvanized steel frames. Provide side access for filter replacement.

.2 Provide a differential pressure switch for interconnection to the "dirty filter" indication in remote panel.

2.7 INLET DAMPER

.1 Provide normally closed low leak dampers with gasketted blade and side seals, prewired damper controls with spring return type damper operator.

.2 Fresh air inlet hood shall be complete with 1/2" x 1/2" mesh bird screen.

2.8 COILS

.1 Coils shall be fully enclosed within casing and mounted on primed steel angle frames manufactured to allow coils to be individually removed.

.2 Removable coil access panels shall be provided to remove coils through casing wall. Coils shall be individually removable towards the access side.

.3 All drain pans shall be continuously welded stainless steel. Intermediate drain pans shall be interconnected with 1” down pipes. Condensate drain shall be 1-1/4” diameter.

.4 Coils shall be certified in accordance with ARI Standard 410.

Construction:

Tubes	Horizontal, copper.
Fins	Aluminum mechanically bonded to tubes.
Casing	16 gauge, galvanized steel channels with 16 gauge centre and end supports.

.5 Provide cooling coil bypass section with lockable opposed blade balancing damper at coil section. Balance air flow through coil as indicated in Schedules.

2.9 CONDENSING UNITS

.1 Compressors shall be resiliently mounted. Compressors shall have timed off control, internal excessive current, temperature protection, crankcase heater, hot gas bypass.

.2 Refrigerant circuit shall have suction and liquid line service gauge ports and service valves, high pressure switch, low pressure switch and driers.

.3 Two stage cooling control shall be standard on units 15 Tons and larger.

2.10 CONTROLS

.1 Provide, within the unit, a control cabinet containing all required contacts, relays, control transformer and starters necessary to provide complete system operation. Unit shall be equipped with high limit, burner air flow switch and electronic modulating discharge air temperature control.

.2 Provide interlocks to operate the unit only when the kitchen exhaust fan is energized.

.3 Provide terminals for fire alarm shutdown and remote start-stop.

.4 Supply a remote panel containing pilot lights to indicate: fan on; burner on; dirty filters; burner lock-out; and low limit alarm. Panel shall also have On/Off switch. Install as directed

by Consultant.

.5 Unit shall meet the following control sequences:

.1 Heating: Burner will fire (start) at 60°F OAT (adjustable) and stop firing at 65°F OAT (adjustable). When burner is on, supply air controller will modulate output to maintain 70°F SAT.

.2 Cooling: Cooling will come on at 77°F OAT (adjustable) and go off at 72°F OAT (adjustable). Hot gas bypass will be available at anytime compressor is on.

.3 Ventilating: When the OAT is between 65°F and 77°F (approximately), neither cooling nor heating will be on. Unit will ventilate.

.4 Supply fan shall run only when Kitchen exhaust fan is energized. Interlock with cooling and heating to ensure fan is “ON” before cooling or heating can start.

PART 3 - EXECUTION

3.1 INSTALLATION

.1 Install unit in accordance with the manufacturer's installation and operating instructions.

.2 Provide lamacoid label on unit identifying its designation and service.

.3 Provide an additional complete set of filters for the unit to be installed following final acceptance of the system.

.4 Provide all necessary natural gas piping, shut-off valves and flue vent to meet codes and regulations.

.5 Manufacturer shall start up and test all unit functions and ensure proper operation. Factory technician to provide copy of start up log to Owner and to demonstrate operation and maintenance to Owner's representative.

.6 Install and wire remote panel and control accessories.

.7 Install condensing units on sleepers for rooftop installation; provide concrete or wood shimming of sleepers as required for installation on sloping roofs.

END OF SECTION

SECTION 15854
DIRECT FIRED
MAKE-UP AIR UNITS

PART 1 - GENERAL

1.1 WORK INCLUDED

.1 Provide direct-fired make-up air handling units incorporating fans, burner section, filters, plenums, motors, drives and control cabinet.

.2 Deliver units to the construction site completely assembled and in one piece. Protect casings from damage and cover all protruding shafts, pipe and duct connections. Close and lock all access doors.

.3 Provide a service technician to supervise start-up of the equipment and to instruct the Owner's representative on the operation and maintenance of the equipment.

1.2 SUBMITTALS

.1 Submit shop drawings in accordance with Section 15010 and including the following data:

.1 Fan performance for the specified air flow and external static pressure, including outlet velocity, fan speed, brake horsepower, total static pressure, fan curves and sound power levels in each octave band.

.2 Burner assembly with pilot ignition system. Flame surveillance with solid state programmable flame relay rod.

.3 Burner type and specifications, operating and safety controls.

.4 Filter specification and performance at design air flow.

.5 Insulation specification, including flame spread and smoke developed ratings.

.2 Provide data for inclusion in the Operating and Maintenance Manuals in accordance with Section 15010

1.3 MANUFACTURER CERTIFICATION

.1 Provide manufacturer certification of the installation.

.2 Unit shall be built to serve NFPA 820 Class I, Div 2 areas. Unit will have NFPA 820 Class I, Div 2 parts.

PART 2 - PRODUCTS

2.1 GENERAL

.1 Provide direct gas-fired make-up air handling unit for indoor installation and as indicated in the Schedules.

.2 Unit shall be factory assembled, wired, tested and bear the CGA label of approval.

.3 Unit shall have unit-mounted disconnect switch.

.4 Unit shall be complete with inlet damper section, filter section with filters, burner section, fan section and control cabinet.

2.2 CASING AND STRUCTURE

.1 Construct casings of minimum 18 gauge satin-coat galvanized steel and in accordance with ASHRAE and SMACNA Standards.

.2 Reinforce the casings to operate with no vibration or "oil canning" under all conditions.

.3 Seal all joints with a water impervious caulking compound to make the unit air tight.

.4 Provide lift out insulated access panels with cam-lock fasteners for access to each section. Access doors shall fit into frame with full perimeter and continuous neoprene gasket. The access door to the burner and control panel shall be hinged and fastened with similar locking devices.

.5 Apply one factory enamel coat of paint proceeded by a suitable prime coat.

.6 Support casings on structural steel welded base frames extending over the entire length of the casing and designed to support the entire weight of all equipment when suspended from multiple lifting lugs.

2.3 INSULATION

.1 Insulate internally the entire casing, including the underside of the cabinet, with 1" thick neoprene coated rigid fibreglass thermal insulation.

.2 Insulate the casing such that no part of the casing is exposed to the air stream.

.3 Use insulation, sealants and waterproofing materials in accordance with all applicable Codes and Authorities.

.4 Heating section insulation shall be of sandwich panel design comprising rigid glass fibre insulation between external cabinetry and internal metal lining. Insulating shall be glued and pinned in place.

2.4 FANS

.1 Provide forward curved double width, double inlet belt driven centrifugal fans rated in accordance with AMCA Standard Test Code. Each fan shall carry the AMCA seal.

.2 Fans and drives shall be statically and dynamically balanced in the factory to operate quietly without pulsation or vibration.

.3 Provide ball or roller type self-aligning, grease lubricated bearings designed for 100,000 hour life. Provide extended grease lines terminating adjacent to the fan section access door where grease fittings are not easily accessible.

.4 Provide balanced variable pitch sheaves.

.5 Motors shall be squirrel cage induction type, open drip proof (ODP), 1750 rpm, EEMAC design 'B' with class 'B' insulation, ball bearing, 1.15 service factor.

.6 Mount motors and drives within the fan casing. Provide internal vibration isolation.

.7 Manufacturer shall supply one extra set of drive for field balancing.

2.5 HEATING SECTION

.1 Provide line type gas burner with 15 to 1 turndown ratio.

.2 Provide factory mounted, wired and fire tested gas burner complete with operating and safety controls, including electric pilot valve, appliance regulator, modulating flow ratio valve, fail safe shut off valve and manual shut off valves.

.3 Supply lubricated manual shut-off cock for field mounting.

.4 Gas pressure at inlet valve shall be 7" WC.

2.6 FILTERS

.1 Provide 2" replaceable media ULC listed filters in permanent galvanized steel frames. Provide side access for filter replacement.

.2 Provide a differential pressure switch for interconnection to the "dirty filter" indication in remote panel.

2.7 INLET DAMPER

.1 Provide normally closed low leak dampers with gasketted blade and side seals, prewired damper controls with spring return type damper operator.

.2 Fresh air inlet hood shall be complete with 1/2" x 1/2" mesh bird screen.

2.8 CONTROLS

.1 Provide, within the unit, a control cabinet containing all required contacts, relays, control transformer and starters necessary to provide complete heating function. Unit shall be equipped with high limit, burner air flow switch and electronic modulating discharge air temperature control.

.2 Provide interlocks to operate when the kitchen exhaust fan is energized.

.3 Provide terminals for fire alarm shutdown and remote start-stop.

.4 Supply a remote panel containing pilot lights to indicate: fan on; burner on; dirty filters; burner lock-out; and low limit alarm. Panel shall also have On/Off switch. Install as directed by Consultant.

PART 3 - EXECUTION

3.1 INSTALLATION

.1 Install unit in accordance with the manufacturer's installation and operating instructions.

.2 Provide lamacoid label on unit identifying its designation and service.

.3 Provide an additional complete set of filters for the unit to be installed following final acceptance of the system.

.4 Provide all necessary natural gas piping, shut-off valves and flue vent to meet codes and regulations.

.5 Manufacturer shall start up and test all unit functions and ensure proper operation. Factory technician to provide copy of start up log to Owner and to demonstrate operation and maintenance to Owner's representative.

.6 Install and wire remote panel and control accessories.

END OF SECTION

SECTION 15855
MONOXIVENT FRP CORROSION DUCTWORK

PART 1 – GENERAL

1.01 **Reference:**

A. This Section of the Contract Specifications shall be read in conjunction with **Section 15000 – General Mechanical Clauses**, which shall apply to and govern the work of this section.

1.02 **Work Included:**

A. FRP – Fiberglass Reinforced Plastic ductwork and appurtenances, complete and in place, in accordance with the requirements of the Drawings.

B. All ductwork in **the Chemical Room and connecting the Hydrochloric Acid Scrubber Unit** shall be FRP.

1.03 **Standards:**

A. Comply with the latest revision of the following codes, standards and specifications, except where more stringent requirements have been specified herein:

a. ASTM C 582 – Standard specification for contact – molded reinforced thermosetting plastic laminates for corrosion resistant equipment.
b. ASTM D 3982 – Standard specification for contact-molded fiberglass ducts and hoods.
c. ASTM D 2996 – Standard specification for Filament-Wound Glass-Fiber-Reinforced Thermoset Resin Pipe.
d. NPS 15-69 - Standards specification for Custom Contact-Molded Reinforced - Polyester Chemical - Resistant Process Equipment.
e. SMACNA Thermoset FRP Duct Construction Manual
f. ASTM E 84 - Test for low flame

1.04 **Submittals:**

A. Submit shop fabrication drawings and installation drawings of the ventilation system in accordance **with Section 01300** – Submittals.

PART 2 – PRODUCTS

2.01 **General:**

A. Manufacturer:
a. Provide FRP duct as manufactured by one of the following without exception:
i. Corrosion Composites by Monoxivent
ii. Yankee Plastics
iii. Or equal

B. Service Conditions:

a. Ductwork shall be designed for **exhausting Hydrochloric Acid fumes at ambient conditions**. The minimum wall thickness for above grade FRP ductwork shall conform to the following:
b. Minimum Wall thickness will be in accordance with NPS 15-69, Table 2.
c. Duct with inside diameter of 20" (508mm) or less shall have a wall thickness of 0.125" (3.2mm); duct with inside diameter of 22" - 36" (559mm - 914mm)shall have a wall thickness of 0.1875" (4.8mm); duct with inside diameter of 38" (965mm) or greater shall have a wall thickness of 0.25" (6.4mm).
    i. Surfacing veil shall be C glass veil with a silane finish and a soluble binder.
    ii. Chopped strand mat shall be type ECR glass minimum 1.5 oz/sq ft (458 g/sq m) with silane finish and styrene soluble binder.
    iii. Continuous roving for chopper gun spray up shall be type E glass.
    iv. Woven roving shall be type E glass minimum 24 oz/sq yd (814 g/sq m)
    v. Continuous roving for filament winding shall be type E glass with silane finish.
d. Minimum Hanger Spacing will be in accordance with ASTM D 3982, Table 1.

C. Construction:
    a. FRP shall be of filament wound construction with a PS 15-69 corrosion barrier. Cast duct with no reinforced internal corrosion barrier or press molded fittings will not be accepted.
    b. FRP duct shall be factory assembled to the greatest possible extent, with a minimum number of field joints.
    c. Maximum allowable deflection for any size ductwork shall be 0.50" (12.7mm) between supports and for any size of duct under worst case operating conditions.
    d. FRP ductwork shall be designed using a safety factor of 10 to 1 for pressure and 5 to 1 for vacuum without exception.
    e. Out of roundness of duct shall be limited to 1% of diameter.
    f. Length of flanged duct sections shall not vary more than 0.50" (12.7mm) at 70 degrees F (21 degrees C).
    g. Un-flanged duct sections shall be square on the ends in relation to the center axis within 0.125" (3.2mm) up to and including 24" (610mm) diameter and within 0.1875" (4.8mm) for all diameters greater than 24" (610mm).

D. Laminates:
    a. Resin shall be a premium grade of fire retardant vinyl ester with a flame spread rating of less than 25, I.D. “Class 1” of ASTM E84 “Standard Method of Test for Surface Burning Characteristics of Building Material”. Resin shall be AOC’s #K022, Ashland’s #FR992 or Reichhold #9300.
    b. Ductwork shall have a resin rich inner surface, an interior layer, a structural layer and an exterior layer with UV resistant coating.
    c. Inner surface: Nominal 10 mils thick composed of a single ply of the “C “glass surfacing veil, having a resin content of 90%.
    d. Interior layer: Nominal 90 mils thick composed of at least two layers of 1-1/2’’ chopped strand mat. Resin content shall be 75%.
    e. Structural layer: Filament wound type E glass to meet minimum wall thickness as specified. The total wall thickness includes the inner surface.

f. Exterior UV resistant coating: Factory applied corrosion resistant gel coat with UV inhibitors. Light gray or white shall be used as the standard colors.

E. Fittings:
   a. Fittings shall be hand lay-up construction fabricated from the same resin and have the same strength as the FRP duct.
   b. The internal diameter of fittings shall be equal to the adjacent duct.
   c. The centerline radius of all elbows shall be 1.5 times the diameter.
   d. Elbows 24" (610mm) diameter and smaller shall be smooth radius. Elbows larger than 24" (610mm) diameter shall be mitered.
   e. Elbows 45 degrees or less shall be at least two (2) miter/three (3) gore. Elbows greater than 45 degrees shall be at least four (4) miter/five (5) gore.

F. Flanges:
   a. Provide flanged connections as required to flexible connectors, expansion joints, vessels, demisters, fans, silencers and other locations as shown.
   b. Flanges shall be hand lay-up construction. Dimensions shall be in accordance with PS 15-69 – Table 2 and the duct dimension schedule.
   c. Flange faces shall be perpendicular to the axis of the duct within 0.5 degree.
   d. Flange faces shall be flat to within 0.0313" (0.8mm) up to and including 18" (457mm) diameter and within 0.0625" (1.6mm) for 20" (508mm) diameter and larger.
   e. Gaskets shall be **EPDM/Neoprene**, full face and minimum 0.125" (3.2mm) thickness.
   f. Bolts, nuts and washers shall be Type 316 stainless steel.

G. Joints:
   a. Provide butt and wrap joints in accordance with ASTM D 3982.
   b. Field weld materials shall be supplied by the duct manufacturer. Complete written and online video instructions shall be provided along with Material Safety Data Sheets.
   c. Resin, catalyst and fiberglass materials shall be supplied in bulk for the total number of joints plus 20% extra.

2.02 **Expansion Joints:**

A. Provide expansion joints where shown on the Drawings.
B. Type: W-design configuration with integral flanges suitable for service with FRP duct under the conditions specified.
   a. Material: **EPDM**
   b. Backing rings: 0.394" (10mm) thick, 2" (51mm) wide, type 316 stainless steel where flanged expansion joints or flex connectors are noted.
   c. Extensions: 3" (76mm)
   d. Compression: 2.5" (64mm)
   e. Lateral offset: 2.5" (64mm)
   f. Thickness: 0.250"(6.4mm) minimum
   g. Bolts, nuts and washers: Type 316 stainless steel.
C. Expansion joints shall be **flanged** where connecting ductwork to equipment, otherwise slip-type will be acceptable. Acceptable manufacturer: **Mercer Rubber** or equal.

2.03 **Butterfly Dampers:**

A. Round FRP dampers:
    a. Round FRP dampers shall be the butterfly type. FRP fabrication shall meet the corrosion requirements specified in this section for FRP ductwork.
        i. Fabrication:
            1. Frame and blade: premium vinyl ester. Blade shall fully encapsulate shaft. Blades that bolt to a single side of the shaft will not be accepted.
            2. Shaft: Pultruded vinyl ester
            3. Bearings: EPDM/Neoprene
            4. Pins and hardware: Type 316 stainless steel.
            5. Shaft seals: EPDM/Neoprene
            6. Isolation dampers will have full circumference EPDM/Neoprene seals.
            7. Dampers shall have flanged ends or plain ends. Provide Type 316 stainless steel bolts, nuts and washers for flanged connections (By Others).
            8. Balancing/Volume dampers shall have a fully adjustable slot with an extra hole drilled in the handle for contractor to "drill –and-pin in-place" once the system is balanced so handle cannot vibrate loose.

PART 3 – EXECUTION

3.01 **Installation:**

A. FRP ducts shall be installed in a neat and workmanlike manner, properly aligned and cut from measurements taken at the site to avoid interferences with structural members, architectural features, openings and equipment.

B. Supports and anchors: All ducting shall be firmly supported with fabricated or commercial hangers or supports in accordance with SMACNA requirements. Where necessary to avoid stress on equipment or structural members, the ducts shall be anchored or harnessed. Expansion joints and guides as shown on drawings shall compensate for expansion due to temperature differences.
C. Support duct risers in accordance with ASHRAE and SMACNA as indicated.

3.02 **Duct Preparations:**

A. Prior to installation, each duct length and all fittings shall be carefully inspected, flushed clean of any debris or dust, and straightened, if not true. All duct and fittings shall be equally cleaned before assembly.

3.03 **Duct Joints:**

A. Butt and Wrap Joints: Prior to joining, ends shall be ground smooth. All dust and debris must be fully removed. Ends shall be resin-coated to prevent corrosion; in duct of 24" (610mm) diameter and above an interior corrosion wrap is required. The joint should be of equal strength as the duct wall. A butt and wrap sequence and thickness chart should be shown on the fabrication drawings and supplied with the Material Safety Data Sheets.

B. Supports and Anchors: All ducting shall be firmly supported with fabricated or commercial hangers or supports in accordance with SMACNA. Where necessary to avoid stress on equipment or structural members, the ducts shall be anchored or harnessed. Expansion joints and guides shall compensate for duct expansion due to temperature differences.

3.04 **Inspection and Field Testing:**

A. Inspection: All finished installations shall be carefully inspected for proper joints and sufficient supports, anchoring, interference and damage to duct, fittings and gel coat. Damage shall be repaired to the satisfaction of the Engineer.

B. Field Testing: Prior to enclosure or buying, all ducting systems shall be pressure tested at 1-1/2 times the maximum working pressure. The contractor shall furnish all test equipment, labor, materials and devices at no extra cost to the owner.

C. Leakage may be determined by loss of pressure, soap solution, chemical indicator or other positive and accurate method. All fixtures, devices or other accessories which are to be connected to the lines and which would be damaged if subjected to the test pressure shall be disconnected and ends of the branch lines plugged or capped as required during the test procedures.

D. Leaks shall be repaired to the satisfaction of the Engineer and the system shall be re-tested until no leaks are found.

END OF SECTION

SECTION 15860
FANS

PART 1 - GENERAL

1.1 WORK INCLUDED

.1 Provide fans and accessories where indicated on the Drawings and of the types and performance as listed in the Schedules.

1.2 SUBMITTALS

.1 Submit shop drawings for each fan in accordance with Section 15010 and including the following:

.1 Certified fan curves and sound power data for 75%, 100% and 125% of rated speed.

.2 For variable volume systems, also provide data at 30% and 50%.

.2 Provide data for inclusion in the operating and Maintenance Manuals in accordance with Section 15010.

1.3 MANUFACTURED ITEMS

.1 Catalogued or published ratings shall be those obtained from tests carried out by manufacturer or those provided by an independent testing agency signifying adherence to codes and standards in force.

.2 Provide confirmation of testing.

PART 2 - PRODUCTS

2.1 FANS - GENERAL

.1 Capacity, total and static pressure, revolutions per minute, power, model, size and sound power levels: as indicated.

.2 Sound ratings: comply with AMCA 301-76 tested to AMCA 300-67. Unit shall bear AMCA certified sound rating seal.

.3 Fans: statically and dynamically balanced, constructed in conformity with AMCA 99-83.

.4 Ratings: based on tests performed in accordance with AMCA 210-74, and ASHRAE 51-85. Unit shall bear AMCA certified rating seal, except for propeller fans smaller than 300 mm (12") diameter. Fans shall have non-overloading characteristics.

.5 Bearings: heavy duty, split pillow-block, flange mounted, grease lubricated ball or roller bearings of self-aligning type with oil retaining, dust excluding seals and a certified minimum rated life of 100,000 hours in accordance with AFBMA l-10 life standard. Bearings to be rated and selected in accordance with AFBMA 9 and AFBMA 11.

.6 Motors: sizes as indicated or specified.

.7 Provide motors capable of accelerating to operating speed in 15 seconds without motor overload. For starting times over 10 seconds, or fan motors 30 hp or over, provide thermistors in motors.

.8 Accessories and hardware: V-belt drives, adjustable motor bases, belt guards, coupling guards and hinged fan inlet and outlet safety screens for exposed inlets or outlets.

.9 Belt guards on exposed belts.

.10 Factory primed exterior and factory primed and enameled interior before assembly in colour standard to manufacturer.

.11 Scroll drains: where indicated.

.12 Balanced sheaves to 15 hp, fixed sheaves above.

.13 Provide an additional set of sheaves as required for balancing.

.14 Fans serving a smoke exhaust function shall have bearings, belts and drives outside the air stream wherever possible. Otherwise, bearings, belts and drives shall be shielded.

.15 V-belt drive shall be capable of transmitting 150% of fan motor horsepower.

.16 Extend lubrication services to outside the casing.

2.2 CENTRIFUGAL FANS

.1 Fan wheels

.1 Welded steel construction.

.2 Maximum operating speed of centrifugal fans shall not be more than 40% of first critical speed.

.3 Airfoil, forward curved, backward inclined blades as indicated.

.2 Housings

.1 Form volute with inlet cones, fabricated steel for wheels 300 mm (12") or greater, cold rolled steel for smaller wheels, braced and with welded supports. Convertible discharge up to 675 mm (27") wheels, fixed discharge for larger.

.2 For horizontally and vertically split housings, provide flanges on each section for bolting together, with gaskets of non-oxidizing non-flammable material.

.3 Provide airtight access doors with handles.

.4 Provide 10 mm (3/4") drain plug.

2.3 CABINET FANS

.1 Single or multiple wheels with DWDI centrifugal fans in factory fabricated casing complete with motor, V-belt drive and guard inside or outside casing.

.2 Fabricate casing of zinc coated or phosphate treated steel of 1.5 mm (16 gauge) thickness reinforced and braced for rigidity. Provide removable panels for access to internal parts. Uncoated steel parts shall be painted over with corrosion resistant paint to CGSB 1-GP-181M+Amdt-Mar-78. Finish inside and out, over prime coat, with rust resistant baked on enamel. Internally line cabinet with 25 mm (1") thick rigid acoustic insulation.

2.4 UTILITY SETS

.1 Characteristics and construction: as for centrifugal fans.

.2 Preassemble single width centrifugal fan with removable protective hood with vents, and automatic back draft dampers and bird screens.

.3 Provide belt driven sets with adjustable motor bed plate and variable pitch driver sheave.

2.5 AXIAL FLOW FANS

.1 Fabricate casings of welded steel with welded motor support, hinged or bolted access plates, streamlined inlet cone and discharge bell sections and integral silencer casing, external silencer.

.2 Provide floor-mounted units with reinforced legs. Provide ceiling-suspended units with support brackets welded to side of casing.

.3 Direct drive

.1 Adjustable blade wheels: totally enclosed, air over motors.

.2 Diameter of wheel hub: at least equal to that of motor frame.

.3 Adjust blades for varying range of volume and pressure. Hubs shall facilitate indexing of blade angle. Provide automatic adjustment stops to avoid overloading motor. Provide easy access to fan wheel.

.4 Belt drive

.1 Drive adjustable blades by externally mounted motors through V-belt drive. Provide internal belt fairing, external belt guards and adjustable motor mounts.

.2 Adjust blades for varying range of volume and pressure. Hubs shall facilitate indexing of blade angle. Provide automatic adjustment stops to avoid overloading motor. Provide easy access to fan wheel.

.5 Provide remote control actuator for hub pitch control, with maximum flow with no signal.

.6 Provide companion flanges of same gauge as fan flanges.

2.6 TUBULAR CENTRIFUGAL FANS

.1 Characteristics and construction: as for centrifugal fan wheels, with axial flow construction and direct drive motor.

.2 Provide AMCA arrangements 1 or 9 as indicated with stiffened flanges, smooth rounded inlets and stationary guide vanes.

2.7 PROPELLER FANS

.1 Fabricate multi-bladed propellers of sheet steel or airfoil shape within bell mouth entrance on integral mounts, with grease lubricated ball bearings suited for operating in any position, direct or belt driven, complete with motor as indicated.

.2 Provide blade guards, bird screen and automatic back draft dampers on discharge, with gasketted edges.

2.8 ROOF-MOUNTED FANS

.1 Provide roof-mounted fans with spun aluminum housing, integral vibration isolation, discharge bird screen and prefabricated roof curb.

.2 All components shall resist corrosion.

.3 Provide automatic (gravity) gasketted aluminum backdraft dampers for all fans except where specifically noted. Damper shall be motorized where indicated on the schedules.

2.9 SUITE WASHROOM EXHAUST FANS

.1 Provide ceiling mounted, direct drive, centrifugal exhaust fans where shown on the drawings and as described in the equipment schedules.

.2 Wheel and scroll shall be high impact polypropylene, forward curved, deep scroll design.

.3 Fan housings shall be constructed of galvanized steel 5” (125mm) diameter discharge collar with integral spring assisted back draft damper.

.4 All motorized impellers shall be totally enclosed, fan cooled, Class B insulation, balanced to provide vibration free operation. Ball bearings shall be permanently lubricated and sealed. Motors shall be rated for continuous operation and automatic reset thermal overload protection. All units shall have PSC motors, 115/1/60.

.5 Provide low profile plastic ceiling grille.

2.10 RANGE HOODS

.1 Unit shall have a lifetime lubricated, dual centrifugal blower controlled with an infinite speed control. RPM not to exceed 2400. Hood shall have a separate light switch.

.2 Sides shall be mitred and bottom edge hemmed – with no sharp edges.

.3 Air delivery shall be no less that 200 CFM at static pressure indicated in Schedules and sound levels no greater than 5.5 Sones (vertical) and 6.5 Sones (horizontal discharge). All air and sound ratings shall be certified by HVI.

.4 Unit shall be CSA listed to conform to C22.2 No. 113 and CAN/CSA C260.

.5 Unit shall be supplied in black paint finish.

.6 Broan Model No. 753023 or equivalent.

2.11 SUITE DRYER EXHAUST FANS

.1 Provide inline, centrifugal, direct drive dryer booster fans where shown on the drawings and as described in the specifications. Fans shall be provided with a positive pressure sensing switch to automatically start the fan when the dryer is started.

.2 Fan housing shall be constructed of heavy gauge galvanized sheet metal. Internal air tuning vanes shall be provided for maximum air performance. Fan shall be supplied with externally mounted electrical terminal box and pre-wired terminal strip connections. Capacitor shall be enclosed within the fan electrical junction box.

.3 Motorized impeller shall be an external rotor type, Class B insulation, totally enclosed

permanent split capacitor type. Bearings shall be permanently sealed self lubricating ball type. Motor shall be equipped with automatic reset thermal overload protection. Motor shall be acceptable for continuous duty.

.4 Fan wheel shall be of the backward inclined centrifugal type with a well designed inlet venturi for maximum performance. Motorized impeller shall be both statically and dynamically balanced as one integral unit to provide for vibration free performance.

.5 Integral positive pressure sensing switch shall be mounted on the fan and prewired to the terminal strip provided in fan electrical junction box. Diaphragm sensitivity shall be a minimum of 0.05" static pressure. Switch shall incorporate a delay-on-make timer cycle to maintain fan performance for intervals of 10 minutes until drying cycle is competed.

.6 Fan shall be tested and approved by ULC and CSA for dryer booster fan application.

.7 All air and sound ratings shall be certified by HVI.

PART 3 - EXECUTION

3.1 FAN INSTALLATION

.1 Install fans as indicated, complete with resilient mountings and flexible electric leads.

.2 Install fans with 100 mm (4") flexible connection on inlet ductwork and on discharge ductwork. Ensure metal bands of connectors are parallel with minimum 25 mm (1") flex between ductwork and fan during running.

.3 Install fan restraining snubbers as indicated. Flexible connections shall not be in tension during running.

.4 Provide sheaves and belts required for final air balance.

END OF SECTION

SECTION 15890
LOW PRESSURE DUCTWORK

PART 1 - GENERAL

1.1 WORK INCLUDED

.1 Provide all low pressure ductwork and accessories as shown on the Drawings.

PART 2 - PRODUCTS

2.1 CLASSIFICATION

.1 Ductwork

Class	Maximum Pressure Pa ("W.G.)	Maximum Velocity m/s (fpm)	Seal Class
I	500 (2)	12.5 (2500)	A
II	250 (1)	12.5 (2500)	B
III	125 (0.5)	10.0 (2000)	C
IV	125 (0.5)	10.0 (2000)	D

.2 Seals

.1 Class A: seams, joints and connections made airtight with sealing compound and tape.

.2 Class B: seams, joints and connections made airtight with sealing compound.

.3 Class C: transverse joints and connections made airtight with sealing compound. Longitudinal seams unsealed.

.4 Class D: seams, joints and connections unsealed.

2.2 SEALANT AND TAPE

.1 Sealant: oil resistant, polymer type flame resistant high velocity duct sealing compound. Temperature range of -30°C to 93°C (-22°F to 200°F).

.2 Tape: polyvinyl treated, open weave glass fibre tape, 50 mm (2") wide.

2.3 DUCT LEAKAGE

.1 Class I: 0.50% of total system design flow at 500 Pa (2" W.G.).

.2 Class II: 1.00% of total system design flow at 250 Pa (1" W.G.).

.3 Class III: 1.50% of total system design flow at 125 Pa (1/2" W.G.).

.4 Class IV: 5.00% of total system design flow at 125 Pa (1/2" W.G.).

2.4 FITTINGS

.1 Fabrication: to SMACNA standards

.2 Radius elbows: standard radius or short radius with single thickness turning vanes.

.3 Square elbows: to 400 mm (16") with single thickness vanes.

.4 Square elbows: over 400 mm (16") with double thickness vanes.

.5 Main supply duct branches with or without splitter damper. If splitter damper is not used, provide branch and main duct balancing dampers.

.6 Sub-branch duct with 45° entry and balancing damper on branch, or sub-branch duct with square connection, volume extractor and branch duct balancing damper.

.7 Transitions:

.1 Diverging: 20° maximum included angle.

.2 Converging: 30° maximum included angle.

.8 Offsets: square elbows or radius elbows as indicated or required.

.9 Obstruction deflectors: maintain full cross-sectional area. Maximum included angles for transitions.

2.5 GALVANIZED STEEL

.1 Lock forming quality: to ASTM A525M-80, Z90 zinc coating.

.2 Thickness: to ASHRAE and SMACNA.

.3 Fabrication: to ASHRAE and SMACNA.

.4 Joints: to ASHRAE and SMACNA or proprietary manufactured duct joint. Proprietary manufactured flanged duct joint shall be considered to be a Class A seal.

.5 All round exposed ductwork shall be, of spiral wound manufacture.

2.6 STAINLESS STEEL

.1 To ASTM A480M-84a, Type 304.

.2 Thickness: ASHRAE and SMACNA, or as indicated.

.3 Fabrication: to ASHRAE and SMACNA or as indicated.

.4 Joints: to ASHRAE and SMACNA, continuous inert gas welded.

2.7 ALUMINUM

.1 To ASHRAE and SMACNA. Aluminum type: 3003-H-14.

.2 Thickness: to ASHRAE and SMACNA or as indicated.

.3 Fabrication: to ASHRAE and SMACNA or as indicated.

.4 Joints: to ASHRAE and SMACNA, continuous weld.

2.8 BLACK STEEL

.1 To ASTM A21M-82.

.2 Thickness: 1.2 mm (16 gauge) or as indicated.

.3 Fabrication: ducts and fittings to ASHRAE and SMACNA.

.4 Joints: to be continuous weld.

2.9 HANGERS AND SUPPORTS

.1 Strap hangers: of same material as duct, but next sheet metal thickness heavier than duct.

.2 Hanger configuration: to ASHRAE and SMACNA. Maximum size duct supported by strap hanger: 500 mm (20").

.3 Hangers: galvanized steel angle with galvanized steel rods to ASHRAE and SMACNA, following table:

Duct Size mm (")	Angle Size mm (")	Rod Size mm (")
up to 750 (30)	25 x 25 x 3 (1 x 1 x 1/8)	6 (1/4)
751 (30) to 1050 (42)	40 x 40 x 3 (1.5 x 1.5 x 1/8)	6 (1/4)
1051 (42) to 1500 (60)	40 x 40 x 3 (1.5 x 1.5 x 1/8)	10 (3/8)
1501 (60) to 2100 (84)	50 x 50 x 3 (2 x 2 x 1/8)	10 (3/8)
2101 (84) to 2400 (96)	50 x 50 x 5 (2 x 2 x 3/16)	10 (3/8)
2401 (96) and over	50 x 50 x 6 (2 x 2 x 1/4)	10 (3/8)

.4 Upper hanger attachments:

.5 For concrete: manufactured concrete inserts.

PART 3 - EXECUTION

3.1 GENERAL

.1 Install ducts in accordance with ASHRAE 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, or as indicated.

.4 Exhaust ductwork commercial dishwashers and commercial clothes dryers shall be of aluminum construction. Kitchen exhaust ductwork shall be constructed as indicated in this section. Unless otherwise indicated, remaining ductwork shall be constructed of galvanized steel.

.5 All exposed round spiral wound ductwork shall be Class IV. All other ductwork shall be Class I, Class II or Class III as required.

3.2 HANGERS

.1 Strap hangers: install in accordance with SMACNA.

.2 Angle hangers: complete with locking nuts and washers.

.3 Hanger spacing as follows:

Duct Size mm (")	Spacing mm (')
to 1500 (60)	3000 (10)
1501 (60) and over	2500 (8)

3.4 WATERTIGHT DUCT

.1 Provide watertight duct for:

.1 Kitchen exhaust.

.2 Dishwasher exhaust.

.3 Fresh air intake.

.4 Downstream of duct mounted steam grid humidifiers.

.5 As Indicated.

.2 Form bottom of horizontal duct without longitudinal seams. Solder or weld joints of bottom and side sheets. Seal all other joints with duct sealer.

.3 Slope horizontal branch ductwork down toward hoods served. Slope header ducts down toward risers.

.4 Fit base of riser with 150 mm (6") deep drain sump and 32 mm (1-1/2") drain connected, with deep seal trap and trap primer and discharging to open funnel drain.

3.5 KITCHEN EXHAUST DUCT

.1 Install to current edition of NFPA 96.

.2 Kitchen exhaust duct: black steel, all welded joints. Slope down toward hood. Provide drains at all low points. Provide gasketted access doors to access full length of duct.

.3 Connect ductwork to kitchen exhaust fan as detailed in NFPA96. Flexible duct connections to exhaust fan are not permitted.

3.6 LEAKAGE TEST

.1 Make trial leak test, as instructed, to demonstrate workmanship.

.2 Install no additional ductwork until trial test has been passed.

.3 Test section minimum of 30 m (100') long with not less than three (3) branch takeoffs and

two (2) 90° elbows.

.4 Conduct test in accordance with AABC standards.

.5 Duct leakage shall not exceed that allowed for ductwork classification.

3.7 SEALING AND TAPING

.1 Apply sealant to outside of joint to manufacturer's recommendations.

.2 Bed tape in sealant and recoat with minimum of one (1) red coat of sealant to manufacturer's recommendations.

END OF SECTION

SECTION 15910
DUCTWORK ACCESSORIES

PART 1 - GENERAL

1.1 WORK INCLUDED

.1 Provide all duct accessories.

1.2 CERTIFICATION OF RATINGS

.1 Catalogue or published ratings shall be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.

PART 2 - PRODUCTS

2.1 FLEXIBLE CONNECTIONS

.1 Frame: galvanized sheet metal frame 1.5 mm (16 gauge) thick with fabric clenched by means of double locked seams.

.2 Material: Fire resistant, self-extinguishing, neoprene coated glass fabric, temperature rated at -40°C to 90°C (-40°F to 194°F), density of 1.3 kg.sq. m (25 lbs/sq.ft).

2.2 SEALANT AND TAPE

.1 Sealant: oil resistant, polymer type flame resistant high velocity duct sealing compound. Temperature range of -30°C to 93°C (-22°F to 200°F).

.2 Tape: polyvinyl treated, open weave fibre glass tape, 50 mm (2") wide.

2.3 ACCESS DOORS

.1 General

1 Non-insulated sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.6 mm (24 gauge) thick, complete with sheet metal angle frame.

2 Insulated sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.6 mm (24 gauge) thick, complete with sheet metal angle frame and 25 mm (1") thick rigid glass fibre insulation.

.2 Gaskets: neoprene or foam rubber.

.3 Hardware:

1 Up to 300 x 300 mm (12" x 12"): two (2) sash locks.

2 301 to 450 mm (12" to 18"): four (4) sash locks.

3 451 to 1000 mm (18" to 40"): piano hinge and minimum two (2) sash locks.

4 Doors over 1000 mm (40"): piano hinge and two (2) handles operable from both sides.

2.4 TURNING VANES

.1 Factory or shop fabricated, single or double thickness to recommendations of SMACNA.

2.5 INSTRUMENT TEST PORTS

.1 1.6 mm (14 gauge) thick steel zinc plated after manufacture.

.2 Cam lock handles with neoprene expansion plug and handle chain.

.3 28 mm (1") minimum inside diameter. Length to suit insulation thickness.

.4 Neoprene mounting gasket.

2.6 BACK DRAFT DAMPERS

.1 Automatic gravity operated, multi leaf, aluminum construction with nylon bearings, and centre pivoted.

PART 3 - EXECUTION

3.1 INSTALLATION

.1 Flexible Connections

1 Install in following locations:

1 Inlets to supply air units, except where units are internally isolated.

2 Outlets from supply air units except where units are internally isolated.

3 Inlets and outlets of fans.

4 As indicated.

2 Length of connection: 150 mm (6").

3 Minimum distance between metal parts when system in operation: 75 mm (3").

4 Install in accordance with recommendations of SMACNA.

.2 Sealants and tapes

1 Apply sealant in accordance with SMACNA and to manufacturer's recommendations.

2 Bed tape in sealant and recoat with minimum of one coat of sealant to manufacturer's recommendations.

.3 Access doors

1 Size:

1 760 mm x 1500 mm (30" x 60") for person size entry.

2 600 mm x 1200 mm (24" x 48") for servicing entry.

3 300 mm x 300 mm (12" x 12") 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 As indicated.

.4 Instrument Test Ports

1 General

1 For traverse readings, install in accordance with recommendations of SMACNA.

2 For temperature readings, install in accordance with recommendations of SMACNA.

3 Install in accordance with manufacturer's instructions.

2 Locations

1 Traverse:

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 As indicated or required for full, accurate readings.

2 Temperature:

1 At outside air intakes.

2 At mixed air locations.

3 At inlet and outlet of coils.

4 Downstream of junctions of two converging air streams of different temperatures.

5 As indicated or required for all necessary readings.

.5 Turning vanes

1 Install in accordance with recommendations of SMACNA.

END OF SECTION

SPEC SECTION 15911
FLEXIBLE DUCTWORK

PART 1 - GENERAL

1.1 WORK INCLUDED

.1 Provide all flexible ductwork.

1.2 REFERENCE STANDARDS

.1 Comply with the requirements of:

.1 ULC S110M for fire tests for air ducts.

.2 UL 181 for factory made air ducts and connectors.

.3 NFPA 90A for installation of air conditioning and ventilating systems.

.4 NFPA 90B for installation of warm air heating and air conditioning systems.

.5 SMACNA for flexible duct installation standards.

1.3 CERTIFICATION OF RATINGS

.1 Catalogue or published data ratings shall be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.

1.4 SAMPLES

.1 Submit samples with product data of each different type of flexible duct being used.

PART 2 - PRODUCTS

2.1 GENERAL

.1 Factory fabricated.

.2 Pressure drop coefficients listed below are based on sheet metal duct pressure drop coefficient of 1.00.

.3 Flame spread rating not to exceed 25. Smoke developed rating not to exceed 50.

2.2 METALLIC - UNINSULATED

.1 Spiral wound flexible aluminum.

.2 Performance:

.1 Minimum working pressure: 2.5 kPa (10" WG)

.2 Maximum pressure drop coefficient: 3.

2.3 METALLIC - INSULATED

.1 Spiral wound flexible aluminum with factory applied flexible glass fibre thermal insulation with vapour barrier and vinyl jacket.

.2 Performance:

.1 Minimum working pressure: 2.5 kPa (10" WG).

.2 Maximum pressure drop coefficient: 3.

.3 Thermal loss/gain: 22 W/sq. m□ C mean (4 BTU/hr./sq.ft □F).

2.4 METALLIC – ACOUSTIC FLEX

.1 Spiral wound perforated flexible aluminum with factory applied flexible glass fibre insulation and flame retardant non-toxic polyethylene vapour barrier.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION

.1 Install where indicated. Provide acoustic metallic flexible duct unless otherwise indicated.

.2 Provide minimum three (3) screws or stainless steel worm drive clamps to fasten flexible

ducts to diffusers or rigid ductwork. Completely seal connections with tape.

.3 Support in accordance with SMACNA.

.4 Maximum length of flexible duct: 3 m (10 ft).

END OF SECTION

PART 1 - GENERAL

1.1 WORK INCLUDED

.1 Provide all balancing dampers and accessories.

PART 2 - PRODUCTS

2.1 SPLITTER DAMPERS

.1 Of same material as duct but one sheet metal thickness heavier, with appropriate stiffening.

.2 Double thickness construction, airfoil blade profile.

.3 Size and configuration to recommendations of SMACNA.

.4 Control rod with locking device.

.5 Bend end of rod to prevent end from entering duct.

.6 Pivot: piano hinge.

2.2 SINGLE BLADE DAMPERS

.1 Of same material as duct. V-groove stiffened.

.2 Size and configuration to recommendations of SMACNA, except maximum height 250 mm (10").

.3 Locking quadrant, with shaft extension to accommodate insulation thickness.

.4 Inside and outside bronze end bearings.

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: pin in bronze bushings.

.5 Linkage: shaft extension with locking quadrant.

.6 Channel frame material of same material as duct, complete with angle stop.

2.4 DIVERTING DAMPERS

.1 Adjustable, curved vanes, mounted in supporting frame.

.2 All aluminum construction.

PART 3 - EXECUTION

3.1 INSTALLATION

.1 Install where indicated and as required to completely balance the air systems.

.2 Install in accordance with recommendations of SMACNA and in accordance with manufacturer's instructions.

END OF SECTION

SECTION 15913
MOTORIZED DAMPERS

PART 1 - GENERAL

1.1 GENERAL

.a This section applies to all dampers indicated on the Drawings as motorized. Controls subcontractor shall provide actuators and linkages between actuator and damper shaft.

1.2 PRODUCT DATA

.a Submit product data in accordance with section 15010.

.b Provide the following:

.i Performance charts indicating pressure drops and leakage rates.

.ii Schedule of damper locations and sizes.

1.3 MAINTENANCE DATA

.a Provide maintenance data for incorporation into manual specified in Section 15010.

1.4 CERTIFICATION OF RATINGS

.a Catalogue or published ratings shall be those obtained from tests carried out by manufacturer or those ordered by him from independent testing agency.

PART 2 - PRODUCTS

2.1 MULTI-LEAF

.a Opposed blade type for modulating service.

.b Parallel blade type for two position service.

.c Structurally formed steel interlocking blades, complete with extruded vinyl seals, spring stainless steel side seals, structurally formed and welded galvanized steel.

.d Pressure fit self-lubricated bronze bearings.

.e Linkage: plate steel tie rods, brass pivots and plated steel brackets, complete with plated steel control rod.

.f Performance: leakage in closed position to be less than 2% of rated air flow at 1 kPa (4" WG) differential across damper. Pressure drop at full open position to be less than 25 Pa (0.10" wG) differential across damper at maximum air flow.

.g Provide insulated aluminum dampers, frames insulated with extruded polystyrene foam with R Factor of 5.0. Blades shall be constructed from aluminum extrusions with internal hollows insulated with polyurethane or polystyrene foam, R Factor of 5.0.

.h Provide damper jackshafts as required for multiple damper sections.

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 Seal multiple damper modules with UL listed non-transparent silicon sealant.

.4 Upon system start-up, ensure that dampers operate properly.

END OF SECTION

SECTION 15916
FIRE DAMPERS

PART 1 - GENERAL

1.1 WORK INCLUDED

.1 Provide all fire dampers and accessories.

1.2 SUBMITTALS

.1 Submit shop drawings for each type of fire damper in accordance with Section 15010.

.2 Provide data for inclusion in the Operating and Maintenance Manuals in accordance with Section 15010.

1.3 CERTIFICATION OF RATINGS

.1 Catalogue or published ratings shall be those obtained from tests carried out by the manufacturer or those ordered by him from an independent testing agency signifying adherence to codes and standards.

PART 2 - PRODUCTS

2.1 FIRE DAMPERS

.1 Fire dampers shall be listed and bear label of ULC and shall meet requirements of authorities having jurisdiction.

.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; multi-blade hinged or interlocking type; roll door type; guillotine type; sized to maintain full duct cross section.

.4 Fusible link actuated, weighted to close and lock in closed position when released or having negator-spring-closing operator for multi-leaf type or roll door type in horizontal position with vertical air flow.

.5 Frame and 40 x 40 x 3 mm (1.5" x 1.5" x 1/8") angle iron on full perimeter of frame on both sides of fire wall and/or fire wall being pierced.

.6 All fire dampers shall be type 'B' fire dampers to maintain full duct cross sectional area when open.

PART 3 - EXECUTION

3.1 INSTALLATION

.1 Install fire dampers in accordance with NFPA 90A.

.2 Maintain integrity of fire wall and/or fire separation.

.3 After completion and prior to concealment, obtain approvals of complete installation.

END OF SECTION

SECTION 15920
ACOUSTIC DUCT LINING

PART 1 - GENERAL

1.1 WORK INCLUDED

.1 Provide all acoustic duct lining and accessories.

1.2 REFERENCE STANDARDS

.1 Do work in accordance with recommendations of SMACNA Duct Liner Application Standard.

PART 2 - PRODUCTS

2.1 DUCT LINER

.1 General

.1 Fibrous glass duct liner density 22 kg/cu. m (1.5 lb/cu.ft): one side coated with black neoprene.

.2 Flame spread rating shall not exceed 25. Smoke development rating shall not exceed 50.

.2 Rigid

.1 25 mm (1") thick, to CGSB 51-GP-10M fibrous glass rigid board duct liner. For ductwork located outdoors, increase thickness to 50mm (2”).

.2 Use on all flat surfaces.

.3 Flexible

.1 25 mm (1") thick, to CGSB 51-GP-11M+Amdt-Apr-78, fibrous glass blanket duct liner. For ductwork located outdoors, increase thickness to 50mm (2”).

.2 Use on round or oval surfaces.

2.2 ADHESIVE

.1 Flame spread rating shall not exceed 25. Smoke development rating shall not exceed 50. Temperature range - 30°C to 93°C (-22°F to 200°F). Meet requirements of NFPA 90A.

2.3 FASTENERS

.1 Weld pins 2.0 mm (0.8") diameter, length to suit thickness of insulation. Metal retaining clips, 32 mm (1-1/4") square.

2.4 JOINT TAPE

.1 Poly-vinyl treated open weave fibre glass membrane 50 mm (2") wide.

2.5 SEALER

.1 Flame spread rating shall not exceed 25. Smoke development rating shall not exceed 50. Temperature range -68°C to 93°C (-90°F to 200°F). Meet requirements of NFPA 90A-1996.

PART 3 - EXECUTION

3.1 GENERAL

.1 Line inside of ducts where indicated on drawings or in Schedules.

.2 Duct dimensions shown on the Drawings are clear inside. Increase actual duct dimensions accordingly to maintain clear dimensions indicated on Drawings.

.3 Manufacture duct in lengths to accommodate installation of duct liner.

3.2 DUCT LINER

.1 Install in accordance with manufacturer's recommendations, recommendations of SMACNA, and as follows:

.1 Fasten to interior sheet metal surface with 100% coverage of adhesive.

.2 In addition to adhesive, install weld pins at one pin per 2 sq. m (20 sq. ft) of liner, but not less than one row per side.

3.3 JOINTS

.1 Seal all joints, exposed edges, weld pin and clip penetrations and all damaged areas of liner with joint tape. Badly damaged areas of lining shall be replaced at discretion of Consultant.

.2 Seal joint tape in accordance with manufacturer's recommendations, recommendations of SMACNA, and as follows:

.1 Bed tape in sealer.

.2 Apply two coats of sealer over tape.

.3 Protect leading and trailing edges with sheet metal edging.

END OF SECTION

SECTION 15935
GRILLES, REGISTERS AND DIFFUSERS

PART 1 - GENERAL

1.1 WORK INCLUDED

.1 Provide all grilles, registers, diffusers and accessories.

.2 Grilles, registers and diffusers shall be the product of one manufacturer.

1.2 SHOP DRAWINGS AND PRODUCT DATA

.1 Submit shop drawings in accordance with Section 15010.

1.3 SAMPLES

.1 Samples are required for each type of grille, register and diffuser.

1.4 CERTIFICATION OF RATINGS

.1 Catalogued or published ratings shall be those obtained from tests carried out by manufacturer or those ordered by him from independent testing agency indicating adherence to codes and standards.

PART 2 - PRODUCTS

2.1 GENERAL

.1 Provide standard product to meet capacity, throw, noise level, throat and outlet velocity.

.2 Where grilles, registers and diffusers penetrate fire walls and fire partitions, provide approved steel sleeve secured to structure in accord with NFPA 90A-1996.

.3 Frames:

.1 Steel: prime coated cold rolled steel with exposed welded joints and mitred corners.

.2 Aluminum: extruded satin finish with mechanical fasteners and mitred corners.

.3 Provide full perimeter gaskets.

.4 Provide plaster frames as plaster stops where set into plaster or gypsum board.

.5 Provide concealed fasteners and operators.

.4 Sizes and capacities as indicated in Schedules.

.5 Floor grilles to be capable of supporting 90 kg (200 lbs) point load weight between supports with negligible deflection.

PART 3 - EXECUTION

3.1 INSTALLATION

.1 Install in accordance with manufacturer's instructions.

.2 Install with flat head cadmium plated screws in countersunk holes where fastenings are visible.

END OF SECTION

SECTION 15936
LOUVRES, INTAKES AND VENTS

PART 1 - GENERAL

1.1 WORK INCLUDED

.1 Provide all intakes, vents and accessories.

.2 Provide blank-off panels for louvres.

1.2 CERTIFICATION OF RATINGS

.1 Catalogued or published ratings shall be those obtained from tests carried out by manufacturer or those ordered by him from an independent testing agency signifying adherence to codes and standards.

1.3 TEST REPORTS

.1 Submit certified data from independent laboratory substantiating acoustic aerodynamic performance to ASTM E90-85.

PART 2 - PRODUCTS

2.1 FACTORY MADE ROOF FRESH AIR INTAKES AND RELIEF VENTS

.1 Aluminum, hinged at curb line, complete with integral 12 mm (1/2") exhaust, 25 mm (1") intake mesh of 2.7 mm (1/8") diameter aluminum wired bird screen and vertical backdraft dampers on faces.

.1 Maximum throat velocity: 3.3 m/s (650 fpm) intake.

.2 Maximum loss through unit: 15 Pa (0.06" WG) exhaust static pressure.

.3 Maximum velocity through damper area: 1.5 m/s (300 fpm).

.4 Shape: as indicated.

2.2 GOOSENECK HOODS

.1 Thickness: to ASHRAE and SMACNA.

.2 Fabrication: to ASHRAE and SMACNA.

.3 Joints: to ASHRAE and SMACNA or proprietary manufactured duct joint. Proprietary manufactured flanged duct joint shall be considered to be a Class A seal.

2.3 LOUVRES

.1 Louvres are provided by Division 10.

PART 3 - EXECUTION

3.1 INSTALLATION

.1 Install in accordance with manufacturer's recommendations and in accordance with recommendations of SMACNA.

.2 Reinforce and brace air vents, intakes and gooseneck hoods for wind speed in accordance with NBC for location.

3.2 LOUVRES

.1 Provide blank-offs on unused portion of louvres using 25 mm (1") rigid glass fibre insulation with 1.5 mm (16 gauge) galvanized sheet metal on both sides.

.2 Paint outside of panel same colour as louvre.

.3 Connect ductwork and plenums to louvres. Seal and caulk all connections.

END OF SECTION

SECTION 15950
CONTROLS

PART 1 - GENERAL

1.1 WORK INCLUDED

.a Provide a complete controls and instrumentation system in accordance with the Specifications and Drawings.

.b Supply automatic control valves.

.c Provide damper operators and linkages for all motorized dampers.

.d Wire components of temperature control system in accordance with the requirements of Division 16. Include wiring between control components and electrical circuit of fans, pumps, and any other equipment or apparatus as indicated in this Section. Provide necessary transformers, relays, etc. to accomplish the specified control functions.

.e The Building Control System (BCS) shall be a direct digital control (DDC) system which can, without additional equipment, perform all of the automatic DDC control, monitoring and optimizing of the HVAC systems and energy management functions as indicated hereafter.

.f The temperature control systems for terminal devices and systems and equipment not specifically identified to be DDC shall be pneumatic. All other control systems shall be DDC and shall utilize electronic sensing as specified. All analog outputs (AO) from the system to valve and damper actuators may be pneumatic or electronic.

.g The BCS shall consist of all hardware, software, wiring, field devices, installation, documentation and training as specified.

.h The work shall be performed by skilled technicians under the direction of experienced engineers, all of whom shall be properly trained and qualified for this work.

.i The system shall be modular, permitting expansion by adding hardware and software without changes in communication or processing equipment.

1.2 SUBMITTALS

.a Submit shop drawings in accordance with section 15010 and including the following:

.i Control air compressor set and accessories.

.ii All automatic temperature and humidity control components.

.iii Schematic control diagrams for all systems with each diagram indicating control components, component catalogue numbers, sequence of operation, and interlocking.

.iv Riser diagram showing the physical location of building control system equipment and the system architecture.

.v List of connected data points, including control units to which they are connected and input/output devices (sensors, transducers, etc.).

.vi Drawings of each HVAC system showing all points (connected and calculated) and operator notations.

.vii Complete sequences of operation of the DDC systems.

.viii BCS central system configuration, complete with all peripheral devices, batteries, power supplies, modems, etc. with interconnection diagrams.

.ix Technical specification data sheets of each system component and software module.

.x Descriptive data and sequence of operation of all operating, user and application software, including a complete Operator's Manual and Programmer's Manual tailored to the project.

.b Provide samples of thermostat covers and space sensors.

.c Provide data for inclusion in the Operating and Maintenance Manuals in accordance with Section 15010.

1.3 TRAINING

.a Training shall be provided to the Owner's designated representative which will cover the complete operation of the BCS and the software procedures to allow the user to add, modify or create points, DDC loops or energy management programmes.

.b The duration of the training period shall be not less than forty (40) hours, conducted during normal working hours. The instruction shall consist of both hands-on and classroom training.

1.4 MANUFACTURER CERTIFICATION

.a Provide manufacturer certification of the installation in accordance with Section 15010.

PART 2 - PRODUCTS

2.1 CONTROL AIR COMPRESSOR SET

.a High capacity, duplex air compressor set with factory supplied alternator to alternate the working compressor on each successive cycle. The compressor set shall meet all requirements of the control systems while operating not more than 33% of the time. The air compressor set shall be complete with an intake air filter and silencer, high pressure air receiver with drain, test cock, pressure gauge, automatic moisture removal trap and relief valve, belt guard and combination magnetic starters.

2.2 CONTROL AIR REFRIGERATED DRYER

.a Wall mounted continuous operating, refrigeration type, 115 Volt, single phase dryer complete with refrigerant evaporator and mechanical condensate separator, and facilities for mounting a condensate discharge valve. The dehydrator shall be

designed for a 120 kPa (17.4 psi) maximum operating pressure and shall be capable of reducing the atmospheric dewpoint to -23° C (-10° F) when dehydrating at 689 kPa (100 psi). Pressure drop across unit must not exceed 20.7 kPa (3 psi) at rated capacity.

2.3 FILTER AND PRESSURE REDUCING VALVE ASSEMBLIES

.a Combination filter/PRV assembly with quantities to suit system capacities and requirements, each assembly complete with:

.i Oil/particle filter with drain port and replaceable filter element.

.ii Adjustable pressure reducing valve with inlet and outlet pressure gauges and outlet safety pressure relief valve.

.b Each filter shall be complete with a replaceable coalescing type filter element which shall be mounted within a transparent polycarbonate bowl Each filter bowl shall be equipped with a drain and a perforated metal shield. Replacement of filter element shall be accomplished without disassembly of any connecting pipe.

.c Compressed air from the filters shall pass through reducing valves to reduce high pressure air supply to required system control pressures. Each assembly shall be complete with a relief valve on the low pressure side of the control valve assembly, a pressure gauge on each side of the pressure reducing valve, and unions where necessary to enable equipment to be dismantled for periodic servicing.

2.4 CONTROL AIR PIPING AND TUBING

.a Control piping mains (high pressure) shall be type 'L' hard drawn seamless copper with forged copper soldering type fittings and 50% lead/50% tin solder joints.

.b Low pressure mains and branch tubing may be fire resistant type 'FR' plastic tubing where it meets the local building department regulations unless otherwise indicated on the Drawings.

.c Control tubing in mechanical rooms shall be type 'M' copper. FR plastic may be used if installed within aluminum tray with cover or EMT conduit.

2.5 DAMPERS AND OPERATORS

.a Unless otherwise indicated, control dampers shall be opposed blade type for mixing and parallel blade type for "on-off" service.

.b Damper blades shall be formed of 0.8 mm (20 gauge) galvanized steel and shall not exceed 200 mm (8") in width. Maximum permissable leakage shall not exceed 1% of the total flow based on an approach velocity of 7.62 m/s (1500 fpm) with a 1 kPa (4") static pressure difference across the closed damper. Blades shall be constructed of formed galvanized steel with neoprene sealed edges, continuous stops and seals on all sides, impregnated bronze bearings and galvanized steel channel frames.

.c Centre bar linkage connectors shall be used; however, where centre bar linkages cannot be used due to space limitations, external side linkage connectors may be used.

.d Damper operators shall be of the replaceable diaphragm piston type with external adjustable stops to limit the length of stroke in either direction. Operators shall be mounted on adjustable brackets. Operating arms shall have double yoke linkages and double set screws for fastening to damper shaft.

.e Damper operators shall be selected to operate maximum damper loads of 2.6 sq. m (28 sq. ft). Where damper sizes exceed this area rating, multiple damper operators shall be provided.

2.6 ELECTRIC DAMPER OPERATORS

.a Provide spring return for "fail-safe" in normally open or normally closed position as indicated.

.b Size operator(s) to control dampers against maximum pressure or dynamic closing pressure, whichever is greater.

2.7 AUTOMATIC CONTROL VALVES AND OPERATORS

.a All characteristics of control valves shall be suitable for the required operation.

.b Straight through water valves shall be single seated with equal percentage flow characteristics.

.c Three-way mixing valves shall be linear for each port giving constant total flow.

.d All valves shall have stainless steel stems and spring loaded teflon cone packing.

.e Valves 50 mm (2") and smaller shall have screwed bodies. Valves 65 mm (2-1/2") and larger shall have flanged cast iron bodies.

.f The maximum pressure drop across any control valves shall not exceed 21 kPa (3 psi) unless specified otherwise.

2.8 ROOM THERMOSTATS

.a Pneumatic sensing thermostat of bimetal element construction, double valve type, operating without a constant waste of air. Each thermostat shall be equipped with a thermometer, shall be adjustable with adjustment keys, and shall be tamper proof with locking Allen key operated covers.

.b Provide thermostats with scale settings and temperature graduations in Celsius units.

.c Approximate thermostat locations are shown on the Mechanical Drawings. All final positions shall be approved by the Consultant.

2.9 AIR GAUGES

.a Air pressure indicating gauges shall be at least 40 mm (1-3/4") in diameter. Install gauges to show main supply air pressures and branch line pressure to valves and damper motors, except for space thermostats. Gauges shall be mounted within

each CU enclosure.

2.10 FIREHEADS/FIRESTATS

.a At excessive temperatures, fireheads shall exhaust air from a normally open P.E. switch, thus stopping interlocked fans and closing related dampers. Install fireheads in intake or discharge of exhaust fans and supply fans.

.b Provide a firehead for every 0.37 sq. m (4 sq.ft) of cross-sectional area arranged in a staggered pattern to give uniform and complete coverage.

.c Firestats may be used in place of fireheads where fan systems are not interconnected and ducts are under 0.37 sq. m (4 sq.ft) of cross-sectional area or largest dimension is not over 750 mm (30").

.d Firestats shall be electrical bimetal operated with manual reset.

2.11 PRESSURE ELECTRIC SWITCHES

.a Switch shall be SPDT snap acting.

.b The pressure range shall be 0 to 138 kPa (0 to 20 psi).

.c The set point shall be adjustable form 21 to 138 kPa (3 to 20 psi) and the differential adjustable between 13.7 and 41.1 kPa (2 and 6 psi).

.d The pressure switch shall be CSA approved.

2.12 DAMPER STATUS SWITCHES

.a Damper status switches shall be lever operated, activated by damper blade movement and mounted securely on damper frame.

.b Damper switch shall have contact rating of 5 Amperes at 120 V AC and be CSA approved and bear a ULC label.

2.13 DIFFERENTIAL PRESSURE SWITCHES

.a The differential pressure range of the switch shall be selected to suit the applications.

.b The switch shall have adjustable set point.

.c The switch shall have SPDT contacts and be CSA approved.

.d The switch shall be mounted with diaphragms in a vertical plane.

2.14 FREEZESTATS

.a Freezestats shall be complete with 6.1 m (20') of capillary. Wire freezestats shall shut down respective fan or fans should temperature over any 25 mm (1") of length drop below 2° C (35.6° F). Freezestats shall have manual reset. Locate freezestats after preheat coil and before cooling coil in air systems utilizing outside air.

2.15 ELECTRIC PNEUMATIC RELAYS

.a Electric pneumatic relays shall have a diaphragm operated SPDT snap-acting electrical switch with voltage and current rating suitable for specified electrical control. Provide auxiliary relays as required.

.b Relays shall have a 3-pipe body. Internal operating ports shall be of corrosion resistant metal.

.c Mount relays adjacent to the motor starter.

2.16 FIELD SENSORS AND CONTROL DEVICES

.a Each control panel shall be directly connected to point devices as specified by the input/output summary.

.b Temperature Sensors

.i All supply air sensors and mixed air sensors shall be resistance temperature detector (RTD) type with a 7.6 m (25') averaging element. Accuracy of the RTD and transmitter shall be ±0.6°C (±1°F) over a range of -7°C to 49°C (19.4°F to 120°F).

.ii All return air sensors shall be RTD or thermistor type. The sensor probe shall have a minimum length of 450 mm (18"). The accuracy of the sensor shall be ±0.6°C (±1°F) over a range of 4°C to 66°C (39.2°F to 150.8°F).

.iii All space sensors shall be RTD or thermistor type. Sensors shall be provided with blank thermostat covers, mounted 1500 mm (60") from floor level unless otherwise indicated.

.iv All liquid immersed sensors shall be RTD or thermistor type. Each sensor shall be provided with a well suitable for the working temperature and pressure of the fluid. The accuracy of the sensor shall be ±0.6°C (±1°F) over a range of -7°C to 49°C (19.4°F to 120°F).

.v Outdoor air sensors shall be the RTD type mounted in a weatherproof enclosure. The accuracy of the sensor shall be ±0.6°C (±1°F) over a range of -34°C to 49°C
(-29°F to 120°F)

.c Humidity Sensors

.i Humidity sensors shall have a range of 5-90% RH with an operating range of 0°C to 60°C (32°F to 140°F).

.ii Duct mounted sensors shall be mounted half-way across the duct. Room mounted sensors shall be provided with blank thermostat covers and mounted adjacent to temperature sensors.

.d Differential Pressure Sensors

.i Differential pressure sensors shall be provided for water differential pressure and static pressure applications. The differential pressure range shall be selected to match the application. Select materials suitable for the measured variable, i.e. water and air, and to withstand a minimum of twice the normal pressure.

.ii The transmitter and sensor shall have a combined accuracy of 0.5% of the differential pressure range.

.e Digital Inputs

.i Wire to the digital input points specified on the input-output summary. The remote device shall have one set of dry contacts to provide the input signal. Provide all remote devices unless otherwise specified.

.f Digital Outputs

.i Each digital output point shall be provided with a relay with 120 Volt rated contacts. These contacts shall be wired to the controlled device, such as the holding coil of a magnetic starter. Refer to the input/output summary and motor control drawings.

.ii Proof of flow (status) shall be provided by auxiliary contacts in the magnetic starters for air handling unit fans, exhaust fans, pumps, cooling towers, and chillers.

2.17 PANELS

.a Control panels shall be sprinkler resistant cabinets with all steel construction. Cabinets shall have hinged door with locking. All cabinet locks shall be common keyed.

.b Panels shall be wall mounted and shall be located in mechanical and electrical rooms.

.c All control units, relays, transducers, etc., shall be located within the control panels.

.d Each enclosure shall have a standard duplex AC power receptacle located within the enclosure to provide power for test equipment, operate communication devices and cassette tape storage devices.

2.18 NAMEPLATES

.a Duct and pipe mounted sensors and panels shall be provided with lamacoid nameplates clearly identifying the equipment.

2.19 CONTROL UNIT (CU)

.a Each control unit shall be capable of full operation either as a completely independent unit or as part of the building-wide control system. All units shall contain the necessary equipment for direct interface to the sensors and actuators connected to it. Provide the necessary quantity of control units to accomplish the requirements of this Specification.

.b Each control unit shall include a local operator interface (keyboard and display). For systems designed to utilize a portable terminal, two units shall be provided.

.c Control strategies shall be user definable for all control units in the system from any control unit or the central computer.

.d Each control unit shall include its own micro-computer controller, power supply, input/output modules, termination modules, real time clock and battery. The battery

shall be self-charging and be capable of supporting all memory within the control unit if the power to the unit is interrupted or lost for up to eight (8) hours.

.e An EIA RS-232 communications port for operator interface to the control unit shall be provided.

.f Each control unit shall be capable of direct interface to a variety of industry standard sensors and input devices.

.i It shall be possible for each control unit to monitor the following types of inputs:

.1 Analog inputs (AI). 4 - 20 mA, thermistors, 0-10 V DC, RTD.

.2 Digital inputs (DI).

.3 Dry contact pulse input.

.ii The control unit shall directly control pneumatic and electronic actuators and control devices. Each control unit shall be capable of providing the following control outputs:

.1 Digital output (DO).

.2 Analog outputs (AO). 20 - 100 kPa (3 to 15 psi), 4-20 mA, 0-10 V DC.

.iii Each digital output shall have an associated LED mounted within the CU enclosure to indicate whether the DO relay is in the energized or de-energized position.

.g CU Control Functions

.i Each control unit within the BCS shall perform operator interface,

temperature control functions and energy management routines without support from the central computer.

.ii All temperature control functions shall be executed within the control unit. Loop control shall be executed via direct digital control algorithms.

.iii Any point connected to the CU shall be assignable to any energy management programme.

.iv It shall be possible to fully create, modify or remove control algorithms within a specific control unit while it is operating and performing other control functions.

.v Should a loss of power exceed memory backup, the building operator shall be able to manually restore all system programmes from a cassette tape at the CU or down load via the central computer system.

.h Operator Interface

.i The control units shall permit full operator communication including:

.1 Obtaining information about the performance of the system.

.2 Allowing the operator to change the system operation.

.3 Diagnosing system malfunctions.

.ii Each operator interface shall be capable of communicating with any and all CU's on the system concurrently.

.i Expansion Capabilities

.i The control unit network shall have sufficient capacity to add 30% more points or control units at a future date with no modifications to the network.

.ii The software (RAM) and firmware (ROM) within each CU shall have sufficient capacity to provide the control and energy management functions specified for the points connected to it. There shall also be sufficient capacity to add 10% more functionability at a future date.

.j Self Diagnostics and Alarm Reporting

.i Each control unit shall contain self diagnostics that continuously monitor the proper operation of the unit. A malfunction of the unit will be reported at the building control centre and shall inform the operator of the nature of the malfunction and the control unit affected.

.ii The system shall also allow on-line diagnosis via telephone modem from a remote location.

2.20 COMPUTER

.a The central computer shall be an IBM-AT Personal Computer or compatible including, as a minimum, system unit with 640 KB memory, serial port, parallel port, one 1.2 MB floppy drive, one 30 MB hard disk, enhanced colour display, enhanced graphics adapter disk operating system software and expanded keyboard.

2.21 PRINTER

.a A dot matrix printer shall be provided for hard copy data and alarm printouts. All change of state reporting, system logs, information summaries, system malfunctions and alarms shall be printed at this device. The minimum acceptable print speed shall be 160 characters per second.

2.22 AUTO ANSWER/DIAL MODEM

.a An auto answer/dial modem shall be furnished and connected to the control units and a telephone line. This device shall be microprocessor-based and shall be capable of both automatic answer and automatic dial methods of call handling. The modem shall support communication at speeds of 300 and 1200 bits per second.

.b As a result of a predefined event or command, the remote unit shall automatically initiate a call or a number of calls to establish communications with a remote terminal.

.c Automatic answer capabilities shall allow access from a remote terminal. The modem shall be able to allow the person calling access to any information on the network.

2.23 BUILDING CONTROL SYSTEM SOFTWARE

.a Provide personal computer based software for the following functions:

.i Automatic collection of trend data from control units.

.ii Storage and downloading of full point and programming data bases for control units.

.iii Full screen, forms based point editor.

.iv Full screen, word processing type programme editor.

.b Automatic collection of stored trend data from control units shall occur automatically, based on a time schedule predetermined by the user. The system shall provide for easy transfer of trended data to a spread sheet type software package for further analysis.

.c Storage and downloading of all point and programming data bases for control units shall be supported, to allow for start-up or to simplify return to normal operation at any other time, such as following an extended power outage.

.d System software shall support a full screen, forms based point editor, to allow for point additions, deletions and changes. Complete point definitions shall be provided by filling spaces within a single screen form. Improper entries shall be automatically disallowed, with concise English messages detailing the nature of the mistake.

.e System software shall support a full screen word processing type programme editor, designed for use on site by the operator to create or modify control sequences. The editor shall be provided with full documentation to facilitate on site use.

.f Time of day scheduling, with week-at-a-glance calendar format and providing for overrides up to a week in advance. The facility shall provide for establishing logical relationships between system components (e.g. pumps, cooling towers, etc). Provisions for holidays and special days to support both types of unusual work schedules. These shall be programmable up to one year in advance.

.g Context sensitive help, which gives instructions appropriate to the current operation.

.h Operator selected point groups, which may be recalled by name to view the current status of associated points.

2.24 CONTROL UNIT (CU) SOFTWARE

.a The CU shall contain all software necessary to maintain control of and monitor all points physically connected to it.

.b Operating System

.i A real time operating system shall be provided which shall include software to operate, manage and communicate to all peripheral devices.

.ii Upon restoration of power, within the eight hour battery back-up period, the operating system software shall ensure that the CU resumes full operation without operator intervention. The CU shall automatically reset its clock such that the proper operation of any time dependent function will occur without manual reset of the clock. All monitored functions shall be updated.

.iii Should a loss of power exceed battery back-up, the operating system software shall ensure that, when power is restored, the operator shall be able to restore the most current versions of all energy management control programmes, direct digital control programmes, data base parameters, and all other data and programmes stored in the RAM of each CU.

.iv The operating system shall provide a method that allows the operator to easily save and load the CU data base locally at the CU with a cassette tape player.

.v The operating system shall include self diagnostic software that shall continuously monitor the operation of the CU. A CU that is malfunctioning shall send a report to the printer indicating the nature of the malfunction and the CU affected.

.vi The operating system shall contain software to allow on-line diagnosis via a telephone modem.

.c Operator/System Communication

.i Each CU shall contain all software necessary for operator/system communication. This software shall permit full operator communication including as a minimum:

.1 Obtaining information about the performance of the system.

.2 Allowing the operator to add, modify or delete point data or programmes.

.3 Diagnosing system malfunctions.

.4 Execution of Report Software as defined in this Specification.

.5 Execution of Alarm and Monitoring Software as defined in this Specification.

.6 Execution of User Programming Software, Energy Management and

Direct Digital Control Software as defined in this Specification.

.ii Provide three-level password protection:

.1 Level One: Operator can request reports and look at point data.

.2 Level Two: Level one access and able to command points.

.3 Level Three: Level two plus full editing capability.

.iii It shall be possible for passwords to be defined by the system manager while the system is on-line and fully operational.

.iv All operator communication shall be by full English language commands and prompts.

.d Point Data Base

.i The CU software shall have the capability to define each point in the point data base and be capable of providing on-line access to the point data base, and on-line editing of the point data base while the Building Control System is functional.

.ii Each point shall have an alphanumeric acronym assigned to it by which it may be referenced for use in any software module or applications programme in the system.

.iii The user editing capabilities of the point data base shall be totally accomplished from any operator communication device.

.iv The operator, without assist from the vendor, shall be able to add, delete and modify all points within the point data base.

.e Report Software

.i Provide software to produce reports in a pre-defined format. All of the reports and logs specified in this Section shall be provided in a "ready to use" state. Documentation for operator use of these reports shall include specific

examples of how to institute and interpret the reports.

.ii The functional operation of the CU shall not be affected by report display or printing.

.iii All reports and logs shall include the date and time of report initiation, the name of the report, and row and column headings with all units clearly labelled.

.iv All reports and logs shall be attainable on a per point basis or on a user defined group of points. Groups of points shall be logically combined without regard to the hardware physical location.

.v As a minimum, the following CU report summaries shall be provided:

.1 All point summary.

.2 Group summary.

.3 Status summary.

.4 Alarm summary.

.5 Analog alarm limit summary.

.6 Locked out points summary.

.7 Message summary.

.8 DDC programme listing.

.9 Historical trend report.

.10 Totalization Report.

.f Energy Management Control Software

.i The energy management control software shall be resident in ROM. The CU shall have sufficient RAM capacity to assign the energy management software to any point on programme. The CU shall also have the capability to add custom programmes into the RAM.

.ii The energy management programmes shall be:

.1 Time of day scheduling.

.2 Optimum start-stop.

.3 Duty cycling.

.4 Peak demand limiting.

.5 Night set back.

.6 Temperature reset.

.g Direct Digital Control (DDC) Software

.i The CU shall contain DDC software that can be assigned to every analog or digital output point.

.ii The DDC software shall have the capability to be linked to any event or energy management programmes.

.iii The DDC software shall contain all the control functions required to perform the specified sequence of operation, including but not limited to the following:

.1 Proportional, integral and derivative control.

.2 On-Off dead band or floating control.

.3 Sequencing and cascading.

.4 Interlocks.

.5 Calculations.

.6 Boolean algebra statements.

.7 Time delays.

.iv All DDC functions shall be written in an English language format using a BASIC type software language.

.v The building operator shall have the capability of adjusting any DDC parameters while the CU is on line.

PART 3 - EXECUTION

3.1 COMPRESSED AIR PIPING

.a Install piping in mechanical or electrical rooms exposed, securely anchored to structure or equipment and run parallel or at right angles to structure.

.b Conceal piping serving equipment outside mechanical or electrical rooms wherever possible, and install so that it does not interfere with other trades.

.c Provide adequate drip runs at low points with petcocks installed in such a manner that the runs are accessible for periodic drainage.

.d Carry out pressure test prior to mounting of control instruments to ensure that piping network is leak free . Pressurize system to 413 kPa (60 psig) air for a period of 24 hours, at the end of which time pressure loss shall not exceed 68 kPa (10 psig). Test shall also conform to the requirements of authorities having jurisdiction.

3.2 CONTROL STRATEGIES

.a The control strategy for each control loop shall be performed by software within the

CU. Refer to the Control Diagrams for complete sequences of operation for each system.

3.3 CONTROL WIRING

.a Provide all necessary conduit, fittings and wire to provide a complete control system described in this Specification. Control wiring shall be coded and identified and installed in EMT conduit to the standards of Division 16.

.b Safety control loops such as freeze and firestats shall be hard wired into the associated system magnetic starter. The primary function shall not be performed by software in this case.

.c Provide power to control panels from the nearest electrical panel (normal power). Co-ordinate with Division 16.

3.4 DEMONSTRATION AND TESTING

.a Submit a schedule of testing for each system, sample checklist and description of tests for review by the Consultant.

.b Provide detailed testing of each system prior to review by the Consultant. Submit a checklist, by system, indicating that all connected points and programming have been verified as specified herein.

.c The FMS will not be considered substantially complete until all specified points are connected to the system and testing has been completed.

.d All digital input alarm points (eg. high level, low pressure, etc.) shall be tested by

physically simulating an alarm condition.

.e Start/stop points shall be verified by physical inspection.

.f All temperature, humidity and pressure sensors shall be calibrated using accurate electronic testing equipment as a reference.

.g All control loops and programmed sequences of operation shall be verified by simulating conditions for each mode of operation.

.h Provide demonstration of each system to the Consultant and the Owner when testing is completed. The purpose of this demonstration is to verify that testing has been successfully completed.

END OF SECTION

SECTION 15950B
CONTROLS

PART 1 - GENERAL

1.1 WORK INCLUDED

.a Provide a complete controls and instrumentation system in accordance with the Specifications and Drawings.

.b Wire components of temperature control system in accordance with the requirements of Division 16. Include wiring between control components and electrical circuit of fans, pumps, and any other equipment or apparatus as indicated in this Section. Provide necessary transformers, relays, etc. to accomplish the specified control functions.

1.2 SUBMITTALS

.a Submit shop drawings in accordance with section 15010 and including the following:

.i All automatic temperature and humidity control components.

.ii Schematic control diagrams for all systems with each diagram indicating control components, component catalogue numbers, sequence of operation, and interlocking.

.b Provide samples of each type of thermostat.

.c Provide data for inclusion in the Operating and Maintenance Manuals in accordance with Section 15010.

1.3 MANUFACTURER CERTIFICATION

.a Provide manufacturer certification of the installation in accordance with Section 15010.

PART 2 - PRODUCTS

2.1 DAMPERS AND OPERATORS

.a Unless otherwise indicated, control dampers shall be opposed blade type for mixing and parallel blade type for "on-off" service.

.b Damper blades shall be formed of 0.8 mm (20 gauge) galvanized steel and shall not exceed 200 mm (8") in width. Maximum permissable leakage shall not exceed 1% of the total flow based on an approach velocity of 7.62 m/s (1500 fpm) with a 1 kPa (4") static pressure difference across the closed damper. Blades shall be constructed of formed galvanized steel with neoprene sealed edges, continuous stops and seals on all sides, impregnated bronze bearings and galvanized steel channel frames.

.c Centre bar linkage connectors shall be used; however, where centre bar linkages cannot be used due to space limitations, external side linkage connectors may be used.

.d Damper operators shall be 120 V electric. Operators shall be mounted on adjustable brackets. Operating arms shall have double yoke linkages and double set screws for fastening to damper shaft.

.e Damper operators shall be matched to damper sizes. Where damper sizes exceed the operator torque capability, multiple damper operators shall be provided.

2.2 AUTOMATIC CONTROL VALVES AND OPERATORS

.a All characteristics of control valves shall be suitable for the required operation.

.b Straight-through water valves shall be single seated with equal percentage flow characteristics.

.c Three-way mixing valves shall be linear for each port giving constant total flow.

.d All valves shall have stainless steel stems and spring loaded teflon cone packing.

.e Valves 50 mm (2") and smaller shall have screwed bodies. Valves 65 mm (2-1/2") and larger shall have flanged cast iron bodies.

.f The maximum pressure drop across any control valves shall not exceed 21 kPa (2 psi) unless specified otherwise.

.g Provide two-position or modulating operators as indicated suitable for the maximum system differential pressure.

2.3 ROOM THERMOSTATS

.a Provide electric thermostats as required by the application and where indicated on the Drawings.

.b Approximate thermostat locations are shown on the Mechanical Drawings. All final positions shall be approved by the Consultant.

2.4 FIRESTATS

.a Firestats shall be electrical bimetal operated with manual reset.

2.5 DAMPER STATUS SWITCHES

.a Damper status switches shall be lever operated, activated by damper blade movement and mounted securely on damper frame.

.b Damper switch shall have contact rating of 5 Amperes at 120 V AC and be CSA approved and bear a ULC label.

2.6 DIFFERENTIAL PRESSURE SWITCHES

.a The differential pressure range of the switch shall be selected to suit the applications.

.b The switch shall have adjustable set point.

.c The switch shall have SPDT contacts and be CSA approved.

.d The switch shall be mounted with diaphragms in a vertical plane.

2.7 FREEZESTATS

.a Freezestats shall be complete with 6.1 m (20') of capillary. Wire freezestats shall shut down respective fan or fans should temperature over any 25 mm (1") of length drop below 2° C (35.6° F). Freezestats shall have manual reset. Locate freezestats after preheat coil and before cooling coil in air systems utilizing outside air.

2.8 NAMEPLATES

.a Duct and pipe mounted sensors and panels shall be provided with lamacoid nameplates clearly identifying the equipment.

PART 3 - EXECUTION

3.1 CONTROL WIRING

.a Provide all necessary conduit, fittings and wire to provide a complete control system described in this Specification. Control wiring shall be coded and identified and installed in EMT conduit to the standards of Division 16.

.b Safety control loops such as freeze and firestats shall be hard wired into the associated system magnetic starter.

.c Provide power to control panels from the nearest electrical panel (normal power). Co-ordinate with Division 16.

END OF SECTION

SECTION 15990
TESTING, BALANCING,
ADJUSTING, COMMISSIONING

PART 1 - GENERAL

1.1 WORK INCLUDED

.1 Provide testing, balancing and commissioning of all systems. Commissioning shall include putting into service, adjusting, calibrating and verifying all systems.

.2 Provide an independent balancing company, acceptable to the Consultant, to test, balance and adjust the air and water systems.

.3 Comply with 1991 ASHRAE HVAC Systems and Applications, Chapter 34, Testing, Adjusting and Balancing and Associated Air Balance Council (AABC) Standards.

.4 Provide one (1) copy of the balancing report to the Consultant for review. Rebalance any systems which are not operating as intended following remedial work directed by the Consultant. Include all revisions in the final balancing report. Submit three (3) copies of the final report.

.5 Prior to commencing the work, identify all deficiencies in the mechanical systems which will affect the performance or accuracy of the work. Balance systems as they are available to meet the schedule for project completion.

PART 3 - EXECUTION

3.1 FLUID SYSTEMS

.1 Test all fluid systems as follows:

.1 Plumbing systems to code requirements.

.2 Fire protection systems to code requirements.

.3 All systems not covered by code to 150% of working pressure, but not less than 1035 kPa (150 psig) or the maximum working pressure of expansion joints or isolators, for 24 hours.

.4 Compressed air systems to 150% of setting of pressure relief valves for 24 hours.

.2 Provide balancing and adjusting of all hydronic systems to achieve specified flow rates.

.3 Provide data in the balancing report which indicates flow rates, motor data, operating curves, operating temperatures and operating pressures for all pumps, coils and heat exchangers.

.4 Mark balancing valves indicating the balanced position.

.5 Verify operation of all control valves including perimeter heating.

3.2 AIR SYSTEMS

.1 Provide balancing and adjusting of all air systems to achieve specified design values (±5%).

.2 Provide data in the balancing report which indicates air volumes at each outlet, static pressures, fan data, motor data and coil data.

.3 Provide duct traverse readings for each air handling unit and fan (with ducted connections and exceeding 1000 cfm).

.4 Identify pressure drop across filters for all air handling units.

.5 Adjust the air pattern for all diffusers as indicated on the Drawings or as directed by the Consultant.

.6 Verify the operation of all control devices, including variable volume boxes.

3.3 EQUIPMENT

.1 Provide balancing, testing and adjusting of all equipment, including refrigeration equipment.

.2 Include the following data in the balancing report:

.1 Electrical characteristics.

.2 Flow rates (air).

.3 Operating pressures and pressure drops.

.4 Operating efficiencies.

3.4 REPORTS

.1 Submit all forms to the Consultant for approval prior to any testing, balancing and adjusting. The forms shall be modified if they are not acceptable to the Consultant.

.2 Provide all data required for evaluation of the work of this Section.

.3 Provide schematic drawings of each system indicating points at which readings have been obtained.

3.5 DEMONSTRATION

.1 Provide the demonstration of all systems and equipment, including complete documentation of the operating procedures of each system or piece of equipment. The time allotted for demonstration shall be adequate for the complexity of the systems and be acceptable to the Consultant.

3.6 TRIAL USAGE

.1 Provide operation of all systems for purposes of demonstration and training of operating personnel. Trial usage does not constitute acceptance by the Owner.

3.7 SMOKE CONTROL SYSTEM

.1 Provide demonstration and testing of the smoke control system, including:

.1 Verification of all control sequences for each zone.

.2 Automatic activation by the fire alarm system for each zone.

.3 Fail safe modes.

.2 Conduct testing in the presence of the Consultant and, if required, a representative of the local fire department.

.3 Provide air quantity readings by duct traverse of all fan systems when operating in life safety mode.

.5 ACCEPTABLE BALANCING CONTRACTORS ARE AS FOLLOWS:

CLARK BALANCING & HYDRONIC TESTING LTD.	R.R. #5 10449 4TH LINE MILTON, ONTARIO L9T 2X9 MR. BARRY CLARK (905) 453-6792
DASS ENTERPRISES	3045 SOUTHCREEK ROAD UNIT 29 MISSISSAUGA, ONTARIO L4X 2X6 MR. IAN BABICH (905) 238-3377
DESIGNTEST + BALANCING	70 EAST BEAVER CREEK ROAD UNIT 35 RICHMOND HILL, ONTARIO L4B 3B2 MR. SURRINDER SINGH SAHOTA (905) 886-6513
PRO-AIR TESTING	31 LELAND AVENUE TORONTO, ONTARIO M8L 2X6 MR. OSCAR HOWAT (416) 252-3232
NATIONAL AIR BALANCE INC.	8 PARKSHORE PLACE CARLISLE, ONTARIO L0R 1H1 MR. ZOLTAN Z. LASAK (905) 690-9559

AERODYNAMICS INSPECTING CONSULTANTS LTD.

5359 TIMBERLEA BLVD., UNIT 62
MISSISSAUGA, ONTARIO
MR. ANDREW T. CHRONOWSKI, P.ENG
(905) 625-4388/89

END OF SECTION

DIVISION 16
ELECTRICAL

16010	Electrical General Requirements
16015	Electrical Systems Analysis
16122	Wires and Cables 0-1000V
16132	Outlet Boxes, Conduit Boxes, and Fittings
16133	Conduits, Conduit Fastenings, and Conduit Fittings
16223	Motor Starters to 600V
16231	Natural Gas Generating Units (Radiator Cooled)
16270	Dry Type Transformers
16271	Power Transformers Dry Type
16289	Transient Voltage Surge Suppression (TVSS)
16412	Moulded Case Circuit Breakers
16441	Panelboards Breaker Type
16450	Grounding – Bonding
16482	Motor Control Centre
16496	Automatic Transfer Switches – Low Voltages
16505	Lighting Equipment
16670	Lightning Protection System
16900	Instrumentation and Controls

SECTION 16010
ELECTRICAL GENERAL REQUIREMENTS

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SECTION 16010
ELECTRICAL GENERAL REQUIREMENTS

1 GENERAL

1.1 GENERAL

.1 Read and conform to the General Requirements (Division 1), which applies to and forms part of all sections of the work. The general instructions are intended to supplement and not to replace Division 1 requirements.

.2 The specification is divided into divisions of work and a division may consist of the work of more than one (1) subContractor. The responsibility as to which subContractor provides labour, materials, equipment and services required to complete the work rests solely with the Contractor.

.3 All new electrical wiring, equipment, and new local control panels are to be supplied to meet the electrical and environmental classifications of area in which they are to be installed. For areas designated as Class I Division 1 or 2 include appropriate conduit seals, junction boxes, materials, and all other appurtenances as necessary and installation techniques as required by applicable codes and regulations

.4 All above grade indoor/outdoor conduits shall be PVC encapsulated rigid steel.

.5 All below grade conduits and duct banks shall be Rigid PVC unless indicated otherwise on the drawings or specifications.

.6 A Low Voltage Design review has been provided by the Electrical Safety Authority (ESA) to suit this project. The ESA Low Voltage Review Report is appended to the end of this section. The Contractor is required to comply with all ESA review comments at no additional cost to the project.

.7 The Contractor shall provide all labour, supervision, tools, equipment, materials, services and miscellaneous expenses necessary to complete the work as outlined in this Section. Install and connect all electrical and instrumentation equipment, controls and devices supplied under other sections. The word “provide” shall be defined to mean supply and install.

.8 The Contractor is required to remove all power distribution, conduit and control wiring for all items that are identified for demolition on the contract drawings. The Contractor shall correlate the demolition requirements on the electrical drawings with all other drawings and

disciplines to ensure that all power and control wiring distribution is removed for any equipment identified for demolition.

1.2 SUMMARY OF DIVISION 16 WORK

.1 Furnish, install, test and commission a complete operational electrical system as required by the drawings and as herein specified.

.2 Provide all labour and materials required to complete electrical (power and control) wiring for plumbing, heating and ventilating and process equipment as called for in these specifications and/or shown on the drawings.

.3 Provide all motor control centre (MCC) motor starters, combination starters and disconnects and other necessary electrical devices as required for mechanical and process equipment unless otherwise specifically called for in other division specifications or on the drawings.

.4 Provide all control components and connections from motor control centres to automatic devices, interlocking etc.

.5 Provide all conduit and wiring unless otherwise specifically called for in other division specification or on the drawings.

1.3 RELATED SECTIONS

.1 Division 1 – General Requirements

1.4 CODES AND STANDARDS

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

.2 Perform overhead and underground systems in accordance with CSA C22.3 No.1-1993 except where specified otherwise.

.3 Abbreviations for electrical terms: to CSA Z85.

.4 Ontario Electrical Safety Code latest edition and and Latest Bulletins of Electrical Safety Authority (ESA).

.5 Building Code of Ontario, O.Reg 413, Latest Revision.

.6 Local applicable codes and regulations.

.7 Perform grounding to CSA C22.3 No.2 .

.8 IEEE 519 for total harmonic distortion, Latest Revision.

1.5 DEMONSTRATION AND TRAINING

.1 Instruct Owner's personnel in the operation, care and maintenance of equipment. Perform demonstration and training in accordance with Section 01800 – Start-up, Commissioning & Training.

1.6 CONTRACT DRAWINGS AND SPECIFICATIONS

.1 Follow the Contract Drawings to become familiar with all conditions affecting the work, and verify spaces in which the work will be installed.

.2 The drawings for electrical work are performance drawings, diagrammatic, intended to convey the scope of work and indicate general arrangement and approximate location of apparatus, fixtures and approximate sizes and location of equipment and outlets. The drawings do not show architectural, process and structural details.

.3 Do not scale the drawings to determine dimensions, but obtain information for accurate dimensions by referring to architectural and structural drawings, or by site measurements.

.4 Review existing drawings as available at the site during the tender period. Become familiar with the condition of the existing drawings and related equipment. Allow for errors and omissions in the existing drawings and ensure that the tender price includes the provisions to make the necessary field reviews, field verifications, field changes, and drawing changes to suit the intent of the modification required.

.5 Work which is indicated, but not completely detailed shall be installed by common practice or as directed by the Contract Administrator.

.6 Make, at no additional cost, any changes or additions to materials, and/or equipment necessary to accommodate structural conditions (runs around beams, columns, etc.).

.7 Alter, at no additional cost, the location of materials and/ or equipment as directed, provided that the changes are made before installation and do not necessitate additional material.

.8 Leave space clear and install work to accommodate future materials and/or equipment as indicated and to accommodate equipment and/or material supplied by other trades. Verify spaces in which work is to be installed. Install conduit and cable runs to maintain headroom and clearances to conserve space.

.9 Confirm on the site the exact location of outlets and fixtures. Confirm location of outlets for equipment supplied by other trades.

.10 The drawings, specifications, and standards are complimentary to one another, meaning that, that which is called for on one is meant to be called for on all. Where conflict exists between the Sections, Standards and/or Drawings, it shall be referred to the Contract Administrator for clarification and rectification before any material is purchased or electrical work commences. Code requirements shall be considered a minimum standard. When materials shown on drawings as indicated in the specifications exceed code requirements, the plans and specifications shall govern. If, having examined all documents pertaining to Division 16, concerning the nature and extent of the work being performed under other sections, clarification of the item and/or items in question will come from the Contract Administrator.

.11 Provide all minor items and work not shown or specified but which are reasonably necessary to complete the Work.

.12 If discrepancies or omissions in the drawings or specifications are found, or if the intent or meaning is not clear, advise the Contract Administrator for clarification before submitting tender.

.13 Responsibility to determine which Division provides various products and work rests with the Contractor. Additional compensation will not be considered because of differences in interpretation of specifications.

1.7 CONSTRUCTION/SHOP DRAWINGS

.1 Submit shop drawings in accordance with Section 01330 – Submittals.

.2 Submit data (drawings) for review prior to commencement of manufacturing or installing with the exception of conduit, standard conduit fittings and low voltage wiring.

.3 Prior to submitting the shop drawings, the Contractor shall review the shop drawings to determine that the equipment complies with the requirements of the specifications and drawings.

.4 Assume responsibility for accuracy of equipment dimensions related to available space and accessibility for maintenance and service, and compliance with codes and inspection authorities.

.5 Show all details of construction, dimensions, capacities, weights, and electrical performance characteristics of equipment or material.

.6 Obtain manufacturer's installation directions to aid in properly executing the work. Submit two copies of such directions to the Contract Administrator prior to installation, for use in inspecting the work.

.7 Prepare composite construction drawings, fully dimensioned of cables, conduit, cable tray, sleeves, clearances, pipes, ducts, etc., and equipment in mechanical and electrical equipment rooms, ceiling spaces and all other critical locations to avoid a conflict of trades. Base drawings on manufacturer's shop drawings. Drawings should be developed from consultation with and agreement of all trades involved.

.8 Prepare drawings of equipment bases, anchors, slabs, floor and roof curbs, if needed, for the electrical work.

.9 In addition to the requirements of Section 01330, provide working drawings with, but not necessarily limited to, the following additional information:

.1 Manufacturer's and Supplier's name.

.2 Manufacturer's bulletins, leaflets and specifications of major electrical equipment.

.3 Catalogue model number.

.4 Number identifying item on the drawings and/or in the specifications such as equipment, item number, panel identification letters, etc.

.5 Indicate details of construction, dimensions, capacities, weights and electrical performance characteristics of equipment or material.

.6 Where applicable, include wiring, single line and schematic diagrams.

.7 Include wiring diagrams or diagrams showing interconnections with work of other sections.

.8 Lighting fixtures, including photometric data.

.9 Contractor is responsible for providing shop drawings showing the integration between supplied control panels and control panels supplied with equipment. These drawings are to be a single drawing for each specific device, showing interconnection between the device and all associated panels and terminal blocks. Contract Administrator reserves the right to request more detailed drawings if those provided are deemed insufficient.

.10 Submit samples of material and equipment where specified or as may reasonably be requested by the Contract Administrator for review before

ordering same in accordance with Division 1. The Contract Administrator may retain the samples until the completion of the contract.

.11 Complete all work in accordance with reviewed shop drawings.

.12 Where conduits, cable trays and lay-in ducts are not detailed, submit conduit, cable tray and wiring layout drawings. Show conduit/tray and cable sizes including number of cables/conductors in each conduit/tray. Drawings shall be on the same size sheets as the contract drawings.

.13 Update single line electrical diagrams to include any modifications to the electrical distribution system.

.14 Indicate the number, letter or equipment tag used on the drawings/specifications as an identification symbol on product data for MCCs, transformers, panelboards, light fixtures, and other equipment submitted.

.15 Bind one complete set of construction/shop drawings showing "as built" conditions in each operating and maintenance instruction manual.

1.8 RECORD DRAWINGS

.1 Comply with requirements for record drawings stated in 01330 – Submittals.

.2 Before commencing work, obtain two sets of electrical drawings for showing "As Built" conditions. As job progresses, mark on field set of prints to indicate accurately all installed work. At completion stage, transfer all information onto master set of drawings and indicate "Contractors Certified Approval of Accuracy" before submitting to Contract Administrator for review and record use.

.3 Indicate on record drawings "As Built" stamp.

.4 Show on the record drawings as-built, all outlets and equipment such as runs of conduit, locations of pull boxes, outlets, motors, panels, etc., as well as all services entering the building and on the property.

.5 Dimension underground services and concealed main and sub-feeder conduits at key points of every run in relation to structure and building. Record all elevations for underground services in relation to the ground floor level of the building. Indicate on record drawings, location of all buried services. This information is to be certified correct by Contract Administrator before backfilling commences.

.6 Indicate exact location of all services left for future work.

1.9 OPERATIONS AND MAINTENANCE MANUALS

.1 Comply with requirements for operating and maintenance manuals stated in 01330 – Submittals.

.2 In addition to the requirements of 01330 – Submittals, include in the Operations and Maintenance Manuals:

.1 Details of design elements, construction features, component function and maintenance requirements, to permit effective start-up, operation, maintenance, repair, modification, extension and expansion of any portion or feature of installation.

.2 Technical data, product data, supplemented by bulletins, component illustrations, exploded views, technical descriptions of items and parts lists. Advertising or sales literature not acceptable.

.3 Wiring and schematic diagrams and performance curves.

.4 Names and addresses of local suppliers for items included in Maintenance Manuals.

.5 Copy of test data.

.6 List of spare parts of all electrical equipment complete with names and addresses of sales, service representatives and suppliers.

.7 A motor list showing each motor number, name, horsepower, full load amps, overload settings, nameplate, current rating, heater size and type, and current being drawn, etc.

.8 Copy of final inspection certificate.

.9 Copy of the purchase order, showing equipment make and model numbers issued to the manufacturer complete with all addenda. All cost details may be hidden.

.10 Copy of all warranty certificates.

.11 Set of final reviewed Shop Drawings.

1.10 WORK INCLUDED

.1 The Contractor shall provide all labour, materials and equipment necessary to complete all electrical work as shown on the drawings and herein specified.

.2 The Contractor shall be responsible for all electrical wiring and terminations required for equipment supplied in other Divisions,

irrespective whether or not it is shown or mentioned on the drawings and specifications respectively so as to supply a complete working system.

.3 Where special wiring (cables supplied with instruments, etc) is supplied by other Divisions, the Contractor will be responsible for the installation of this wiring in coordination with the Division supplying said wiring.

.4 Where spare wiring is installed, all spare wiring shall be identified (tagged) at both ends and shown on record drawings.

.5 Where equipment is supplied by other Divisions and installed under this Division:

.1 The Contractor shall be responsible for the proper installation of all panels, enclosures, switches, fixtures, etc., as shown on the drawings.

.2 The Contractor shall be responsible for coordination with other Divisions supplying equipment, as to the exact location for installation of said equipment.

.3 The Contractor shall request from other Divisions supplying equipment for installation and/or wiring under this Division, all pertinent instruction manuals, diagrams, specifications sheets, etc., required for the proper installation of the equipment.

.4 The Contractor shall be responsible for verifying that the equipment's electrical specifications are suitable for the intended application as per Division 1. Check all voltage ratings, wiring terminations, current ratings and other electrical characteristics so as to supply a complete working system.

.6 The work to be carried out by the Contractor shall include, but not be limited to the supply and installation of the following:

.1 New MCC and all associated electrical connections from MCC. Replace

.2 New back up Gas Generator.

.3 Provide an electrical grounding system to suit all new distribution and equipment including ground and bonding connections in accordance with Ontario - Electrical Safety Code (OESC) – Latest Edition. Provide dedicated bonding connections to all equipment and distribution systems in accordance with Table 16 of the Code.

.4 Supply and installation of all power and control wiring to suit all new control and communications equipment.

.5 All conduit and wiring for signal and control systems as shown on the drawings.

.6 All conduit and wiring of electrical and control equipment supplied under other Divisions, as shown on the drawings and/or specified herein.

.7 Provide 120/208 & 600 V electrical distribution including all power and lighting as shown on the drawings and specified herein.

.8 Provide wire, cable, conduit, duct, cable tray as shown on the drawings and/or specified herein.

.9 Provide conduit fittings, outlets, wall sleeves, etc.

.10 Provide electrical testing, cabling meggering, component tuning, calibration, adjustment, start-up and commissioning.

.11 Duct Bank for 27.6kV Primary Cable.

1.11 WIRING - GENERAL

.1 Unless otherwise indicated on the drawings all power and control conduit shall be surface mounted.

.2 Power and control wiring to suit all the new SCADA communications, PLC and/or remote I/O control panels, as follows.

.1 All power and control wiring to be in PVC Encapsulated Rigid steel conduit to suit all outdoor applications.

.2 Control wiring terminations to be in Liquid tight, PVC encapsulated steel armoured flex to suit the transition from conduit or junction box to the respective process equipment and instrumentation. Liquid tight flex shall not exceed 2m in length.

.3 All control and communication wiring shall be installed in PVC Encapsulated Rigid steel conduit in all outdoor applications.

.4 Provide 20% spare control wiring capacity in each control-wiring conduit.

.5 Provide 20% spare control wiring capacity in each multi-conductor Teck style cable.

.3 Wiring general.

.1 "Wiring" shall include wiring of power and control conductors to lighting, receptacles, and any controlling or controlled devices associated with them.

.2 All wiring to be copper conductors.

.3 All conductors to be stranded copper.

.4 All surface wiring in non classified indoor areas to be in PVC Encapsulated Rigid steel conduit. Connection to electrical equipment not wall mounted will be from a conduit terminal box then via TECK cable to the equipment. The conduit terminations will be placed to minimize the length of the TECK cable. Teck cable length not to exceed 2 m.

.5 All wiring to be installed in PVC Encapsulated Rigid steel conduit to suit indoor application.

.6 All wiring to be installed in PVC Encapsulated Rigid steel conduit, to suit all outdoor applications.

.7 Provide a dedicated green jacket bond conductor in all raceways including PVC, and all Metal conduits.

.8 Under no circumstances will more than one (1) conductor or ground be installed in a screw type connector, lug or terminal block.

.9 Where stranded conductors terminate on a screw, the conductor will be terminated with a full ring terminal.

.10 No wiring installed under this contract shall violate the Ontario Electrical Safety Code – Latest Edition.

.11 Provide a ground/bond conductor to suit all power distribution wiring applications. Unless otherwise indicated on the drawings the ground conductors are to be sized in accordance with the Ontario Electrical Safety Code – Latest Edition.

.12 #12 AWG minimum wire size – power.

.13 Provide 20% spare control conductors in each control wiring conduit.

.14 All below grade and/or concrete encased wiring applications to be in Rigid PVC conduit.

.15 All wiring located above ceiling tiles shall be installed in aluminum conduit.

.4 Wiring Hazardous Areas

.1 All wiring located in hazardous areas or outdoors to be in PVC Encapsulated Rigid steel conduit installed with sealed fittings.

.5 Life Safety Systems

.1 All wiring associated with fire alarm, fire protection and emergency lighting to be in PVC encapsulated Rigid steel.

.2 All fire alarm system raceways, junction boxes, fittings, and elbows are to be coloured RED.

1.12 MISCELLANEOUS ELECTRICAL COMPONENTS

.1 Control Relays (Instantaneous)

.1 General purpose plug-in type relays, low coil current heavy duty contacts with multi-contact poles as indicated.

.1 Coil rating (Vac systems): 120 V, 60 Hz.

.2 Coil rating (Vdc systems): 125 V.

.3 Contact rating (Vac systems): 120 V, 10A.

.4 Contact rating (Vdc systems): 125 V, 2A.

.2 Acceptable Manufacturers.

.1 Omron

.2 Potter-Bromfield

.3 Allen-Bradley

.2 Relay Accessories

.1 Overlap contact cartridges: supplied in pairs having NO contact that closes before NC contact opens (early make -late break).

.2 Mounting strips: indexed strips easily cut to required length and bolted in place. Relays are installed in rows on strip with captive mounting screws. Rows of relays on mounting strip form their own wiring trough.

.3 Timing Relays

.1 General purpose plug-in type relays, low coil current heavy duty contacts with multi-contact poles as indicated. Coil rating: 120 V, 60 Hz. Contact rating: 120 V, 10A.

.2 Potentiometer: self contained to provide time interval adjustment. Timing range as indicated.

.3 Acceptable manufacturers:

.1 Omron

.2 Potter-Bromfield

.3 Allen-Bradley

.4 Pushbuttons

.1 Momentary contact type: Heavy duty – oil tight, operator flush type, colour as indicated, 1-NO and 1-NC contacts rated 5A at 120V AC, labels as indicated.

.2 Push-pull contact type: Heavy duty – oil tight, operator mushroom head type, red colour, provision for padlocking in "OFF" position, 2-NO and 2-NC contacts rated 5A at 120V AC, labels as indicated.

.3 Pushbutton ratings:

.1 NEMA type 13 for indoor control panels

.2 NEMA type 4 for outdoor control panels

.4 Acceptable Manufacturers

.1 Allen-Bradley

.2 Schneider

.3 Cutler Hammer, PB Series

.5 Selector Switches

.1 Maintained contact type, 2 or 3 positions (as indicated), heavy duty – oil tight, operators standard knob, contact arrangement as indicated rated 5A at 120V AC, labels as indicated.

.2 Switch ratings:

.1 NEMA type 13 for indoor control panels

.2 NEMA type 4X for outdoor control panels

.3 Acceptable Manufacturers

.1 Allen-Bradley

.2 Square D

.3 Cutler Hammer

.6 Indicating Lights

.1 Heavy duty – oil tight, LED cluster Push-To-Test type, lens colour: as indicated, supply voltage: 120 V, labels as indicated.

.2 Indicating light ratings:

.1 NEMA type 13 for indoor control panels

.2 NEMA type 4X for outdoor control panels

.3 Acceptable manufacturers

.1 Allen-Bradley

.2 Square D (Schneider)

.3 Cutler Hammer

1.13 TRANSIENT VOLTAGE SURGE SUPPRESSION

.1 Transient voltage surge suppression (TVSS) devices shall be provided for all new switchboards, panelboards and MCC's. Each unit shall be designed for parallel connection to the wiring system and shall utilize non-linear voltage-dependent metal oxide varistors (MOV) in parallel. Switchboard protection shall meet the requirements for high exposure levels, motor control center protection shall meet the requirements for medium exposure levels, and panelboard protection shall meet the requirements for low exposure levels-C235-83.

.2 Unit Operating Voltage. The nominal unit operating voltage and configuration shall be 600/347 volts three phase, 4 wire, solidly grounded for switchboards and motor control centers and 120/208 volt single and three phase, 4 wire, solidly grounded for panelboards.

.3 The specified unit shall be designed, manufactured, tested and installed in compliance with the following standards:

.1 ANSI/IEEE C62.41 and C62.45

.2 ANSI/IEEE C62.1 and C62.11

.4 Integral TVSS devices shall be manufactured by Cutler-Hammer, General Electric, Siemens Energy & Automation, or Allen Bradley.

.5 Provide a TVSS at the main service point of the electrical distribution equipment. Provide TVSS units to suit the following applications:

.1 MCC's

.2 600Volt Panelboards

1.14 VOLTAGE RATINGS

.1 Operating voltages: to CAN2-C235-83.

.2 Control and distribution devices and equipment to operate satisfactorily at 60Hz within normal operating limits established by above standard. Equipment to operate in extreme operating conditions established in above standard without damage to equipment.

1.15 PERMITS, FEES AND INSPECTION

.1 The Engineer shall submit to the Electrical Safety Authority (ESA) necessary number of drawings and specifications for examination and review prior to commencement of work. The Contractor is required to comply with all recommendations and comments provided by the ESA in the plan review report, at no additional cost.

.2 Submit all necessary documentation to the ESA during the construction period. The Contractor shall abide by all comments and recommendations provided by the ESA based on the submitted information, at no additional cost.

.3 Pay associated fees, for all permits, inspections, and power outages to suit supply authority/utility requirements.

.4 Notify the Contract Administrator of changes required by Electrical Safety Authority (ESA) prior to making changes.

.5 Furnish Certificates of Acceptance from the Electrical Safety Authority (ESA) on completion of work to the Contract Administrator.

.6 Arrange for inspection of all work by the Authorities having jurisdiction over the work. On completion of the work, present to the Owner the final unconditional certificate of approval of the Inspection Authorities.

.7 Comply with the requirements of the latest edition of the Ontario Electrical Safety Code (OESC) and ESA latest bulletins, applicable CSA Standards, the requirements of the Authorities, Federal, Provincial and Municipal Codes, the applicable Standards of the Underwriters' Association and all other authorities having jurisdiction. These codes and regulations constitute an integral part of these specifications. In case of conflict, the more stringent requirement will take precedence. Otherwise follow the standards established by the contract drawings and specifications.

.8 Before starting any work, submit the required number of copies of drawings and specifications to the Authorities for their approval and comments. Comply with any changes requested as part of the contract, but notify the Contract Administrator immediately of such changes for proper processing of the requirements. Prepare and furnish any additional drawing details for information as may be required.

.9 The Contractor shall submit the following documentation to the Electrical Safety prior to proceeding with construction:

.1 Electrical Shop Drawings of All 600V distribution Equipment, switchgear, MCC, switchboards rated over 400A.

1.16 MATERIALS AND EQUIPMENT

.1 Provide materials and equipment in accordance with Section 16010 – Electrical General Requirements.

.2 Equipment and material to be CSA certified. Where there is no alternative to supplying equipment which is not CSA certified, obtain special approval from the ESA.

1.17 FINISHES

.1 Shop finish metal enclosure surfaces by application of rust resistant primer inside and outside, and at least two (2) coats of finish enamel.

.1 Paint outdoor electrical equipment "equipment green" finish to ANSI C57.12.28.

.2 Paint indoor switchgear and distribution enclosures light grey ANSI-ASA 61 to EEMAC 2Y-1-1958.

.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 Provide finish and colour of retrofit components to match the colour and finish of the existing switchgear.

1.18 ELECTRICAL EQUIPMENT IDENTIFICATION

.1 To meet the requirements of CSA and Electrical Safety Authority.

.2 Supply and install identification nameplates on all equipment such as switchgears, MCCs, transformers, safety switches, panelboards, pushbutton stations, control

.3 Non corroding, visible and legible after equipment is installed.

.4 Provide “Asbestos Free” labels on switchgear.

.5 Provide the type, material, color, and letter sizing in accordance with the City standard. Nameplates are to be 3 mm thick laminated plastic engraving sheet, white face, black letters, mechanically attached with stainless steel screws.

.6 Wording on nameplates to be approved by the Contract Administrator prior to manufacture.

.7 Identification to be English.

.8 Nameplates for terminal cabinets and junction boxes to indicate system and/or voltage characteristics.

.9 Disconnects, starters and contactors: indicate equipment being controlled and voltage.

.10 Terminal cabinets and pull boxes: indicate equipment being controlled and voltage.

.11 Transformers: indicate capacity, primary and secondary voltages.

.12 Issue nameplates lists for review prior to manufacture.

.13 Lighting panels: Plates shall be mounted on front door, typical identification “Lighting Panel ‘A’ 120/208V, 3 phase, 4 wire”.

.14 Disconnect switches and starters: Plates shall be mounted externally on switch box cover. Typical identification – “Pump No. 1, 575V, 3 phase”.

.15 Plates shall be installed after all painting has been completed and shall be secured with self-tapping screws except on the inside of panel doors where gluing will be accepted.

.16 Have the manufacturers' nameplates affixed to each equipment showing the size, name of equipment, serial number and all information usually provided, including voltage, cycle phase, horsepower, etc., and the name of the manufacturer and his address. Ensure that all stamped, etched or engraved lettering on plates is perfectly legible. Do not paint over nameplates and where apparatus is to be concealed, attach the nameplate in an approved location on the equipment support or frame.

.17 Wording on nameplates to be approved by Contract Administrator prior to manufacture.

.18 Disconnect switches, starters and contactors: Plates shall be mounted externally on switch box cover. Indicate equipment being controlled and voltage. Typical identification - "Pump No. 600 V, 3 phase – P-0400". Provide tagging in accordance with City Tagging Standards.

.19 Terminal cabinets and pull and junction boxes: indicate system and voltage.

.20 Transformers: indicate tag number, capacity, phases, primary and secondary voltages.

.21 Panelboards: provide a typewritten circuit directory with clear plastic cover for each panelboard in a suitable holder on the inside of each panel door. Indicate breaker circuit number, rating, load description, and associated load data. On outside of panelboard door, indicate tag number, capacity, phases and voltages. Typical identification - "Lighting Panel `A' 120/240 V, 1 phase, 3 wire"

.22 Plates shall be installed after all painting has been completed and shall be secures with self-tapping screws except on the inside of panel door where gluing will be accepted.

.23 Have the manufacturers' nameplates affixed to each equipment showing the size, name of equipment, serial number and all information usually provided, including voltage, cycle, phase, horsepower, etc. and the name of the manufacturer and his address. Ensure that all stamped, etched or engraved lettering on plates is perfectly legible. Do not paint over nameplates.

.24 Identify all equipment with the corresponding remote controls.

1.19 OWNER EQUIPMENT TAGGING

.1 In addition to the nameplates and labelling described in clause 1.19, equipment tagging on separate labels are required for all switchgear cells, MCC sections, metering equipment, motor starters, control panels,

new pumps and motors. Nameplate physical characteristic: in conformance with City of Hamilton Standards.

.2 Provide a proposed nameplate description table to be reviewed by the Contract Administrator prior to fabrication of the nameplates.

1.20 WIRING AND CONDUIT IDENTIFICATION

.1 Identify wiring with permanent indelible identifying markings, either numbered or coloured plastic tapes, on both ends of phase conductors of feeders and branch circuit wiring.

.2 Maintain phase sequence and colour coding throughout.

.3 Colour code: to CSA C22.1.

.4 Control wiring to have same tag at both ends.

.5 Provide wire tag and/or circuit identification in all junction boxes.

.6 Colour code conduits, boxes and metallic sheathed cables.

.7 Code with plastic tape or paint at points where conduit or cable enters wall, ceiling, or floor, and at 10 m intervals.

.8 Colours: 25 mm wide prime colour and 20 mm wide auxiliary colour.

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

1.21 WIRING TERMINATIONS

.1 Lugs, terminals, screws used for termination of wiring to be suitable for either copper or aluminum conductors.

1.22 MANUFACTURERS AND CSA LABELS

.1 Visible and legible after equipment is installed.

1.23 WARNING SIGNS

.1 As specified and to meet requirements of Electrical Inspection Department and Contract Administrator.

.2 Decal signs, minimum sized 175 x 250mm.

.3 Protect exposed live equipment during construction for personnel safety.

.4 Shield and mark live parts “LIVE 600 VOLTS”, or with appropriate voltage in English.

1.24 LOCATION OF OUTLETS

.1 Do not install outlets back-to-back in wall; allow minimum 150mm horizontal clearance between boxes.

.2 Change location of outlets at no extra cost or credit, providing distance does not exceed 3000mm, and information is given before installation.

.3 Locate light switches on latch side of doors. Locate disconnect devices in mechanical and elevator machine rooms on latch side of floor.

1.25 MOUNTING HEIGHTS

.1 Mounting height of equipment is from finished floor to centreline of equipment

.2 If mounting height of equipment is not specified or indicated, verify before proceeding with installation.

.3 Install electrical equipment at following heights unless indicated otherwise.

.1 Local switches: 1400mm.

.2 Wall receptacles:

.1 General: 300mm.

.2 Above top of continuous baseboard heater: 200mm.

.3 Above top of counters or counter splash backs: 175mm.

.4 In mechanical rooms: 1400mm.

.4 Panelboards: as required by Code or as indicated.

.5 Telephone and interphone outlets: 300mm.

.6 Wall mounted telephone and interphone outlets: 1500mm.

.7 Disconnect switches: 1400mm.

1.26 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.

1.27 CONDUIT AND CABLE INSTALLATION

.1 Install conduit and sleeves prior to pouring of concrete. Sleeves through concrete: plastic, sized for free passage of conduit, and protruding 50mm.

.2 If plastic sleeves are used in fire rated walls or floors, remove before conduit installation.

.3 Install cables, conduits and fittings to be embedded or plastered over, neatly and close to building structure so furring can be kept to minimum.

1.28 INSERT, SLEEVES, FASTENINGS AND SUPPORTS

.1 Provide all necessary inserts, hangers, fastenings, sleeves and curbs for electrical equipment, suspended from or passing through structural walls or floors, to suit the specific location, and as approved by the Contract Administrator.

.2 Sleeves: allow 12 mm clearance over the O.D. of all cables and conduits, 25 mm horizontally and vertically for rectangular openings.

.3 Finish sleeves flush with wall finish (each side) or the ceiling to curb top.

.4 Secure equipment to solid masonry, tile and plaster surfaces with lead anchors or nylon shields, properly sized for the load to be carried.

.5 Secure equipment to poured concrete with expandable inserts, properly sized for the load to be carried.

.6 Secure equipment to hollow masonry walls or suspended ceilings with factory made threaded or toggle type inserts, properly sized for the load to be carried.

1.29 CUTTING, PATCHING AND WELDING

.1 Conform to the requirements of Division 1 in respect to cutting, patching, and fitting electrical equipment.

.2 Where installation of equipment by this section requires cutting or patching of new or existing work, the work shall be performed by, and under direction and supervision of, this section. Make good surface finishes to satisfaction of the Contract Administrator.

.3 Locate and provide holes and sleeves required for electrical work. Relocate improperly located holes and sleeves at no cost.

.4 No cutting or welding of beams, columns or structural surfaces is permitted without approval of the Contract Administrator and all damage to finished or unfinished surfaces shall be made good to the satisfaction of the Contract Administrator.

.5 Pay all costs for cutting and patching resulting from failure to co-ordinate timely installation of electrical inserts, sleeves, etc., into masonry structures.

.6 Provide fire rated ULC transits to suit any raceway, conduit and/or cable tray transitions through fire rated walls, floors or ceilings.

1.30 FIELD QUALITY CONTROL (TESTING)

.1 General

.1 Comply with requirements of 01800 – Startup, Commissioning.

.2 All equipment and electrical systems which are provided under this Division shall be performance tested for electrical and mechanical defects and all defects and adjustments made, prior to requesting inspection by the Contract Administrator.

.3 Submit original copies of letters from the manufacturers of auxiliary systems indicating that their technical representatives have inspected and tested the respective systems and are satisfied with the methods of installation, wiring and operation.

.4 Prior to the Owner's acceptance, all electrical equipment, materials and systems installed shall be subject to an inspection and applicable performance tests supervised by the Contract Administrator to ensure that the operation of the system and components satisfy the requirements of the Contract Documents.

.5 Refer to specific equipment sections for additional details and requirements.

.6 Ensure that the system and its components are ready prior to the inspection and test for acceptance.

.7 Conduct all testing by fully qualified personnel only. Tests requiring initial power energization of a system shall not be made without notification of the Contract Administrator. Tests, checks and the like carried out by or on behalf of the Contractor shall be documented and certified at no additional cost to the Owner. Submit two copies of the test certificates to the Contract Administrator.

.8 Carefully check wiring for each system and/or part of a system to ensure that the system will function properly as indicated by wiring and schematic diagrams, description of operation, etc.

.9 Manually operate alarms and control devices to check whether their operation during normal and abnormal operating conditions causes the proper effect.

.10 In addition to tests on purely electrical systems, supply the necessary labour and equipment for operational tests required by other Divisions where electrical services are involved and make final adjustments to the electrical controls at no additional cost to the Contract Administrator.

.11 Perform tests on auxiliary or specialized systems with the assistance of the manufacturer's representative. Upon successful conclusion of the tests, obtain a certificate from the manufacturer stating that the system has been installed to their satisfaction and that it is in good working order.

.12 Ensure circuit protection devices such as overcurrent trips, relays and fuses are installed to values and settings as indicated.

.13 Replace at no additional cost all fuses, relays, or other devices destroyed during field quality control (testing).

.14 Supply all instruments, meters and personnel required for the tests.

.15 Clean equipment by vacuum. Clean, wax and polish all new exterior surfaces, check and tighten all electrical connections.

.16 All testing shall be scheduled and coordinated through the Contract Administrator. No testing of any kind shall be done without this clearance.

.17 Single phase loads shall be connected so that there is the least possible imbalance of the supply. Common neutral shall be used for maximum three (3) single phase circuits, each circuit on a different phase.

.18 Furnish labour, materials, instruments and bear all costs for tests as requested by the Contract Administrator.

.19 Conduct and pay for tests identified in this Section.

.20 Carry out tests in presence of Contract Administrator. Give three (3) working days notice of proposed tests.

.21 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.

.22 Submit two (2) copies of test results for Contract Administrator's review in addition to copies included in maintenance data.

.2 Cable and Wire – 1000 Volt and Below

.1 Limit all tests on cables in this voltage range to insulation resistance measurements using a megger: 500 V instrument for circuits up to 350 V systems; 1000 V instrument for 351-600 V systems.

.2 Record all test results in a log book and submit to the Contract Administrator for reference. Replace or repair all circuits which do not meet minimum requirements specified in the governing Electrical Safety Code or 2 Mega Ohms, which ever is the greater value. Measure insulation resistance of the following circuits:

.1 Power and lighting feeders (with equipment disconnected): phase-to-phase, and phase-to-ground.

.2 Control circuits: measure to ground only.

.3 Do not perform megger tests on control circuits containing transistorized or solid-state components.

.4 Where power factor correction equipment is installed, it may be necessary to disconnect the capacitors from the system prior to testing to avoid overvoltage.

.5 Disconnect sensing and protection equipment from the respective circuits to be megger tested including PT's and Surge Protectors.

.6 Conduct tests in accordance to NETA standards.

.3 Instrumentation and Thermocouple Wiring

.1 Check continuity of each wire using ohm meter or DC buzzer. Megger or 120 V filament lamp testing is not acceptable.

.2 Test thermocouple wiring for continuity and polarity in accordance with manufacturer's recommendations.

.4 Conduits and Ducts

.1 Conduits or ducts which are required to be installed but left empty shall be tested for clear bore using a ball mandrel of approximately 85% of the conduit or duct inside diameter. Any conduit or duct which rejects the ball mandrel shall be cleared at no additional cost to the Owner. These tests shall be witnessed by the Contract Administrator. Three days notice shall be given prior to testing.

.5 Transformers

.1 Refer to Sections 16271 for details.

1.31 COORDINATION OF PROTECTIVE DEVICES AND ELECTRICAL TESTING

.1 The Contractor shall implement all protective setting recommended by the Short Circuit Study. Study part of the Contractors scope

.2 Ensure circuit protective devices such as over-current trips, relays and fuses, are installed to correct values and settings.

.3 Ensure all protective devices ratings and settings are set to the coordination study settings.

.4 Record and submit to Contract Administrator all protective devices settings as left.

.5 Provide tests for all relays and provide full and complete data sheets on as found settings, as tested settings, and as left settings.

.6 Provide full data sheets for all settings of multifunction relays within the scope of this contract: Full data sheets to include:

.1 All protective settings

.2 All relay input settings

.3 All relay output settings

.4 All communications settings.

1.32 TRIAL USAGE

.1 The Owner and Owner's representatives shall have the privilege of trial usage of the electrical system or parts thereof for the purpose of testing and verifying operational procedures.

.2 Trial usage by the Owner shall not waive the Contractor/Sub-Contractor of any responsibility because of trial usage.

.3 Trial usage shall not be construed as acceptance by the Owner.

1.33 FIRE TRANSITS

.1 All cable trays, conduit etc. transitioning thru building walls, floors, ceilings to be sealed with a two (2) hour fire rated caulking or fire transit.

.2 Fire transit to be ULC listed.

1.34 CLEANING

.1 Comply with Section 01000 – General Requirements.

.2 Before energizing any system, inspect and clean all the inside of switchgear, MCC, etc. to ensure that they are free from dust and debris.

.3 At time of final cleaning, clean lighting reflectors, lenses, and other lighting surfaces that have been exposed to construction dust and dirt.

.4 Clean all polished, painted and plated work brightly.

.5 Remove all debris, surplus material and all tools.

1.35 EXECUTION

.1 The use of permanent electrical system for temporary construction service shall be only with written permission of the Contract Administrator.

.2 Maintain at the job site, at all times, qualified personnel and supporting staff, with proven experience in erecting, supervising testing projects of comparable nature and complexity.

.3 Provide an as build 'D' size electrical single line diagram in the electrical room in accordance with ESA requirements. Drawing shall be wall mounted under glass or UV resistant laminated on a 25mm wooden back board. An Electrical Single Line Diagram shall be installed in the following areas:

.1 Pump Station Electrical Room.

.4 Expedite the work as follows:

.1 Continuously check and expedite delivery of equipment and materials.

.2 If necessary, inspect at the source of manufacture.

.3 Continuously check and expedite the flow of necessary information to and from all parties involved.

.4 Inform the Contract Administrator promptly where information is required.

.5 The work of this division shall be coordinated with other divisions in such a manner as not to interfere with other work. In areas where the ducts, pipes, wiring and equipment for other sections will be installed in proximity to pipes, wiring and equipment pertaining to this division, cooperate to ensure that all pipes, ducts, wiring and equipment are installed to the best advantage.

.6 Equipment, conduit, etc., installed but not coordinated with the work of other trades shall be relocated as directed by the Contract Administrator without extra cost to the Owner.

.7 Install equipment, conduit and cables in a workmanlike manner to present a neat appearance and to function properly to the satisfaction of the Contract Administrator. Install exposed conduit runs parallel and perpendicular to building planes. Install conduit concealed in chases, behind furring, or above ceiling, except in unfinished areas. Install exposed systems neatly and group to present a neat appearance.

1.36 TEMPORARY POWER

.1 The Contractor shall be responsible for all costs associated with servicing the site with temporary power (ie: Electricity) for the purpose of construction as well as maintaining a site office.

END OF SECTION

SECTION 16015
ELECTRICAL SYSTEMS ANALYSIS

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SECTION 16015
ELECTRICAL SYSTEMS ANALYSIS

PART 1 GENERAL

1.1 GENERAL CONDITIONS

.1 Refer to all other Divisions of the Specifications and these documents and drawings to determine their effect upon the work of this section.

.2 All sections of Divisions 1 to 16 inclusive form part of the Contract Documents. Refer to Section 16010 for General Electrical requirement related to this work.

1.2 REFERENCES

.1 The following is a list of standards which may be referenced in this section:

.1 Institute of Electrical and Electronics Engineers, Inc. (IEEE):

.1 242, Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems.

.2 399, Recommended Practice for Industrial and Commercial Power System Analysis.

.2 American National Standards Institute (ANSI): C57.12.00, Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers.

.3 CSA Standard C22.41 Grounding and Bonding Equipment.

.4 Ontario Electrical Safety, latest edition, including amendments and published bulletins (at the time of this specification, this is the 25th Edition, 2012).

1.3 SEQUENCING AND SCHEDULING

.1 An initial, complete short circuit & protection coordination (SCPC) study and Arc Flash study will be performed by the Contractor prior to submitting shop drawings for any Electrical Equipment.

.2 Supply and install all arc flash labels for MCC, generator, panels, and starters.

.3 During the shop drawing process, the SCPC and Arc Flash Study will be updated by the Contractor to incorporate actual impedances and devices proposed for installation.

.4 The Contractor shall prepare a complete parameter setting file based on the updated SCPC study and download the recommended settings to each Multilin Relay device during construction.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.1 GENERAL

.1 Adjust relay and protective device settings according to values established by the coordination study.

.2 Provide detailed data sheets for all programmable meters, relays and monitors within the scope of this study, including all multifunction relays, feeder protection relays, motor protection relays and power monitors.

.1 Detailed data sheets to include all:

.1 Protective device settings

.2 Ranges

.3 Output relay functions

.4 Parameters for input devices

.5 Addressing

.6 Communication settings

.2 Data sheets to be in electronic format, suitable for downloading to devices, and in hardcopy format for review and inclusion in the final Operation and Maintenance Manual.

.3 Make minor modifications (relay setting changes, fuse changes) to equipment as required to accomplish conformance with the short circuit and protective device coordination studies.

.4 Notify Contract Administrator in writing of any required major equipment modifications.

3.2 FIELD QUALITY CONTROL

.1 Test relay trip functions and verify trip settings.

.2 Test ground continuity and resistance to meet electrical code requirements prior to energizing electrical systems.

.3 Contractor performs testing. Notify and Coordinate with Inspection and Supply Authority so that they may witness testing.

END OF SECTION

SECTION 16122
WIRES AND CABLES 0-1000V

1 GENERAL 1

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SECTION 16122
WIRES AND CABLES 0-1000V

1 GENERAL

1.1 RELATED SECTIONS

.1 Section 13010 – Process Control - General

1.2 REFERENCES

.1 CSA C22.2 No.0.3-92, Test Methods for Electrical Wires and Cables.

.2 CAN/CSA-C22.2 No.131-M89 (R1994), Type TECK 90 Cable.

1.3 PRODUCT DATA

.1 Submit product data in accordance with Section 01330-Submittals.

2 PRODUCTS

2.1 BUILDING WIRES

.1 Conductors: stranded for all conductors.

.2 Copper conductors: size as indicated, with 1000 V insulation of chemically cross-linked thermosetting polyethylene material rated RW90.

.3 Conductors below grade in conduit shall be type RWU90 cross-link polyethylene.

.4 Motor or branch circuit feeder sizes shall be as noted on drawings and in no case shall be smaller than #12 AWG. Control wiring shall be of minimum size #14.

.5 All feeders shall be run in continuous length between power supply point and the load. No splices will be allowed in feeder cable.

.6 Ground wire to be green jacket with RW90 insulation when run in ducts or conduits.

.7 Ground wire to be bare stranded soft drawn copper conductor when installed in cable trays.

.8 Install 20% spare control wiring capacity in each controls conduit.

.9 All wiring for remote DC emergency fixtures shall be #10 AWG.

.10 Identify all wiring with wire markers at both ends.

.11 All branch circuit wiring and all systems wiring shall be identified at all panels and terminal boxes with Thomas & Betts SM markers.

.12 All necessary power and control wiring to all equipment shall be supplied and installed to suit the power and control requirements noted on the drawings. It shall be noted that the drawings do not necessarily indicate the locations of each individual feeder, but these shall be located to best suit the site conditions.

.13 All wiring connections shall be made with T & B StaKon pressure connector, or approved equal, applied with a pressure tool.

.14 Wiring connections, where required, shall be made with CSA approved compression tool with a nylon cap equal to Buchanan “Pres Sure”.

.15 All wiring shall be identified with Brady Markers at junction boxes and termination points.

.16 All wiring shall be sized so that voltage drop between the panel board and the furthest outlet shall not exceed 2% when the circuit has a full load.

.17 Cables to submersible pumps shall have sufficient cable slack to permit adjustment and removal of equipment.

.18 Only circuits of the same voltage shall be installed in a common conduit or duct or share the same ground return line. Do not mix voltage in the same duct or conduit.

.19 Colour Coding:

.1 Phase A - Red

.2 Phase B – Black

.3 Phase C – Blue

2.2 TECK CABLE

.1 Cable: to CAN/CSA-C22.2 No.131.

.2 Conductors:

.1 Grounding conductor: copper

.2 Circuit conductors: copper, size as indicated

.3 Inner jacket: polyvinyl chloride material

.4 Armour: aluminum

.5 Overall covering: polyvinyl chloride material

.6 Fastenings:

.1 One (1) hole malleable iron straps to secure surface cables 50mm and smaller. Two (2) hole steel straps for cables larger than 50mm.

.2 Channel type supports for two (2) or more cables at 600mm centres.

.3 Threaded rods: 6mm dia. to support suspended channels.

.7 Connectors:

.1 Watertight approved for TECK cable.

2.3 ARMOURED CABLES

.1 Conductors: insulated, copper, size as indicated.

.2 Type:

.3 Armour: interlocking type fabricated from aluminum strip.

.4 Type: PVC flame retardant jacket over thermoplastic armour meeting requirements of Vertical Tray Fire Test of CSA C22.2 No.0.3 with maximum flame travel of 1.2m.

.5 Connectors: specific to type of cable.

2.4 COMMUNICATIONS CABLES

.1 Supply and install all communications cables to suit the SCADA system architecture connection requirements.

.2 Coordinate cable types and installation requirements with Division 13 Network Cabling.

.3 All communications cables located outdoors or in classified areas are to be installed in dedicated PVC encapsulated rigid metal conduit, Plasti-Bond type.

2.5 INSTRUMENTATION, CONTROL, COMMUNICATION, AND SPECIAL FIELD WIRING

.1 Conform to the requirements of Division 13.

.2 Run all wiring in conduit or duct (underground wire) unless otherwise specified. Refer to this division and to the drawings for additional information, requirements and details.

.3 Provide minimum 20% spare wiring or two (2) conductors (1 pair) whichever is greater for each run.

.4 All wires must be tagged with pre-numbered slip-on markers. Allow for up to ten (10) characters per individual wire. No wrap around markers will be accepted.

.5 Control Wiring (Field)

.1 All control wiring to be stranded, annealed copper conductors, 600 V minimum rating 14 AWG, RW90 XLPE, 600 V rated conductors to be provided.

.2 Where conductors to be buried in conduit 14 AWG, RWU90, XLPE, 600 V rated conductors to be provided.

.6 Instrumentation Cable (Field)

.1 Cable to be 300 V rated and meet CSA, C22.2 No. 239 standard with the following features:

.1 Seven (7) strand copper conductor with TW75 (-40°C) 105°C dry PVC insulation formed into pairs or triads.

.2 Aluminum/polyester tape shield over individual pairs or triads.

.3 Individual shield, 7 strand tinned copper drain wire.

.4 Aluminum/polyester tape shield over cable.

.5 Overall shield, 7 strand tinned copper drain wire.

.6 Ripcord.

.7 90°C (-40°C) FRPVC jacket.

.2 Cable to be as manufactured by SHAWFLEX LTD. or BELDEN LTD.

.7 Communication and Special Wire and Cable (Field)

.1 The Contractor shall provide all wiring and cable, including connectors, plugs and termination devices required for the wiring

of the systems and equipment shown on the drawings, unless otherwise specified.

.2 Provide quantities and lengths of cable and wire type as recommended by the system equipment manufacturers. Do not de-rate any cabling and wire. No wire/cable to be sized less than 18 AWG unless approved by the Contract Administrator or unless a specific requirement of the equipment manufacturer.

.3 Coordinate with the manufacturer and other sections of these specifications to ensure proper conduit type (ie: metal) and sizes are provided.

.4 All cables and wire to be continuous runs.

.5 Provide, as part of shop drawing submittal, cable and wire specifications and data for each system. Include written proof that cable and wire meets requirements of equipment supplier.

.6 Any wire and cable installed that does not meet the wiring specifications of the equipment manufacturer shall be removed and replaced (including conduits, if necessary), at the Contractor's expense..

3 EXECUTION

3.1 INSTALLATION OF BUILDING WIRES

.1 Install wiring as follows:

.1 In conduit systems in accordance with Section 16133.

3.2 INSTALLATION OF TECK CABLE 0 – 1000 V

.1 Install cables.

.2 Group cables wherever possible on channels.

3.3 INSTALLATION OF ARMOURED CABLES

.1 Group cables wherever possible.

3.4 TESTING

.1 Perform 1000V DC megger test on all power cables specified in this section prior to energization. This test to be witnessed by Contract Administrator.

.2 Provide a written (typed) report to suit the test results for each cable within 1 week of testing.

.3 The Contractor shall repeat the test in the presence of the Contract Administrator for any cable listed in the test report, at the request of the Contract Administrator.

END OF SECTION

SECTION 16132
OUTLET BOXES, CONDUIT BOXES AND FITTINGS

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3 EXECUTION 3

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SECTION 16132
OUTLET BOXES, CONDUIT BOXES AND FITTINGS

1 GENERAL

1.1 REFERENCES

.1 Ontario Electrical Safety Code – 2012 and ESA latest bulletins.

1.2 GENERAL REQUIREMENTS

.1 All mounting hardware shall be of non-corrosive type material including:

.1 Stainless steel

.2 Aluminum

.3 PVC encapsulated rigid steel

.2 Outlet and Conduit Boxes must be of the same material as the conduit application.

.3 All outlet boxes, conduit boxes and fittings installed indoors or outdoors shall PVC encapsulated rigid metal type to match PVC encapsulated rigid steel conduit applications.

.4 All Junction Boxes, Pull Boxes and Cabinets installed outdoors shall be of the same manufactures as the conduit application.

2 PRODUCTS

2.1 OUTLET AND CONDUIT BOXES GENERAL

.1 Size boxes in accordance with code requirements.

.2 102mm square or larger outlet boxes as required for special devices.

.3 Gang boxes where wiring devices are grouped.

.3 Blank cover plates for boxes without wiring devices.

.4 347 V outlet boxes for 347 V switching devices.

.5 Combination boxes with barriers where outlets for more than one (1) system are grouped.

.6 All boxes used with exposed conduits to be galvanized rigid metal. Boxes to be as manufactured by Appleton or equal.

.7 Each light, switch, receptacle and/or outlet shall be provided with suitable outlet box, each approved for the particular area which it is to be installed.

.8 One outlet box shall be installed per switch, receptacle, light, etc.

.9 Provide PVC encapsulated outlet and conduit boxes to suit all PVC encapsulated conduit applications. Acceptable product: Plasti-Bond.

2.2 SHEET STEEL OUTLET BOXES

.1 Electro-galvanized steel single and multi gang flush device boxes for flush installation, minimum size 76 x 50 x 38mm or as indicated. 102mm square outlet boxes when more than one (1) conduit enters one (1) side with extension and plaster rings as required.

.2 Electro-galvanized steel utility boxes for outlets connected to surface mounted EMT conduit, minimum size 102 x 54 x 48mm.

.3 102mm square or octagonal outlet boxes for lighting fixture outlets.

.4 102mm square outlet boxes with extension and plaster rings for flush mounting devices in finished walls.

2.3 MASONRY BOXES

.1 Electro-galvanized steel masonry single and multi gang boxes for devices flush mounted in exposed block walls.

2.4 CONCRETE BOXES

.1 Electro-galvanized sheet steel concrete type boxes for flush mount in concrete with matching extension and plaster rings as required.

2.5 CONDUIT BOXES

.1 Cast FS boxes with factory-threaded hubs and mounting feet for surface wiring of switches and receptacle.

2.6 OUTLET BOXES FOR NON-METALLIC SHEATHED CABLE

.1 Electro-galvanized, sectional, screw ganging steel boxes, minimum size 76 x 50 x 63mm with two (2) double clamps to take non-metallic sheathed cables.

2.7 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 32m and pull boxes for larger conduits.

.4 Double locknuts and insulated bushings on sheet metal boxes.

2.8 SERVICE FITTINGS

.1 'High tension' receptacle fitting made of two (2) piece stainless steel housing finish for one (1) single receptacle(s). Bottom plate with two (2) knockouts for centered or offset installation. 12 x 102mm extension piece as indicated.

.3 Pedestal type 'low tension' fitting made of two (2) piece stainless steel housing finish to accommodate two (2) amphenol jack connectors.

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 6mm 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

SECTION 16133
CONDUITS, CONDUIT FASTENINGS AND CONDUIT FITTINGS

1 GENERAL 1

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SECTION 16133
CONDUITS, CONDUIT FASTENINGS AND CONDUIT FITTINGS

1 GENERAL

1.1 REFERENCES

.1 Canadian Standards Association (CSA)

.1 CAN/CSA C22.2 No. 18-92, Outlet Boxes, Conduits Boxes, and Fittings.

.2 CSA C22.2 No. 45-M1981 (R1992), Rigid Metal Conduit.

.3 CSA C22.2 No. 56-1977(R1977), Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.

.4 CSA C22.2 No. 83-M1985 (R1992), Electrical Metallic Tubing.

.5 CSA C22.2 No. 211.2-M1984 (R1992), Rigid PVC (Unplasticized) Conduit.

.6 CAN/CSA C22.2 No. 227.3-[M91], Flexible Nonmetallic Tubing.

1.2 GENERAL REQUIREMENTS

.1 All conduits located indoors, outdoors or in hazardous areas shall be PVC Encapsulated Rigid steel Conduit.

.2 Provide Rigid PVC Conduit to suit all power distribution and control wiring applications installed indoors.

.3 Conduit located below grade shall be Rigid PVC, except for applications that require specific continuous conduits types as specified herein. Below grade conduit that transitions above grade to the outdoors shall be PVC Encapsulated Rigid Metal Conduit type.

.4 All mounting hardware shall be of non-corrosive type material including:

.1 Stainless steel

.2 Aluminum

.3 PVC encapsulated steel

.5 All conduits that transition between electrical manholes and a building shall be sealed such that the conduits are water tight. All conduit entries into building shall be sealed and water tight such that no water infiltrates

the building via the conduit or via the penetration in the building or structure to suit the conduit entry.

2 PRODUCTS

2.1 CONDUITS

.1 Rigid PVC conduit: to CSA C22.2 No. 211.2.

.2 Flexible metal conduit: to CSA C22.2 No. 56, liquid-tight flexible metal.

.3 Rigid Galvanized Steel Conduit (RGS):

.1 Meet requirements of CSA C22.2 No. 45.

.2 Material: Hot-dip galvanized, inside and outside, with chromated protective layer.

.4 PVC Schedule 40 Conduit:

.1 Meet requirements of CSA C22.2 No. 211.2 and NRMA TC 2.

.2 Suitable for areas NOT exposed to physical damage, underground direct burial, concealed or direct sunlight exposure and 90°C insulated conductors.

.5 PVC Schedule 80 Conduit:

.1 Meet requirements of CSA C22.2 No. 211.2 and NEMA TC 2.

.2 Suitable/listed for areas exposed to physical damage, for underground direct burial, concealed or direct sunlight exposure and 90°C insulated conductors.

.6 PVC Coated Rigid Galvanized Steel Conduit:

.1 Meet requirements of NEMA RN 1.

.2 Material:

.1 Meet requirements of CSA C22.2 No. 45.

.2 Exterior finish: PVC coated, 40 mils nominal thickness, bond to metal shall have tensile strength greater than PVC.

.3 Interior finish: Urethane coating, 2 mils nominal thickness.

.3 Threads: Hot-dipped galvanized and factory coated with urethane.

.4 Bendable without damage to either interior or exterior coating. Any damages during construction shall cause replacement by the Contractor. Minor scratches to PVC coating shall be addressed using manufacturer's touch-up paint referenced in 2.1.6.5.

.5 Acceptable Manufacturer: "Plasti-Bond Red" by Robroy Industries.

2.2 CONDUIT FASTENINGS

.1 One (1) hole steel straps to secure surface conduits NPS 2 50mm and smaller. Two (2) hole steel straps for conduits larger than NPS 2 50mm.

.2 Beam clamps to secure conduits to exposed steel work.

.3 Channel type supports for two (2) or more conduits at 15m oc.

.4 Threaded rods, 6mm dia., to support suspended channels.

2.3 CONDUIT FITTINGS

.1 Fittings: manufactured for use with conduit specified. The fitting material and coating shall be the same as conduit used in the application.

.2 Rigid Galvanized Steel

.1 General:

.1 Meet requirements of CSA C22.2 No. 45.

.2 Type: Threaded, galvanized - Set screw and threadless compression fittings not permitted.

.2 Bushing:

.1 Material: Malleable iron with integral insulated throat, rated for 150°C.

.2 Manufacturers and Products:

.1 Appleton: Series BU-1

.2 O-Z/Gedney: Type HB

.3 Grounding Bushing:

.1 Material: Maleable iron with integral insulated throat rated for 150°C, with solderless lugs.

.2 Manufacturers and Products:

.1 Appleton: Series GIB

.2 O-Z/Gedney: Type HBLG

.4 Conduit Hub:

.1 Material: Malleable iron with integral insulated throat with bonding screw.

.2 UL listed for use in wet locations.

.3 Manufacturers and Products:

.1 Appleton: Series HUB-B

.2 O-Z/Gedney: Type CH

.3 Meyers: ST Series

.5 Conduit Bodies:

.1 Sized as required by CEC.

.2 Manufacturers and Products (For normal Conditions)

.1 Appleton: Form 35 threaded unilets

.2 Crouse-Hinds; Form 7 or 8 threaded condulets

.3 Killark: Series O electrolets

.4 Thomas & Betts: Form 7 or 8

.3 Manufacturers (For hazardous Locations):

.1 Appleton

.2 Crouse-Hinds

.3 Killark

.6 Couplings: As supplied by conduit manufacturer

.7 Unions:

.1 Concrete tight, hot-dip galvanized, malleable iron.

.2 Manufacturers and Products:

.1 Appleton: Series SCC Bolt-On Coupling or Series EC Three-Piece Union

.2 O-Z/Gedney: Type SSP split coupling or Type 4 Series, three-piece coupling.

.8 Conduit Sealing Fitting Manufacturers and Products

.1 Appleton: Type EYF, EYM or ESU

.2 Crouse-Hinds; Type EYS or EZS

.3 Killark: Type EY or EYS

.9 Drain Seal Manufacturers and Products:

.1 Appleton: Type SF

.2 Crouse-Hinds; Type EYD or EZD

.10 Drain/Breather Fitting Manufacturers and Products

.1 Appleton: Type ECDB

.2 Crouse-Hinds; ECD

.11 Expansion Fitting Manufacturers and Products:

.1 Deflection/Expansion Movement

.1 Appleton: Type DF

.2 Crouse-Hinds: Type XD

.2 Expansion Movement Only:

.1 Appleton: Type XJ

.2 Crouse-Hinds: Type XJ

.12 Cable Sealing Fittings

.1 To form watertight nonslip cord or cable connection to conduit.

.2 For conductors with OD of 13 mm or less; Neoprene bushing at connector entry.

.3 Manufacturers and Products

.1 Appleton: CG-S

.2 Crouse-Hinds: CGBS

.3 PVC Conduit and Tubing:

.1 Meet requirements of NEMA TC-3.

.2 Type: PVC, slip-on

.4 PVC-Coated Rigid Galvanized Steel Conduit:

.1 Meet requirements of NEMA RN 1.

.2 Fittings: Rigid galvanized steel type, PVC coated by conduit manufacturer.

.3 Conduit Bodies: Cast metal hot-dipped galvanized or urethane finish. Cover shall be of same material as conduit body. PVC coated by conduit manufacturer.

.4 Finish: 40-mil PVC exterior, 2-mil urethane interior.

.5 Overlapping pressure sealing sleeves.

.6 Conduit Hangers, Attachments, and Accessories: PVC-coated

.7 Manufacturers:

.1 Robroy Industries

.2 Ocal

.13 Expansion Fitting Manufacturer and Product: Ocal; OCAL-BLUE XJG

.5 Flexible, Nonmetallic, Liquid-Tight Conduit:

.1 Type: High strength plastic body, complete with lock nut, O-ring, threaded ferrule, sealing ring, and compression nut.

.2 Body/compression nut (gland) design to assure high mechanical pullout strength and watertight seal.

.3 Manufacturers and Products:

.1 Carlon: Type LT

.2 O-Z/Gedney: Type 4Q-P

.3 Thomas & Betts: Series 6300

.6 Watertight Entrance Seal Device:

.1 New construction:

.1 Material: Oversized sleeve, malleable iron body with sealing ring, pressure ring, grommet seal, and pressure clamp.

.2 Manufacturer and Product: O-Z/Gedney; Type FSK or WSK, as required

.2 Cored-Hole Application

.1 Material: Assembled dual pressure disks, neoprene sealing ring, and membrane clamp.

.2 Manufacturer and Product: O-Z/Gedney: Series CSM.

2.4 EXPANSION FITTINGS FOR RIGID CONDUIT

.1 Weatherproof expansion fittings with internal bonding assembly suitable for 200mm linear expansion.

.2 Watertight expansion fittings with integral bonding jumper suitable for linear expansion and 19mm deflection in all directions.

.3 Weatherproof expansion fittings for linear expansion at entry to panel.

2.5 FISH CORD

.1 Polypropylene 6mm in all empty conduits.

2.6 ACCESSORIES

.1 Identification Devices:

.1 Raceway Tags

.1 Material: Permanent, nylon or polyethylene

.2 Shape: Round

.3 Raceway Designation: Pressure stamped, embossed, or engraved.

.4 Tags relying on adhesives or taped-on markers not permitted.

.2 Wraparound Duct Band:

.1 Material: Heat-shrinkable, cross-linked polyolefin, pre-coated with hot-melt adhesive.

.2 50 mm width (minimum).

.3 Manufacturer and product: Raychem: Type TWDB.

3 EXECUTION

3.1 INSTALLATION

.1 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.

.2 Conceal all conduits in finished rooms that are equipped with suspended ceilings.

.3 Use rigid conduit for wiring of life safe systems and concealed wiring, approved product green guard or equal.

.4 Use liquid tight flexible metal conduit for connection to motors or vibrating equipment.

.5 Use rigid conduit in all classified areas.

.6 Use explosion proof flexible connection for connection to explosion proof motors.

.7 Install conduit sealing fittings in hazardous areas. Fill with compound.

.8 Minimum conduit size for lighting and power circuits: 19mm.

.9 Bend conduit cold. Replace conduit if kinked or flattened, as determined by the Contract Administrator.

.10 Mechanically bend steel conduit over 19mm dia.

.11 Field threads on rigid conduit must be of sufficient length to draw conduits up tight.

.12 Install fish cord in empty conduits.

.13 Run 2-25mm spare conduits up to ceiling space and 2-25mm spare conduits down to ceiling space from each flush 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 surface type box.

.14 Remove and replace blocked conduit sections. Do not use liquids to clean out conduits.

.15 Dry conduits out before installing wire.

3.2 SURFACE CONDUITS

.1 Run parallel or perpendicular to building lines.

.2 Locate conduits behind infrared or gas fired heaters with 1.5m clearance.

.3 Run conduits in flanged portion of structural steel.

.4 Group conduits wherever possible on suspended surface 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 with minimum of 25mm at crossovers.

3.3 CONDUITS IN CAST-IN-PLACE CONCRETE

.1 All cast in place conduit installations not specified on the drawings must be approved by the Contract Administrator.

.2 Locate to suit reinforcing steel. Install in centre one third of slab.

.3 Protect conduits from damage where they stub out of concrete.

.4 Install sleeves where conduits pass through slab or wall.

.5 Provide oversized sleeve for conduits passing through waterproof membrane, before membrane is installed. Use cold mastic between sleeve and conduit.

.6 Do not place conduits in slabs in which slab thickness is less than four (4) times conduit diameter.

.7 Encase conduits completely in concrete with minimum 25mm concrete cover.

.8 Organize conduits in slab to minimize crossovers.

3.4 CONDUITS IN CAST-IN-PLACE SLABS ON GRADE

.1 All cast in place conduit installations not specified on the drawings must be approved by the Contract Administrator.

.2 Run conduits 25mm and larger below slab and encased in 75mm concrete envelope. Provide 50mm of sand over concrete envelope below floor slab.

3.5 CONDUITS UNDERGROUND

.1 Slope conduits to provide drainage.

.2 Waterproof joints (PVC excepted) with heavy coat of bituminous paint.

3.6 CONNECTIONS

.1 For motors, wall or ceiling mounted fans and unit heaters, dry type transformers, electrically operated valves, instrumentation, and other equipment where flexible connection is required to minimize vibration:

.1 Conduit size 103mm or less: flexible, liquid-tight conduit.

.2 Conduit size over 103mm: nonflexible.

.3 Wet or Corrosive areas: flexible, non-metallic, liquid-tight.

.4 Dry Areas: flexible, metallic liquid-tight.

.5 Length: 450mm minimum, 1500mm maximum, sufficient to allow movement or adjustment or equipment.

.2 Outdoor areas, process areas exposed to moisture, and areas required to be oiltight and dust-tight: flexible non-metallic, liquid-tight conduit.

.3 Under equipment mounting pads: rigid galvanized steel, PVC-coated rigid steel, PVC schedule 80 conduit.

.4 Exterior light pole foundations: rigid galvanized steel conduit.

3.7 PENETRATIONS

.1 Make at right angles, unless otherwise shown.

.2 Notching or penetration of structural members, including footings and beams, not permitted.

.3 Fire-Rated walls, floors, or ceilings: firestop openings around penetrations to maintain fire-resistance rating as specified in Section 16010 – 1.34 Fire Transits.

.4 Apply single layer of wraparound duct band to all metallic conduit protruding through concrete floor slabs to a point 50mm above and 50mm below concrete surface.

.5 Concrete walls, floors, or ceilings (aboveground): provide nonshrink grout drypack or use watertight seal device.

.6 Entering Structures:

.1 General: Seal raceway at the first box or outlet with oakum or expandable plastic compound to prevent the entrance of gases or liquids from one area to another.

.2 Concrete roof or Membrane Waterproofed Wall or Floor:

.1 Provide a watertight seal.

.2 Without concrete encasement: Install watertight entrance seal device on each side.

.3 With concrete encasement: Install watertight entrance seal device on the accessible side.

.4 Securely anchor malleable iron body of watertight entrance seal device into construction with one or more integral flanges.

.5 Secure membrane waterproofing to watertight entrance seal device in a permanent, watertight manner.

.3 Heating, Ventilating, and Air Conditioning Equipment:

.1 Penetrate equipment in area established by manufacturer.

.2 Terminate conduit with flexible PVC encapsulated metallic conduit at junction box or conduit attached to exterior surface of equipment prior to penetrating equipment.

.3 Seal penetration with Type 5 sealant, as specified in Section 07900 – Joint Sealants.

.4 Corrosive-Sensitive Areas:

.1 Seal all conduit passing through chlorine/chemical room walls.

.2 Seal conduit entering equipment panel boards and field panels containing electronic equipment.

.3 Seal penetration with Type 5 sealant, as specified in Section 07900 – Joint Sealants.

.5 Existing or Precast Wall (Underground): Core drill wall and install a watertight entrance seal device.

.6 Nonwaterproofed Wall or Floor (Underground without Concrete Encasement):

.1 Provide Schedule 40 galvanized pipe sleeve, or watertight entrance seal device.

.2 Fill space between raceway and sleeve with expandable plastic compound or oakum and lead joint on each side.

.7 Maintenance holes and Hand holes:

.1 Metallic Raceways: Provide insulated grounding bushings.

.2 Nonmetallic Raceway: Provide bell ends flush with wall.

.3 Install such that raceways enter as near as possible to one end of wall unless otherwise shown.

3.8 SUPPORT

.1 Support from structural members only, at intervals not exceeding Canadian Electrical Code requirements and in any case not exceeding 3.0 metres. Do not support from piping, pipe supports or other raceways.

.2 Multiple Adjacent Raceways: Provide ceiling trapeze. For trapeze-supported conduit allow 25 percent extra space for future conduit.

.3 Application/Type of Conduit Strap:

.1 Rigid Steel or EMT Conduit: Zinc coated steel, pregalvanized steel or malleable iron.

.2 PVC Coated Rigid Steel Conduit: PVC coated metal.

.3 Nonmetallic Conduit: Nonmetallic or PVC coated metal.

.2 Provide and attach wall brackets, strap hangers, or ceiling trapeze as follows:

.1 Wood: wood screws

.2 Hollow Masonry Units: toggle bolts

.3 Concrete or Brick: expansion shields or threaded studs driven in by powder charge with lock washers and nuts

.4 Steelwork: machine screws

.5 Location/Type of Hardware:

.1 Dry, noncorrosive areas: galvanized

.2 Wet, noncorrosive areas: stainless steel

.3 Corrosive areas: stainless steel

.3 Nails or wooden plugs inserted in concrete or masonry for attaching raceway not permitted. Do not weld raceways or pipe straps to steel structures. Do not use wire in lieu of straps or hangers.

3.9 BENDS

.1 Install concealed raceways with a minimum of bends in the shortest practical distance.

.2 Make bends and offsets of longest practical radius. Bends in conduits and ducts being installed for fiber optic cables shall be not less than 20 times cable diameter, 375mm minimum.

.3 Install with symmetrical bends or cast metal fittings.

.4 Avoid field-made bends and offsets, but where necessary, make with acceptable hickey or bending machine. Do not heat metal raceways to facilitate bending.

.5 Make bends in parallel or banked runs from same center or centerline with same radius so that bends are parallel.

.6 Factory elbows may be installed in parallel or banked raceways if there is change in plane of run and raceways are same size.

.7 PVC Conduit:

.1 Bends 30° and larger: provide factory-made elbows.

.2 Use manufacturer's recommended method for forming smaller bends.

.8 Flexible Conduit: Do not make bends that exceed allowable conductor bending radius of cable to be installed or that significantly restricts conduit flexibility.

3.10 EXPANSION/DEFLECTION FITTINGS

.1 Provide on all raceways at all structural expansion joints and in long tangential runs.

.2 Provide expansion/deflection joints for 14°C maximum temperature variation.

.3 Install in accordance with manufacturer's instructions.

3.11 PVC CONDUIT

.1 Solvent Welding:

.1 Provide manufacturer recommended solvent: apply to all joints

.2 Install such that joint is watertight.

.3 Adapters:

.1 PVC to metallic fittings: PVC terminal type

.2 PVC to rigid metal conduit: PVC female adapter

.4 Belled-End Conduit: Bevel the unbelled end of the joint prior to joining.

3.12 PVC-COATED RIGID STEEL CONDUIT

.1 Install in accordance with manufacturer's instructions.

.2 All tools and equipment used in the cutting, bending, threading and installation of PVC-coated rigid steel conduit shall be designed to limit damage to the PVC coating.

END OF SECTION

SECTION 16223
MOTOR STARTERS TO 600V

1 GENERAL 1

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SECTION 16223
MOTOR STARTERS TO 600V

1 GENERAL

1.1 RELATED SECTIONS

.1 Section 16010 – Electrical General Requirements.

.2 Section 16482 – Motor Control Centre.

1.2 REFERENCES

.1 International Electrotechnical Commission (IEC)

.1 IEC 947-4-1-1990, Part 4: Contactors and motor starters.

1.3 PRODUCT DATA

.1 Submit shop drawings in accordance with Section 01330 – Submittal Procedures.

.2 Shop drawings to indicate:

.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 type of starter.

.6 Interconnection diagrams.

1.4 OPERATION AND MAINTENANCE DATA

.1 Provide operation and maintenance data for motor starters for incorporation into manual specified in Section 01330 - Submittals.

.2 Include operation and maintenance data for each type and style of starter.

1.5 MAINTENANCE MATERIALS

.1 Provide maintenance materials in accordance with Section 01330 - Submittals.

.2 Provide listed spare parts for each different size and type of starter:

.1 3 contacts, stationary.

.2 3 contacts, movable.

.3 1 contact, auxiliary.

.4 1 control transformer.

.5 1 operating coil.

.6 2 fuses.

1.6 10% LED PUSH TO TEST TYPE BULBS.

2 PRODUCTS

2.1 MATERIALS

.1 Starters: to IEC 947-4 with AC4 utilization category.

2.2 ENCLOSURE

.1 Supply and install the respective motor starters in the respective MCC's and/or in dedicated motor starter enclosures as indicated on the drawings.

.2 Dedicated Motor Starter enclosures shall have a minimum rating of NEMA 12 unless otherwise indicated on the drawings. All dedicated motor starter enclosures shall include a front door complete with a full piano door hinge and external operating handle that is interlocked with the door to prevent live access to the motor starter interior components.

.3 Install arc flash labels on all motor starters to 600V.

2.3 MANUAL MOTOR STARTERS

.1 Single or three (3) phase manual motor starters of size, type, rating, and enclosure type as indicated, with components as follows:

.1 Switching mechanism, quick make and break.

.2 Three (3) overload heaters, manual reset, trip indicating handle.

.2 Accessories:

.1 Selector switch and/or push button: heavy duty/oil tight labelled as indicated.

.2 Indicating light: oil tight type and colour as indicated (LED Push to Test type).

.3 Locking tab to permit padlocking in “ON” or “OFF” position.

2.4 FULL VOLTAGE & REDUCED VOLTAGE STARTERS

.1 Provide starters of the Full Voltage (FV) or Reduced Voltage (RV) type as specified and shown on the drawings.

.2 Each starter shall be provided with a control transformer, 600V, fused, primary connections phase to phase and 115V secondary shall be grounded on one (1) side and a suitable control circuit fuse provided on the other side. Control power transformers shall be adequately rated to carry continuously the control circuit burdens and intermittently, the inrush currents imposed by the contactor coil. One (1) side of coil shall be connected to the grounded side of the C.P.T. secondary. Each starter in addition to its holding contact shall be provided with two (2) normally open and two (2) normally closed auxiliary contacts for control and interlocking.

.3 The reduced voltage combination starters (auto transformer type) shall be provided with three (3) pole molded case circuit breaker having adjustable instantaneous magnetic trips properly related to motor Full Load (FL) current. Contactors shall be rated for repetitive operation over a prolonged period with minimum maintenance. All contactors used to control motors shall have a bimetallic or eutectic alloy isothermic overload relay in each phase, the element of which shall be correctly rated to the nameplate full load rating and service factor of the motor, and taking into account the reduction of FL current due to Power Factor (PF) correcting capacitors if used. The overload relay shall be temperature compensated with single phase protection over the complete load range of the motor. The external handle of all circuit breakers shall be interlocked with the door so that the handle must be in the “OFF” position before the door can be opened and shall have provision for padlocking.

.4 All starters shall be closed transition type and designed for front access. Each starter shall be provided with a cover mounted red indicating light which is visible with the door closed to indicate when the motor is running. Provide heavy duty oil tight pushbutton, or selector stations in the covers of those starters as indicated on the drawings. Each motor starter and unit compartment shall be provided with flange formed doors with concealed hinges, and large captive screws for fastening in closed position. Starters shall be capable of being removed from a section for maintenance without the need of disconnecting power to any or complete MCC. Motor starters of EEMAC size No. 5 and smaller shall be connected to vertical bus by means of “stab-on” connectors providing a positive tin-

plated contacts with both sides of the bus at all times and shall be easily removable from the unit compartment and readily interchangeable with other starters of same size. Means shall be provided in the stationary structure for supporting and aligning starter units during their removal or replacement.

.5 Each starter shall be provided complete with a contactor for power factor correction equipment.

.6 Provide all control wiring, interlocking, auxiliary contacts, timers, double voltage relays or Ontario Hydro Electrical Safety Code approved mylar barriers called for on the drawings or required for proper operation. Each terminal block shall be isolated to permit working on any section with MCC with the remainder of MCC energized. Terminal blocks and terminals shall be numbered and clearly identified.

2.5 CONTROL TRANSFORMER

.1 Single phase, dry type, control transformer with primary voltage as indicated and 120V secondary, complete with secondary fuse, installed in with starter as indicated.

.2 Size control transformer for control circuit load plus 50% spare capacity.

2.6 MOTOR MANAGEMENT RELAYS

.1 Provide motor management relay’s and remote RTD modules as shown on the drawings.

2.7 FINISHES

.1 Apply finishes to enclosure in accordance with Section 16010 – Electrical General Requirements.

2.8 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section 16010 – Electrical General Requirements.

.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.

3 EXECUTION

3.1 INSTALLATION

.1 Install starters, connect power and control as indicated.

.2 Ensure correct fuses and overload devices elements installed.

3.2 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 16010 – Electrical General Requirements and manufacturer's instructions.

.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

SECTION 16231
NATURAL GAS GENERATING UNITS (RADIATOR COOLED)

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SECTION 16231
NATURAL GAS GENERATING UNITS (RADIATOR COOLED)

1 GENERAL

1.1 GENERAL

.1 The intent of this Specification is to outline the Work required by the Supplier to provide a natural gas fuelled generator complete with all auxiliary systems.

.2 Provide an automatic, unattended, emergency power supply system consisting of:

.1 Radiator cooled jacket water and aftercooler circuits.

.2 Accessories and equipment specified in this Specification.

.3 Provide design, fabrication, testing, transportation, demonstration and warranty of the equipment.

.4 The generator set engine shall be certified by the Environmental Protection Agency (EPA) for stationary emergency and non emergency applications .

.5 Allowable combustion exhaust system backpressure to be 8.2kPa.

.6 The base of the generator shall be engineered and constructed from structural steel to support the engine and generator units. The base shall be heavy duty and suitable for installation on vibration isolators with zero deflection of the base.

.7 The generator must be capable of handling 25% light load capacitive reactive load current. Written confirmation of this capability must be provided at the time of shop drawing submission.

.8 The generator shall be a factory assembled and tested package inclusive of engine, generator and local engine control panel.

.1 Factory testing to be in the greater Toronto area. If more than 100kms from Hamilton, Ontario the Contractor shall be responsible for all costs associated with air travel, accommodation, car rental and meals for two representatives of the owner to attend the FAT.

.9 The Supplier shall provide all fuel required for FAT testing.

.9 The Supplier shall be responsible for obtaining TSSA inspection of the fuel system and combustion exhaust system. If there are any requirements for obtaining variances from the TSSA the Supplier shall be responsible for all associated costs.

.10 The combustion air intake damper to fail open in the event of a power outage.

1.2 RELATED SECTIONS

.1 Section 16010 – Electrical General Requirements

1.3 REFERENCES

.1 Comply with the latest edition of the applicable requirements of the following associations and institutes.

.1 Canadian Standards Association (CSA).

.2 Electrical Equipment Manufacturers' Association of Canada (EEMAC).

.3 National Electrical Manufacturers Association (NEMA).

.4 American National Standards Institute (ANSI).

.5 Institute of Electrical and Electronic Engineers (IEEE).

.6 American Society of Mechanical Engineers (ASME).

.7 ASTM International (ASTM).

.8 Society of Automotive Engineers (SAE).

.9 Canadian General Specifications Board (CGSB).

.10 International Standards Organization (ISO).

.11 Equipment shall meet the requirements of the Canadian Standard Association B149.1-10 (latest edition) Natural Gas & Propane Installation Code.

1.4 MEASUREMENT AND PAYMENT

.1 The Work outlined in this Section shall be included in the lump sum price for Section 16231 – Natural Gas Generating Units (Radiator Cooled) as indicated in the Bid Form.

1.5 DESIGN CRITERIA

.1 Design equipment suitable to meet the following criteria:

.1 Generator set minimum standby rating 125kW, 156kVA.

.2 Voltage: 600V.

.3 Frequency: 60 Hz.

.4 Phase/Wire: 3 Phase / 4 Wire

.5 Power factor: 0.8.

.6 Load harmonic content: 5% THD.

.7 Maximum rotational speed: 1800 rpm.

.8 Duty rating: Standby

.9 Performance: automatic.

.10 Elevation above sea level: 200 m ±.

.11 Ambient temperature: 40 degrees Celsius.

.12 Relative humidity: 60%.

.2 The unit must be designed to start and attain settled voltage and frequency limits and accept 100% rated load with voltage and frequency settling to steady state of 60Hz and 600V, all within 15 seconds for any temperature between 0 degrees Celsius to 40 degrees Celsius.

.3 Use the engine manufacturer's standard, published continuous (prime) horsepower rating in assessing engine capacity and de-rate this rating for the conditions specified in the Contract Documents and engine driven accessories in accordance with latest revisions of ISO 3046-1.

.4 Description of generating set operation:

.1 Automatic starting on abnormal or loss of normal voltage: voltage sensing relays shall sense all three phases of the hydro supply. If the voltage on any one phase should drop below preset limits (adjustable) for an adjustable period of time, the air intake combustion air damper shall activate from the fully closed position to the fully open position, then the engine start contact shall close and cause the engine to start.

.2 When the emergency supply has reached settled voltage and frequency preset limits (adjustable) the transfer switch will transfer the load to the emergency supply.

.3 The set will continue to supply the load until hydro supply returns or the set is shut down manually or under failure conditions.

.4 Upon restoration of the power supply, confirmed by three phase sensing of voltage above an adjustable preset, for a time period in excess of three minutes (adjustable), the transfer switch will transfer the load to the hydro supply. Provide a dead bus timer to allow motor starters to drop out and motors to stop prior to connecting to hydro.

.5 An adjustable time delay relay shall allow the engine to run unloaded to cool down and subsequently to shut down, ready for the next cycle. It is only when the engine has fully stopped that the intake combustion air damper shall return from the fully opened position to the fully closed position.

.6 The engine shall be equipped with a key switch with the following positions: auto-off-crank-start, key removable in auto position only.

.7 Automatic shut down on

.1 Over-cranking

.2 Over-speed

.3 High Engine Temperature

.4 Low lubricating oil pressure

.5 Over and under frequency

.6 Emergency breaker failure

.7 Electrical fault lock-out on short circuit and generator over and under voltage.

.5 Design, fabricate and assemble the equipment to provide electrical emergency power. This includes:

.1 Diesel engine directly connected to the generator, all mounted on a common base plate.

.2 Free standing control panel for the generator, all mounted on a common base plate.

.3 Ancillary equipment, inclusive of but not limited to, fuel oil tank, batteries, charger, exhaust muffler and exhaust insulation.

.6 Ensure that the components are suitably matched to operate with each other to provide satisfactory performance and long life, including the following components for the generator:

.1 Engine and speed governor.

.2 Engine and generator.

.3 Generator and voltage regulator.

.4 Engine safety and control devices rigidly mounted to prevent improper functioning of related equipment.

.5 Engine instruments isolated from vibrations with anti-vibration mountings.

.7 Ensure that the model and type of engine is of proven design for this class of service.

.1 Upon request, submit a list of approximately 12 recent installations in Canada, preferably in Ontario, where similar equipment has been in service for over two years, indicating engine model and type.

.8 Ensure that each generator set shall:

.1 Be of new material.

.2 Comprise components made in or stocked (over three units) in Canada and of current manufacture.

.3 Have components which are CSA approved where applicable and comply with the requirements of ESA.

1.6 QUALITY ASSURANCE

.1 All Work shall meet requirements of Quality Standard CSA Z299.3.

1.7 LOCATION OF PROJECT

.1 The location of the project is Hamilton, Ontario.

1.8 SHOP DRAWINGS

.1 Submit shop drawings plan and elevation views of the enclosure with overall and interconnection point dimensions, ventilation, fuel system, ventilation and combustion air, electrical wiring diagrams and all required building services.

.2 Submit shop drawings for review/approval by the Consultant.

.3 Shop drawings and specifications shall include, at a minimum, the following for the generator:

.1 Provide shop drawings of Engineering Submittal, stamped by PEO certified engineer, for approval, prior to production release. Drawings shall show all components, in addition to the engine and generator. Submittals shall include compliance with these specifications.

.2 Factory published specification sheet indicating standard and optional accessories, ratings, etc.

.3 Manufacturer's catalog cut sheets of all auxiliary components such as isolators, battery charger, silencer, exhaust flex, main circuit breaker, etc.

.4 Dimensional elevation and layout drawings of the generator set.

.5 Weights of all equipment

.6 Engine mechanical data at varying loads up to full load, including heat rejection, exhaust gas flows, combustion air and ventilation air flows, noise data, fuel consumption, etc.

.7 Generator electrical data including temperature and insulation data, cooling requirements, excitation ratings, voltage regulation, voltage regulator, efficiencies, waveform distortion and telephone influence factor.

.8 Generator resistances, reactance’s and time constants.

.9 Generator current decrement curve.

.10 Generator motor starting capability.

.11 Engine: Make, model, rating and performance curves.

.12 Local Engine Control Panel (LECP)

.13 Starter motor: Make and model.

.14 Generator: Make, model and rating complete with generator saturation curves, heat damage curves, reactive capability and special data.

.15 Control panel schematics.

.16 Emissions data (sound and environmental)

.17 Breaker specifications, including trip unit curves

.18 Voltage regulator: Make, model, type.

.19 Governor: Type and model.

.20 Battery: Make, type, voltage and capacity.

.21 Charger: Make, model, input and output rating.

.22 Submit a detailed technical drawing set of the complete assembly showing engine, radiator and generator mounting, exhaust, re-circulating and intake air louver arrangement, exhaust gas silencer and pipe arrangement, locations of fuel and lubricating oil filters, fuel supply and return line connections, lubricating oil drain valve, radiator and coolant drain valves, air cleaner, engine instrument panel, starting motor, power and control junction boxes, engine and generator mounting feet and the weather proof – explosion proof enclosure structure. Indicate on drawings horizontal and vertical dimensions, minimum door opening required for moving the unit, head room required for removal of piston and connecting rod, and weight of engine, generator, baseplate, radiator and exhaust silencer.

.23 Baseplate construction details and materials.

.24 Outline and layout of all panels.

.25 Schematic and wiring diagrams of engine, generator, control panel, automatic transfer isolation and bypass panels complete with interconnecting wiring diagrams.

.26 Single line diagram showing all breakers, switches, metering and protective relays.

.27 Field wiring diagrams.

.28 Complete bill of materials, including manufacturer's name, catalogue numbers and capacity.

.4 Express all dimensions and data in metric units and symbols followed by imperial units and symbols in brackets, wherever applicable in accordance with CSA Z234.1, Metric Practice Guide.

.5 Device Numbering System shall be in accordance with IEEE 200 Metric Practice and Graphic Symbols and Designations used in Technical Documentations.

1.9 FINAL SHOP DRAWING BINDERS

.1 Submit shop drawings for review/approval by the Consultant.

.2 Shop drawings and specifications shall include, at a minimum, the following for the generator:

.1 Engine: Make, model, rating and performance curves.

.2 Local Engine Control Panel - LECP

.3 Starter motor: Make and model.

.4 Generator: Make, model and rating complete with generator saturation curves, heat damage curves, reactive capability and special data.

.5 Voltage regulator: Make, model and type.

.6 Governor: Type and model.

.7 Battery: Make, type, voltage and capacity.

.8 Charger: Make, model, input and output rating.

.9 Submit a detailed technical drawing set of the complete assembly showing engine, radiator and generator mounting, exhaust, re-circulating and intake air louver arrangement, exhaust gas silencer and pipe arrangement, locations of fuel and lubricating oil filters, fuel supply and return line connections, lubricating oil drain valve, radiator and coolant drain valves, air cleaner, engine instrument panel, starting motor, power and control junction boxes, engine and generator mounting feet and the weather proof enclosure structure. Indicate on drawings horizontal and vertical dimensions, minimum door opening required for moving the unit, head room required for removal of piston and connecting rod, and weight of engine, generator, baseplate, radiator and exhaust silencer.

.10 Baseplate construction details and materials.

.11 Outline and layout of all panels.

.12 Schematic and wiring diagrams of engine, generator, LECP, AC & DC systems inclusive of interconnection diagrams.

.13 Single line diagram showing all breakers, switches, metering and protective relays.

.14 Field wiring diagrams.

.15 Complete bill of materials, including manufacturer's name, catalogue numbers and capacity.

.16 Submit all shop drawings electronically in PDF format.

.3 Express all dimensions and data in metric units and symbols followed by imperial units and symbols in brackets, wherever applicable, in accordance with CSA Z234.1, Metric Practice Guide.

.4 Device Numbering System shall be in accordance with IEEE 200 Metric Practice and Graphic Symbols and Designations used in Technical Documentation.

1.10 MAINTENANCE DATA AND INSTRUCTION MANUALS

.1 Provide three (3) paper copies and one (1) digital copy of owner’s manuals specific to the product supplied must accompany delivery of the equipment. General operating instructions, preventive maintenance, wiring diagrams, schematics and parts exploded views specific to this model must be included.

.2 Provide, at a minimum, the following in for incorporation into instruction manuals for the generator:

.1 Factory test data of engine, generator, exciter, control logic, metering and all other pertinent test data.

.2 Maintenance and operation bulletins for:

.1 Engine and Accessories

.2 Generator

.3 Voltage Regulator and Accessories

.4 Exciter

.5 Permanent magnet generator if installed

.6 Battery charger

.7 Speed Governor

.8 Starting Motor

.9 Batteries

.10 Ventilating Equipment

.11 Timers, Relays, Meters

.12 Power Circuit Breakers

.13 Controller, Contactors

.14 Enclosure

.15 Other Accessories

.3 If brochures are submitted, these shall be originals; photocopies are not acceptable. Brochures shall contain all technically relevant data.

.4 Complete sequence of system operation.

.5 Complete bill of materials including nameplate data of equipment and accessories.

.3 Provide within 10 Working Days prior to the factory tests, one copy of instruction manual for the unit to the Consultant.

.4 Provide within 10 Working Days after the factory tests, three copies of instruction manuals, with updated drawings, for the unit to the Consultant. Submit one set of sepias along with the manuals.

.5 Crate the unit, with updated drawings, plus one extra loose set of drawings all in protective cover and one instruction manual.

.6 Bind in 25cm x 30cm, vinyl hard covered, 3 D ring loose leaf binders.

.7 Enclose a title sheet, project name, date and list of contents.

1.11 DELIVERY, STORAGE AND HANDLING

.1 Arrange for delivery of equipment to the Site inclusive of any special provisions to facilitate transportation. Arrange for suitable equipment to offload equipment.

.2 Protect equipment from dirt and moisture

2 PRODUCTS

2.1 GAS ENGINE

.1 The prime mover shall be a liquid cooled, natural gas, internal combustion engine. It will have a minimum displacement of DISPLACEMENT liters. The engine will utilize in-cylinder combustion technology, as required, to meet the latest applicable US-EPA NSPS rule for stationary reciprocating Spark-ignition engines as tested in accordance with ISO 8178.

.2 The engine fuel system shall be designed for primary operation on natural gas having a calorific content of 1000 BTU (high heat value – HHV)per cubic foot delivered to the unit in a vapor state. A carburetor, secondary regulator, fuel lock-off solenoid and all piping must be installed at the point of manufacturing, terminating at a single pipe opening external to the mounting base.

.3 The fuel gas train (FGT), shipped loose for field installation at site, will be part of the generatorset vendor's scope of supply. It shall be designed to operate on 10 PSI (69 kPA) natural gas pressure. The sizing of FGT shall be designed by the generator set vendor in consideration of the generator set maximum and minimum recommended fuel inlet pressures taking into account the fuel gas piping restriction from the NG utility metering station. Furthermore consideration must be given to delivering the necessary fuel gas flow in order to minimize the generator set's transient response. The entire fuel gas train shall be designed in accordance with CSA Code 149 (latest version) and be complete with a floor mounting stand. The FGT shall include alarm and shutdown pressure switches wired to a terminal strip mounted NEMA 4 steel terminal box for ease of field installation. In addition to the components specified in CSA B149 the FGT shall incorporate a pilot controlled gas pressure regulator, gas filter, and isolation valves suitably positioned to permit easy inspection, testing, and maintenance of the FGT. The complete FGT and related piping and components shall be preassembled and pressure tested by certified gas fitters and shall be painted in accordance CSA colour code and provide appropriate adherence to the FGT materials used. The entire fuel piping system, including the FGT, will be subject to TSSA field inspection for code compliance.

.4 The engine is to be water cooled with heat exchangers using city water

.5 The intake air filter(s) with replaceable element must be mounted on the unit

.6 Generator set to be equipped with fuel shutoff solenoid, secondary fuel regulator, braided flex for supply (terminated at base rails).

.7 Operating fuel pressure must be between 11in. H20 to 14in. H20 (0.397 to 0.505 psi)

.8 Full pressure lubrication shall be supplied by a positive displacement lube oil pump. The engine shall have a replaceable oil filter(s) with internal bypass and replaceable element(s).

.9 Sensing elements to be located on the engine for:

- Low oil pressure alarm/shutdown
- High coolant temperature alarm/shutdown
- Low coolant level shutdown
- Overspeed shutdown
- Overcrank shutdown
- Emergency stop shutdown
- Low coolant temperature alarm
- Low battery voltage alarm
- High battery voltage alarm
- Control switch not in auto alarm
- Battery charger failure alarm
- Low fuel gas pressure
- High fuel gas pressure

.10 These sensors are to be connected to the control panel using a wiring harness, each connector to be sealed to prevent corrosion and all wiring to be run in flexible conduit for protection from the environment and any moving objects.

.11 Engine speed shall be controlled by isochronous governor, regulated during steady state operation to +/- 0.9Hz.

.12 The generator set shall be capable of accepting a single-step block load applied instantly of 50% of nameplate rating and recover to stead-state conditions within 30 seconds. For units with nameplate ratings above

300kW, generator set shall be capable of accepting a block load of 30% of nameplate rating.

.13 The following equipment is to be provided by the engine-generator set manufacturer and shipped loose with the unit:

- Silencer
- Silencer flex coupling
- Battery charger
- Vibration isolators
- Natural Gas Fuel Train

2.2 MOUNTING

.1 Connect engine flywheel housing rigidly to generator stator housing with SAE adapter meeting requirements of SAE J 617. Mount unit on a common, heavy duty fabricated steel baseplate. Design of, and materials comprising the baseplate must be approved by engine manufacturer and the Consultant.

.2 Baseplate shall be of sufficient rigidity to maintain alignment of engine-generator shafts and frames under all conditions incident to shipping, installation and service.

.3 Machine engine-generator feet and baseplate sole plates parallel and true. Shimming shall be steel type and only permitted underneath the generator feet.

.4 Support baseplate on spring type isolating fixtures from welded side brackets located in such a manner that bottom of baseplate will be approximately 25mm above supporting floor. Isolators shall have cast iron housings and shall be complete with levelling bolts, adjustable oil proof snubbers and sound pads which are a minimum of 6 mm thick. Isolation efficiency shall be not less than 95%.

.5 Determine quantity and location of isolators in such a manner that each isolator will carry equal proportion of weight and to ensure that the pressure exerted on the floor by each isolator does not exceed 345 kPa.

.6 Isolators shall be shipped loose for installation at the Site.

2.3 FLUIDS

.1 Engine Jacket Water

.1 The Supplier shall supply all necessary Ethylene Glycol/Water at a 50/50 concentration by volume until equipment is commissioned.

.2 Engine Jacket Water Coolant

.1 Long life ethylene glycol including additives.

.2 Shop drawings must be submitted for approval by the Consultant.

.3 Ethylene Glycol to be heavy duty suitable for use with the engine comprising the generator set ("generator") package.

2.4 LUBRICATION SYSTEM

.1 Provide a full pressure lubricating system complete with duplex filters and oil cooler.

.2 Oil pump shall be engine driven gear type complete with strainer.

.3 Equip filters with automatic by-pass valve and full flow filter elements conveniently located for servicing and directly replaceable with elements of a Canadian manufacture. Cooler to have sufficient capacity to maintain oil temperature within 93°C with unit operating at rated load under conditions specified in the Contract Documents.

.4 Equip engine oil sump with oil drain pipe, gate valve and pipe cap. Permit complete drainage in a convenient manner. Extend 75mm beyond base plate.

.5 Operational requirements are such that unit may lay idle for periods up to one month and then be required to start and assume full rated load within the specified (15 seconds) time period. To protect service life of engine components, provide an electrical motor driven, integrally mounted, gear type oil priming pump with interval timer and breaker type combination starter. The starter shall be mounted in the control panel. Provide a lubrication oil pressure switch to stop priming pump when engine is running. Where pump is not being provided, submit a letter certifying that oil pump is not required for these conditions and will not detract from the service life of engine components.

.6 All metallic oil hoses shall be of the steel reinforced rubber type with crimped or swaged end fittings.

.7 The first on Site replacement of lubricating oil shall be shipped loose in containers. Upon completion of commissioning, engine oil shall be replaced by the Supplier. Used oil shall be disposed by the Supplier at its own expense.

2.5 EXHAUST SYSTEM

.1 Provide a complete exhaust system including combustion exhaust silencer with condensate drain, plug and flanged couplings; stainless steel, corrugated expansion joints, of suitable length, to absorb both vertical and horizontal expansion; all flanges, bolts, gaskets, adjustable hangers complete with rollers and isolation springs, as well as pipe and pipe-thimble to permit projection of pipe 1.0 m beyond wall. Exhaust tail pipe end to be cut at 45 degree angle and terminate in bird screen. All interior exhaust piping and silencer shall be insulated.

.2 Arrange exhaust system to suit openings. Where schedule of dimensions does not indicate location of opening, arrange exhaust run best suited to the engine.

.3 Provide exhaust pyrometers located on common exhaust manifold or two pyrometers on separate manifolds. Pyrometer range shall include temperature at 110% load.

.4 Exhaust piping shall be VAN PACKER Minimum size of piping 150mm. Refer to Drawings

.5 All pipe connectors shall be Vanstone-type flanges with 57 kg to 68 kg backing rings and 143°C gaskets.

.6 Inside piping shall be securely supported from the ceiling. Hanger bolts shall be positively locked to prevent piping from coming loose through vibration and creating load on the turbocharger.

.7 Flexible connection at engine.

.1 Exhaust flexible connection, T321 stainless steel, bellows type 600mm length, ANSI flanges for connecting to the exhaust manifold.

.2 Approved Suppliers:

.1 Senior Flexonics Canada Ltd .

.2 Silex Innovations Inc.

.3 Approved equal

.8 Exhaust silencer:

.1 One (1) silencer shall be provided per engine to attenuate both high and low frequency noise.

.2 Silencer shall be rated for 510°C temperatures.

.3 Silencer shall be provided with flanges and port orientation as shown on Contract Drawings.

.4 Silencer No. 1

.1 Providing attenuation of 45 dBA to 55 dBA across the audible range of a frequency spectrum of 63 HZ to 6000 HZ.

.2 Silencer shall be constructed of stainless plate steel and shall be of a welded design.

.3 Provide a 12mm drain piped to a discharge point using copper tubing. Tubing to be terminated with a ball valve as directed by the Consultant.

.4 Finish: 510°C high temperature aluminum paint.

.5 Acceptable Suppliers:

.1 Silex Innovations Inc.

.2 Approved equal

.9 Insulation

.1 Firwin insulating blankets

.2 Approved Suppliers:

.1 Firwin Corporation

.2 Approved equal

.10 Roof sleeve

.1 Roof sleeve to be ULC listed for exhaust pipe transition through building wall construction being used.

.2 Acceptable Suppliers:

.1 Silex Innovations Inc.

.2 Approved equal

2.6 JACKET COOLANT HEATER

.1 Provide engine jacket coolant heaters complete with 20°C to 60°C adjustable immersion type thermostat. Size heaters to maintain coolant at 40°C in an ambient temperature of 0°C.

.2 Obtain circulation of heated coolant on thermosyphon principle. However, if this does not provide sufficient circulation to avoid hot spots in the system, provide electrical motor driven circulating pump to operate automatically when heater is energized. Each motor shall be 120V single phase splash-proof type complete with breaker type combination starter. Starter shall be installed in a wall-mounted enclosure mounted in the control panel.

.3 Heater and aquastat shall be Kim Hotstart Industrial Equipment Company Ltd or an approved equivalent.

2.7 SPEED GOVERNOR

.1 Provide full electronic governor with speed changer and dry type actuator. Governing system shall be in accordance with ISO 3046-4.

.2 Governor shall provide the following features:

.1 Ten turn locking type manual speed adjustment.

.2 Speed regulation, steady state, no-load to full load and vice versa: □0.25%.

.3 Transient peak, no-load to full-load and vice versa □10%.

.4 Recovery time to steady state condition on application of full load from no load not to exceed 3 seconds.

.5 Frequency shall be externally adjustable from zero to 5% while engine is running.

.6 Class A accuracy.

2.8 STARTING SYSTEM

.1 For the generator, provide a complete starting system, 24V DC, including cranking starting motor(s), batteries, battery stand, heavy-duty battery cables and battery charger.

.2 Provide positive engaging type cranking motors. Cranking motors and flywheel ring gear arrangements which may permit tooth to tooth abutment are not acceptable.

.3 Provide lead acid battery, type 8D with sufficient capacity in an ambient room temperature of 0 degrees Celsius to crank the unit at engine manufacturer's recommended cranking starting speed for a period of 3 minutes. Voltage measured at starting motor terminals at end of 3 minutes cranking, with cranking current flowing, shall be a minimum of 1.75 V per cell. Size battery on the basis of engine and battery manufacturer's published data. Batteries to be dry charged, specific gravity of electrolyte 1.22 when fully charged at 27ºC. Battery termination shall be bolt-on or study type. Terminals and all exposed electrical connections shall be protected from accidental short circuit by falling conductive objects on the battery. Such protection shall be transparent.

.4 Provide battery stand coated with acid resistant paint and fabricated from angle irons with 20mm plywood bottom and heavy duty casters for ease of movement.

.5 Provide battery charger with 120 volt AC input and output equal to 1.20 times the ampere-hour capacity of the battery based on an 8 hour rate. Output voltage ripple shall be 3% or less. Provide an AC input circuit breaker and a 24 hour terminating equalizer timer with approximately 4 m of connecting cord and permanent connectors for connecting to battery terminals. Provide 5 spare fuses inside charger panel. Charger to be CSA approved.

.6 Provide all necessary heavy duty, maintenance-free battery cables and connectors. Select cable wire size on the basis of allowing a maximum of 5% voltage drop at time of peak load. Cable length to be sufficient to allow battery to be located on either side of the engine.

2.9 GENERATOR

.1 Provide generator, drip proof, single bearing and close coupled to engine with SAE housing. Generator to have a full amortisseur winding, direct connected brushless exciter with easily removable bolt-on diodes with surge protection, and meet or exceed EEMAC MG1-22 and current IEEE Standards.

.2 Maximum deviation of open circuit terminal voltage waveform not to exceed 5%.

.3 Provide permanent magnet generator (PMG) for generator short circuit sustaining capability of a minimum of 2.4 times rated current.

.4 Generator winding insulation shall be Class F; winding temperature rise not to exceed 105°C as measured by resistance in an ambient temperature of 40°C.

.5 Identify generator windings with metal tags. Bring windings to insulated terminals in a metal junction box mounted on the side or top of generator. Size junction box to permit mounting of engine and generator low voltage controls and wiring terminals blocks. Provide barrier in junction box to separate low and high voltage wiring.

.6 Design equipment to minimize radio frequency interference (RFI) under all operating conditions. Balanced telephone influence factor (TIF) to meet or better requirements of EEMAC Standard MG1-22.43.

.7 600V, 3 phase, 60 HZ, 1800 RPM.

.8 Acceptable manufacturers

.1 Caterpillar Inc. – Century Alternator

.2 Cummins Inc. – Stamford Alternator

.3 Marathon

2.10 VOLTAGE REGULATOR

.1 Provide a voltage regulation system complete with auto/manual control module. Voltage regulator shall be capable of withstanding continuous vibration, 15 shock and temperatures of up to 50°C while maintaining accuracy to plus/minus 1%.

.2 Steady-state voltage regulation shall not exceed 1%. Transient voltage regulation, when full load is applied or removed, not to exceed 10% when measured by oscilloscope or high speed strip chart recorder with recovery time to steady-state less than 3 seconds.

.3 The automatic voltage regulator shall be a Basler Electric Company, SSR63-12 AVR or approved equal.

.4 AVR shall have the following features:

.1 Regulation: ± 1.0%, steady state, NL to FL.

.2 Sensing: three phase, 600 V AC, 60 Hz.

.3 External voltage adjust range: ±10% of nominal voltage.

.4 Built in EMI interface suppression and built in under frequency control for 60 Hz operation.

.1 Under frequency roll off which shall reduce output voltage in proportion to frequency below a threshold of 54 Hz.

.5 Operating Temperature: -40°C to 60°C.

.6 AVR to be located in control cubicle.

.1 NOTE: If additional field resistance is required, locate resistor in switchgear/control cubicle.

.7 Recovery time from load change to steady state regulation shall be better than two (2) seconds for the following.

.1 NL to 25% load

.2 NL to 50% load

.3 NL to 75% load

.4 NL to 100% load

2.11 PANEL - GENERAL

.1 Panel shall be microprocessor based and genset mounted.

.2 Design and construct panel to withstand strains, jars, vibrations and other conditions incident to shipping, storage, installation and service.

.3 Panel to be CSA certified. Mount a nameplate bearing CSA monogram in a prominent position on panel.

.4 Identify all instruments and controls with lamacoid or metal engraved nameplates fastened by rivets or screws for permanent identification. All items mounted on door shall also be identified with nameplates. Nameplates shall not be attached to removable items such as relays and wire way covers.

.5 Factory wire panel completely. Use stranded, minimum No. 14 AWG, TEW 105°C and coloured for control wiring. Use No. 10 AWG for CT secondary connections:

.1 Blue - DC control.

.2 Red - AC control.

.3 Black - PT secondary connections.

.4 Orange - CT secondary connections.

.5 Green - non-current carrying ground.

.6 White - current carrying ground.

.7 Yellow - interlocks.

.8 Brown - generator excitation system.

.6 Code wiring at each wire end with permanent, non-aging slip on markers. Support and run wiring neatly. Protect wiring from mechanical damage by grommets and shields.

.7 Terminal blocks to be coded, clamp type, serrated for positive grip and of tough, non-brittle, unbreakable nylon, size 3,453/0 or equivalent. For current transformer secondary circuits, provide terminals blocks of dual connector type, Electrovert 9060 by Speedline Technologies Inc. or approved equal. Provide test block for current transformer secondary connections.

.8 Provide door detent mechanism to maintain hinged door at the open position.

.9 Supply loose 2 sets of wiring markers for each external wiring connection. Markers shall be contained in a plastic bag and secured inside the panel.

.10 Use wiring duct for interconnection within panel.

.11 Direct inter-panel connection not permitted, use terminal blocks.

2.12 CONTROL PANEL

.1 Provide a control panel for controlling engine generator unit.

.2 Provide hinged front door.

.3 Electrical connection of components to be as shown in solid lines on the shop drawings.

.4 Mount terminal blocks on common mounting strips for interconnection wiring between the following:

.1 Sub-panel and panel door.

.2 Sub-panel and external wiring from diesel generator unit circuits.

.3 Sub-panel and external indicating circuits.

.4 Sub-panel and secondary circuits of power sub-cubicle.

.5 Sub-panel and external wiring from power transfer panel.

.5 Provide a 1cm x 4cm horizontal copper ground bus for the whole length of the enclosure, and two ground lugs; one at each end. The lug shall be capable of accepting grounding conductor of range from No. 8 to No. 2/0 AWG.

.6 Terminal blocks to be CSA approved, clamp type, serrated for positive grip and of tough, non-brittle unbreakable nylon material. Provide a maximum of two wires per terminal block. Use factory made terminal block jumpers wherever necessary.

.7 Provide circuit breakers for equipment protection: fuses shall only be used where breakers are not applicable.

.8 Provide top and bottom entry for power and control cables. Bottom plate shall be removable and sized 0.45m by 0.15m.

2.13 COMBUSTION AIR DAMPER

.1 The combustion air damper to fail open in the event of a power failure.

.2 The combustion air damper actuator to have limit switch for monitoring damper position for open and closed status.

2.14 ENGINE/GENERATOR CONTROLLER

.1 The engine generator controller shall be microprocessor based and shall contain the following basic features: automatic and manual start/stop control modes, monitoring and control of essential engine generator set parameters and automatic shutdown and/or alarm status of specified protection fault circuits. The automatic operation mode shall have provisions for accepting an automatic starting/stopping signal from a remote device. Alarm and shutdown fault circuits provided shall meet CSA 282, Ontario Building Code standards and NFPA 110 level 1 regulatory standards. The following alarm and shutdown fault circuits shall be provided at a minimum:

.1 Low oil pressure shutdown

.2 High engine temperature shutdown

.3 Low coolant level shutdown

.4 Low fuel level alarm

.5 Overcrank shutdown

.6 Overspeed shutdown

.7 Loss of speed shutdown

.8 Low battery voltage alarm

.9 High battery voltage alarm

.10 Weak battery alarm

.11 Low oil pressure alarm

.12 High engine temperature alarm

.13 Low engine temperature alarm

.14 Reverse power shutdown

.15 Under-voltage shutdown

.16 Overvoltage shutdown

.17 Under-frequency shutdown

.18 Over-frequency shutdown

.19 Breaker tripped shutdown

.20 Fail to sync alarm

.21 Emergency stop shutdown

.22 Switch not in auto alarm

.23 Spare shutdown

.24 Spare shutdown

.2 Individual contacts shall be provided for each alarm/shutdown fault circuit. Contacts shall be user configurable for open or close upon initiation of the fault. Fault contacts shall be factory configured for “close on fail”. Contacts shall be rated 0.5A AC 120V AC, 1.0A DC, 30V DC resistive, maximum.

.3 The microprocessor based engine generator controller shall include a security password system for access to all programming functions. Specific password levels shall be provided for “read only”, “read/write” and “master”. All programming set points for voltage, frequency and time delays shall be software programmable from the front panel mounted keypad, and all parameters shall be displayed in alpha numeric format.

.4 The microprocessor based engine generator controller shall include an operator interface, liquid crystal display (LCD) screen which is door mounted. The following parameters shall be displayable:

.1 Generator AC digital metering (3 phase V, A, F)

.2 Timer countdown display

.3 Operating status /switch position

.4 Alarm/Shutdown fault display

.5 Engine Hour meter

.6 Engine Oil Pressure (kPa)

.7 Engine Coolant Temperature (°C)

.8 Engine RPM (Tachometer)

.9 Battery Voltage

.5 Generator AC digital metering shall be integral to the engine generator controller and the Multifunction Generator Protection relay (they shall have an accuracy of +/-1%). The digital metering shall be fully programmable from the front panel display. Programming for voltage and current PT/CT ratios and software calibration shall be provided for all input ranges. The following generator output AC parameters shall be monitored and displayed:

.1 AC Voltage -3 phase (line to line and average)

.2 AC Current -3 phase (individual phases and average)

.3 AC frequency (resolution to 0.1 Hz)

.6 Digital display of engine parameters shall be provided by the engine generator controller. Engine oil pressure and engine temperature shall be monitored and shall be displayed in metric or imperial engineering units. Oil pressure and temperature senders shall be supplied for mounting on the engine generator set.

.7 Long life LED type pilot lights shall be provided on the engine generator controller to indicate general operating conditions as follows:

.1 Common Alarm (Flashing-Amber)

.2 Common Shutdown (Flashing-Red)

.3 System Ready (Green)

.4 Speed Signal Present (Green)

.8 The engine generator controller shall contain the following protective functions utilizing analog input signals:

.1 (27/59) Three phase under/over voltage protection shall be provided for the engine generator. The under/over voltage protection function shall be programmable as follows:

.1 under voltage pick-up 70-100% of nominal, factory set at 90%.

.2 under voltage dropout 70-100% of nominal, factory set at 80%.

.3 under voltage delay 0 - 10 seconds, factory set at 3 seconds.

.4 over voltage pick-up 100-130% of nominal, factory set at 110%.

.5 over voltage dropout 100-130% of nominal, factory set at 108%.

.6 over voltage delay 0 - 10 seconds, factory set at 2 seconds.

.2 (81 O/U) Over/under frequency protection shall be provided for the engine generator. The over/under frequency protection function shall be programmable as follows:

.1 under frequency set point 70-100% of nominal, factory set at 90%.

.2 under frequency delay 0 - 10 seconds, factory set at 5 seconds.

.3 over frequency set point 100-130% of nominal, factory set at 110%.

.4 over frequency delay 0 - 10 seconds, factory set at 2 seconds.

.3 (51) Three phase over current alarm protection shall be provided for the engine generator. The over current protection function shall be programmable as follows:

.1 over current set point 100-150% of nominal, factory set at 110%.

.2 over current delay 0 - 10 seconds, factory set at 5 seconds.

.4 Low/High battery voltage protection shall be provided for the control system. The protection function shall be programmable as follows:

.1 Low battery voltage set point 50-100% of nominal, factory set at 12.8V DC (12V DC systems) or 25.6V DC (24V DC systems).

.2 Low battery voltage delay 0-300 seconds, factory set at 120 seconds.

.3 High battery voltage set point 100-130% of nominal, factory set at 15.2V DC (12V DC systems); 30.4V DC (24V DC systems).

.4 High battery voltage delay 0-300 seconds, factory set at 10 seconds.

.5 Weak battery sensing shall be provided to detect a low capacity engine starting battery system. This function shall be programmable as follows:

.1 Weak battery set point 50-100% of nominal, factory set at 8.0V DC (12V DC systems) 18.0V DC (24V DC systems).

.2 Weak battery transient delay 0-300 seconds, factory set at 3 seconds.

.9 Diagnostic LED's shall be provided on the rear of engine generator control module to allow simple visual indication of operating status or mode. Individual LED's shall be provided for the following functions:

.1 Watchdog (Central Processing Unit (CPU) running)

.2 Remote start signal activated

.3 Crank output energized

.4 Run output energized

.5 Common fail alarm activated

.10 The engine generator controller shall have an audible alarm feature to signal shutdown and alarm conditions.

.11 The engine generator controller shall include the following operator control functions:

.1 Operation Mode (Auto/Off/Manual/Load Test)

.2 Programming (Enter/Exit/Value Increment/Decrement)

.3 Lamp Test

.4 Fault Reset

.5 Alarm Horn Silence

.6 Emergency Stop

.12 The engine generator controller shall provide cycle cranking control logic with programmable number of crank attempts (Adjustable 1-99, factory set at 3 attempts) crank period time (Adj. 0-99 sec., factory set at 15 sec) and rest period time (Adj. 0-99 sec., factory set at 10 sec.).

.13 Engine control logic shall include the following sensing and protection circuits:

.1 Loss of speed signal sensing shutdown

.2 Starter re-engage sensing control (to re-engage starter motor upon initial failure to engage).

.3 Run output fail safe selection (to prevent engine starting if speed signal is not present).

.14 Programmable output function contacts shall be provided by the engine generator controller. Contacts shall be type Form C, rated 10A, 240V AC, 30V DC resistive, maximum. The following programmable output control functions shall be available for specific system applications:

.1 Energize to stop

.2 Over current

.3 Cycle lube

.4 Engine run

.5 System ready

.6 Oil bypass delay expired

.7 Air flap

.8 Common fail

.9 Preheat

.10 Common alarm

.11 ATS test

.12 Switch not in auto

.13 Common shutdown

.15 A time delay on engine start shall be provided to delay the engine start signal. The time delay shall be programmable 0 - 60 seconds, factory set at 2 seconds

.16 A time delay for engine cool-down shall be provided which delays engine stopping. The time delay shall be programmable 0 - 30 minutes, factory set at 5 minutes.

.17 The engine generator controller shall provide a lamp test function to test all LED lights and the LCD display.

.18 The engine generator controller shall have the ability for remote communication of all status points (alarms, shutdowns, switch position) and all measured analog values. Remote control and configuration of all switch functions and setups shall be supported. Communication shall be via RS422/485 port located on the engine generator controllers. The RS422/485 shall allow all engine controllers to be interconnected together to form a common communication link. A common communication module shall be provided which shall provide communication to all connected engine controllers. The communication module shall support Modbus for connection into the City's SCADA system.

.19 AC Metering

.1 Analog metering shall be provided to monitor the output of each engine generator. Metering shall be 100mm, 250 degree movement with 1% accuracy and scaled to suit the specific application. The following meter types shall be provided:

.1 AC voltmeter c/w phase selector switch (line to line)

.2 AC ammeter c/w phase selector switch

.3 Frequency meter

.4 Kilowatt meter

.5 Power factor meter

.2 Potential and current metering transformers shall be provided of adequate burden and thermal ratings to meet the specified metering accuracy. Potential transformers shall be provided with primary side fusing of adequate rating.

2.15 ENGINE WIRING AND TERMINAL BOX

.1 Provide heat and oil resistant wire from the safety switches and control devices. Run the wire neatly in a harness, secure to the engine and terminate at the engine terminal box.

.2 Provide a CSA enclosure 5 for the engine terminal box with a numbered terminal strip to correspond with the schematic diagram. Provide a separate junction box for the 120V and 24V DC circuits.

2.16 ENGINE GAUGES

.1 Provide the following engine gauges.

.1 Lube oil pressure gauge.

.2 Lube oil temperature gauge.

.3 Jacket water temperature gauge.

.4 Pyrometer (Dual scale for V type Engines)

2.17 TOOLS

.1 Supply suitable engine barring devices and the battery manufacturer's standard set of tools for battery service. Battery service tools shall include as a minimum, hydrometer, one plastic bottle for topping up purposes and one insulated battery terminal wrench.

.2 Provide a complete set of specialized tools required for the proper care, adjustment and maintenance of the equipment supplied.

2.18 SIGNS

.1 Provide at the front top of each panel and on each generator junction box, a lamicoid or metal engraved identification nameplate.

2.19 FINISHING AND PAINTING

.1 Properly clean, finish and paint equipment with a smooth and durable finish. Use grey gloss 501.108 except on the inside of the panel which shall be painted with white gloss 513-101 in accordance with CGSB 1-GP-12c schedule of paint colours.

.2 Provide one half pint can of grey gloss 501.108 paint.

.3 Paint the complete equipment, except for the finished and machined parts and also the special items listed below:

.1 One coat of primer, red lead, iron oxide, oil alkyd, heat resistant 0.04mm - 0.05mm dry.

.2 One top coat of enamel, light equipment grey, alkyd gloss, heat resistant, 0.05mm - 0.08mm minimum.

.3 Protect data labels on all equipment while painting and ensure that all labels are legible.

.4 Coat liberally, all finished and machined parts with petroleum or wax based, temporary protective coating.

.5 Paint protective guards on the set red.

.6 Finish the control panel white on the inside and light gray on the outside unless otherwise noted on the Contract Drawings.

.7 Finish the exhaust silencer and flexible connector with aluminum silicone alkyd paint, heat resistant to approximately 650°C.

2.20 WORKMANSHIP

.1 Manufacture and construct the equipment with new materials, and comply with the applicable codes and standards including those specified in subsection 1.3 above.

.2 Ensure that the Work is free from blemishes, defects, burrs and sharp edges; ensure the accuracy of dimensions and marking of parts and assemblies; ensure the thoroughness of welding, brazing, painting and wiring, alignment of parts and tightness of assembly screws and bolts.

2.21 CRANKCASE VENTILATION SYSTEM

.1 Provide a manufacturer’s recommended crankcase ventilation system which allows crankcase fumes to be returned to the engine air intake. System to be mounted on or near the engine base at bottom of the generator. Do not mount on top of engine.

.2 Provide all required fastening and hoses for a complete system

.3 For vee type engines two filter banks are required.

.4 Approved product

.1 Nelson Industries Inc. - Ecovent Recirculator

.2 Approved equal

2.22 ACCEPTABLE GENERATOR VENDORS

.1 Kohler

.2 Toromont

.3 Cummins

3 EXECUTION

3.1 INSTALLATION

.1 Provide all necessary labour, equipment, tools, supports, etc., for a complete installation.

.3 The Contractor shall install the complete electrical generating system including all fuel connections in accordance with the manufacturer's recommendations as reviewed by the Engineer.

.4 Contractor shall supply and install anchors for the engine/generator base in the pad and connect to isolating devices on base.

.5 Batteries shall be filled with electrolyte, charged and connected.

.6 Contractor shall supply and install interconnecting wiring between engine/generator, transfer switch, dampers and other equipment.

.7 Contractor shall provide 120V, 1 Phase normal power connection to all accessories. Use a separate suitably sized branch circuit for each separate component. Label load centre accordingly.

3.2 PACKING

.1 Protect the equipment against corrosion, dampness, heavy rain, etc. Also, provide adequate protection against damage or loss of components from the time the equipment leaves the manufacturer's factory until it has been accepted by the MOE. Ensure that the packing meets the requirements of,

and is otherwise acceptable to, the companies responsible for transporting the equipment.

.2 Include heavy duty plastic sheet or bags to cover components which may be vulnerable to construction dust. Tag this packing sufficiently in order to allow for this protection to be left in place (where practical) until construction and clean up is complete.

.3 Arrange each engine for shipment and ensure that each engine is suitably tagged with warning labels.

.1 Tag the engine sump to indicate that the lube oil to be replaced at commissioning.

.2 Tag the radiator, etc., to indicate that the coolant includes antifreeze.

.4 Provide in each manual, a complete inventory of all spare parts, tools and accessories, a copy to accompany the shipment and a copy forwarded to the Consultant.

.5 Do not ship the equipment from the plant except with the prior written consent of the Consultant and the MOE.

.6 Arrange the shipment on the transport in order to facilitate off-loading by the Contractor's crane or skids at the Site.

.7 Provide instructions for care of the equipment and spares while in storage.

3.3 WARRANTY

.1 Provide a written warranty (for complete parts and labour and all incidental charges including overhead and profit) signed and issued in the name of the MOE stating that the complete assembly consisting of the diesel generator unit and all equipment and accessories is guaranteed against defects and malfunction for a period of 24 months from the date of Substantial Performance of the Work.

3.4 SPARES

.1 For panels provide the following:

.1 One spare control circuit breaker per rating.

.2 Twenty four spare indicating light bulbs per rating.

.3 One spare control relay and socket per rating and contact arrangement.

.4 One spare contactor operating coil.

.2 Provide for the generator unit, a standard set of engine manufacturer's spare parts for one year of normal operation of 1000 operating hours. Spares shall include as a minimum.

.1 Six fuel filter elements for each type of fuel filter/water separator.

.2 Six lubricating oil filter elements.

.3 Three air cleaner elements.

.4 One injector assembly.

.5 One set of drive belts.

.3 Where metric size nuts and bolts are used, provide one set of sockets complete with ratchet handle and set of combination wrenches, to fit all sizes used.

.4 Provide conclusive evidence that a Canadian distributor has been established and will stock in Canada spare parts likely to be required during the normal life of the engine.

3.5 ACCEPTANCE (SHOP) TESTS

.1 General: before acceptance, assemble and set up the unit, complete with specified equipment, for tests at the manufacturer's plant. Tests shall be witnessed by the Consultant on a date mutually agreed upon date. Provide suitable test area with adjustable loading facilities. The Supplier shall ensure that the engine has been run in sufficiently prior to load test, and that all test forms have been filled in, the system has been debugged and recorders connected.

.2 Examination of Product: a complete mechanical and electrical examination to determine compliance with the Specifications and Drawings with respect to materials, workmanship, dimensions and marking.

.3 Non-operational tests and checks: perform the following tests and checks before starting the unit:

.1 Shaft alignment, end float, angular and parallel.

.2 Cold resistance of generator windings.

.3 Belt tensioning.

.4 Equipment grounds.

.5 Electrical wiring.

.6 All grease lubricating points.

.7 Personnel safety guards.

.8 Air cleaner.

.9 Coolant.

.10 Lubricating oil type and level.

.11 Type of fuel.

.12 Vibration isolator adjustment.

.13 Temperature and pressure sensors.

.14 Engine exhaust system.

.15 Tools.

.16 Spares.

.4 Operation test and check: on completion of paragraph 3.4.3, start the unit cold. Provide multi-channel recorder and record the following:

.1 Time for unit to start and reach settled voltage and frequency.

.2 Time from initiation of start to full load application, with voltage and frequency settled.

.3 Voltage and frequency transient and steady state limits for full load to no load, 4/4 load to no load, 3/4 load to no load, 1/2 load to no load, 1/4 load to no load and vice versa. Measure machine vibration levels under the same load conditions.

.4 Record battery voltage drop during cranking.

.5 Protection and control demonstration: upon completion of the testing described in subsection 3.5.4, demonstrate the following:

.1 Overheat protection.

.2 Low oil pressure protection.

.3 Cranking cut out.

.4 Over-crank protection (3 tries).

.5 Over-speed protection.

.6 Under and over frequency.

.7 Under and over voltage.

.8 Electrical fault protection:

.1 Failure to close breaker.

.2 Failure to build up voltage.

.9 All control functions.

.6 Load tests: load test the unit for 4 hours at full rated load and a further 1 hour at 110% rated load in ambient room temperature of 40 degree Celsius. Take the following data at the start of load test and every 15 minute interval thereafter:

.1 Frequency.

.2 Voltage.

.3 Current.

.4 Kilowatts.

.5 Generator winding temperature.

.6 Generator frame temperature.

.7 Engine coolant temperature.

.8 Oil temperature and pressure.

.9 Manifold pressure.

.10 Ambient room temperature.

.11 Generator cooling air outlet temperature.

.12 Exciter field current and voltage.

.13 Vibration displacement.

.14 Ambient air temperature inside panel with all doors closed.

.7 Miscellaneous: provide an accurate means for determining fuel and lubricating oil consumption. Provide strip chart recorders for monitoring frequency, voltage and load. Recorder shall have a selection of speeds to allow accurate measurement of voltage, frequency and time during the tests. The recorder shall have been calibrated by the recorder manufacturer (or designated representative) within three months of the factory testing.

.8 Interpretation of ambient room temperature: consider ambient room temperature as that temperature, which is the lowest temperature registered out of a group of three thermometers when placed in engine room as follows:

.1 One thermometer located on each side of the engine block, approximately two-thirds of the length of the block back from front (radiator) end of block, 900mm out from block and at a height equal to height of block. A third thermometer located over end of exciter on the unit centre line, approximately 150 mm above top of exciter.

.2 Take the thermometer showing the lowest temperature to give true ambient air temperature. Adjust temperature to maintain this thermometer at 40 degrees Celsius during heat test.

.9 Voltage and frequency regulation tests: upon completion of load tests take the hot resistance readings of generator windings. Subject the unit to hot voltage and frequency regulation tests for full load to no load, 4/4 load to no load, 3/4 load to no load, 1/2 load to no load, 1/4 load to no load and vice versa.

.10 Panel performance and functions: check sequence of operation under service conditions. Make provision for supplying and connecting required levels of voltage for primary circuits. Test overcurrent relays by impressing current in secondary circuits.

.11 Hi-pot tests: perform over potential tests on primary and secondary wiring in accordance with appropriate EEMAC Standard.

.12 Additional tests: perform any tests, consistent with the requirements of the Contract, which the Consultant may require to satisfy itself of the adequacy and satisfactory operation of the unit.

.13 The Supplier shall provide the forms referred to in subsection 3.4.14 below with the requisite information pertaining to make, model and serial numbers prior to the test.

.14 The supplier will record all test data on the Natural Gas Generating Units Factory Test Result form . The Contractor shall provide recording charts

and manufacturers' test forms complete with diagrams and description of test results, deficiencies and corrective action. Test data sheets shall be signed by the Supplier.

3.6 ACCEPTABLE (SITE) TESTS

.1 All testing identified in subsection 3.5 above shall be repeated on Site.

3.7 COMMISSIONING

.1 When the Contractor has completed its installation Work and before any equipment is operated, the Contractor shall instruct its supplier to commission the equipment. The Contractor shall ensure that its supplier will provide the services of a skilled technical representative for a minimum period of two Working Days (16 hours) at the Site in order to carry out the following Work as a minimum requirement.

.1 Check the installation as to its workmanship.

.2 Check the operation of the set as required above.

.3 Check that the operation of the engine cooling equipment is satisfactory.

.4 Check the interconnecting wiring of the engine safety devices.

.5 Perform further tests as directed by the Consultant.

.6 Instruct the plant personnel in the operation and service of the equipment.

END OF SECTION

SECTION 16270
DRY TYPE TRANSFORMERS

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SECTION 16270
DRY TYPE TRANSFORMERS

1 GENERAL

1.1 RELATED WORK

.1 Electrical General Requirements – Section 16010

1.2 REFERENCES

.2 CSA C9-M1981, DRY-TYPE TRANSFORMERS.

.3 EEMAC GL1-2-1978, Transformer and Reactor Bushings.

.4 ANSI-C57.12.51 requirements for ventilated dry type.

.5 CSA-C22.2 No. 47 air cooled dry type transformers.

.6 Ontario Electrical Safety Code – 2002.

.7 All references to be latest revision.

1.3 SOURCE QUALITY CONTROL

.1 Factory tests: to CSA C9-M

.2 Submit production test certificates for:

.1 Voltage ratio

.2 Polarity or angular displacement

.3 No load losses

.4 Load loss

.5 Impedance voltage

.6 Dielectric withstand, applied and induced

.7 Exciting current

.8 Resistance

.3 Submit type test certificates for:

.1 Temperature rise

.2 Sound level

.3 Radio influence voltage

.4 Basic insulation impulse level

1.4 SHOP DRAWINGS AND PRODUCT DATA

.1 Submit shop drawings in accordance with Section 01330.

.2 Include:

.1 Dimensioned drawing showing enclosure, mounting devices, terminals, taps, internal and external component layout.

.2 Technical data:

.1 KVA rating

.2 Primary and secondary voltages

.3 Three Phase

.4 Polarity or angular displacement

.5 Full load efficiency

.6 Regulation at unity PF

.7 BIL

.8 Insulation type

1.5 OPERATION AND MAINTENANCE DATA

.1 Provide data for incorporation into maintenance manual.

.2 Operation and maintenance instructions to include:

.1 Tap changing

.2 Recommended environmental conditions

.3 Recommended periodic inspection and maintenance

1.6 STORAGES

.1 Store transformers indoors in a dry location.

2. PRODUCTS

2.1 Transformer Characteristic Up to 75kVA

.1 Type: ANN, Dry Type, Self Cooled

.2 Rating: as indicated on drawings

.3 600V primary – delta

.4 120/208V secondary – 4 wire

.5 60 Hz

.6 Class H insulation: 150°C rise. Transformer compartments shall be adequately ventilated to permit natural cooling.

.7 Provide four (4) 2.5% full capacity taps, 2 FCAN and 2 FCBN. All taps shall be brought out to a suitable tap changing board.

.8 Indoor ventilated, self cooled type.

.9 Primary conductor entry through bottom.

2.2 MATERIALS

.1 Dry type transformers: to CSA C9.

.2 Bushings: to EEMAC GL1-2

2.3 TRANSFORMER ENCLOSURES

.1 Fabricated from sheet steel and to connect to existing primary and new secondary switchgear.

2.4 VOLTAGE TAPS

.1 Four (4) 2½% standard full capacity taps.

2.5 TAP CHANGER

.1 Bolted-link type.

2.5 WINDINGS

.1 Primary and secondary coils:

.1 Copper

.2 Coil and core assembly:

.1 Taps located at front of coils for accessibility.

.3 Sound level: not to exceed 50db.

2.6 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section 16010.

3. EXECUTION

3.1 INSTALLATION

.1 Mount dry type transformers up to 75kVA as indicated.

.2 Ensure adequate clearance around transformer for ventilation.

.3 Install transformers in level upright position.

.4 Remove shipping supports only after transformer is installed and just before being put into service.

.5 Loosen isolation pad bolts until no compression is visible.

.6 Make primary and secondary connections in accordance with wiring diagrams.

.7 Energize transformers and check secondary no load voltage.

.8 Adjust primary taps as necessary to produce rated secondary voltage at no load.

.9 Check the transformer for dryness before putting into service if it has not been energized for some considerable time.

3.2 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 16010.

.2 Energize transformers and apply incremental loads:

.1 0% for 4 hrs.

.2 10% for next 1 hr.

.3 25% for next 2 hrs.

.4 50% for next 3 hrs.

.5 Full load

.6 At each load change, check temperature ambient, enclosure, ventilating air and winding.

.3 Protect transformer against moisture until energized. Method to be approved by Contract Administrator.

3.3 ACCEPTABLE MANUFACTURER

.2 Federal Pioneer

.3 Hammond

.4 Approved equal

END OF SECTION

PART 1. GENERAL

1.1 General Scope

.1 The Contractor shall provide and install single-phase and three phase general purpose, individually mounted, dry-type transformers of the two-windings type, self-cooled as specified herein, and as shown on the Contract Drawings. Where indicated on the Contract Drawings provide K-factor transformers for non-sinusoidal loads.

1.2 Related Sections

.1 Section 16010 – Electrical General Requirements

1.3 References

.1 CSA C9-M1981, Dry-Type Transformers.

.2 CSA C22.2 No.47-M90 (R2001) Air Cooled Transformer (Dry Type).

.3 EEMAC GL1-2-1978, Transformer and Reactor Bushings

1.4 Source Quality Control

.1 Factory tests: in accordance with CSA C9 and CSA C22.2.

.2 Submit production test certificates for:
- .1 Voltage ratio
- .2 Polarity or angular displacement
- .3 No load losses
- .4 Load loss
- .5 Impedance voltage
- .6 Dielectric withstand, applied and induced
- .7 Exciting current
- .8 Resistance

.3 Submit type test certificates for:
- .1 Temperature rise
- .2 Sound level
- .3 Radio influence voltage
- .4 Partial discharges (corona)
- .5 Basic insulation impulse level

1.5 Shop Drawings and Production Data

.1 Submit shop drawings and Product data in accordance with Division 1, including:
- .1 Dimensioned drawing showing enclosure, mounting devices, terminals, taps, internal and external component layout.
- .2 Connection wiring diagrams.
- .3 Technical data:

1. KVA rating
2. Primary and secondary voltages
3. Three phase
4. Polarity or angular displacement
5. Full load efficiency
6. Regulation at unity PF
7. BIL
8. Insulation class and temperature rise
9. TAP's
10. Design impedance
11. Sound level

1.6 Operation and Maintenance Data

.1 Provide data for incorporation into the maintenance manual.

.2 Operation and maintenance instructions to include:
- .1 Tap changing
- .2 Recommended environmental conditions
- .3 Recommended periodic inspection and maintenance
- .4 Bushing replacement

1.7 Storage

.1 Store transformers indoors in a dry location

PART 2. PRODUCTS

2.1 Transformers Characteristics up to 75 kVA

.1 Type: ANN, Dry Type, Self Cooled

.2 Rating: as indicated on the Contract Drawings

.3 Class 4:150^{o}C temperature rise. Transformer compartments shall be adequately ventilated to permit natural cooling.

.4 Impedance: 5.5%

.5 Primary winding: 600 V, delta, BIL 95 kV

.6 Secondary winding: 120/208 V, star, BIL 95 kV, four wire and neutral brought out and low resistance.

.7 Provide four (4) 2.5% full capacity taps, 2 FCAN and 2 FCBN. All taps shall be brought out to a suitable tap changing board.

.8 Design for floor or wall mounting

.9 Indoor ventilated, self cooled type

.10 Conductor entry through bottom

.11 Bolted removable panels for access to tap connections, enclosed terminals

2.2 Materials

.1 Dry-type transformers: in accordance with CSA C9 and CSA C22.2 No.47.

.2 Bushings: in accordance with EEMAC GL1-2.

2.3 Transformer Enclosures

.1 The enclosure shall be made of heavy-gauge steel. All transformers shall be equipped with a wiring compartment suitable for conduit entry and large enough to allow for convenient wiring. The maximum temperature of the enclosure shall not exceed 90°C. The core of the transformer shall be grounded to the enclosure.

2.4 Voltage Taps

.1 Four (4) 2.5% standard full capacity taps.

2.5 Tap Changer

.1 Bolted link type.

2.6 Windings

.1 Primary and secondary coils:
.1 Copper

.2 Coil and core assembly:
.1 Taps located at front of coils for accessibility

.3 Sound Level: not to exceed 60 dbA.

2.7 Construction

.1 Insulation Systems
.1 Transformer insulation system shall be as follows:
1. Class B insulation system with a 150°C rise, ventilated design.
.2 Required performance shall be obtained without exceeding the above indicated temperature rise in a 40°C maximum ambient, and a 24 hour average ambient of 30°C.
.3 All insulation materials shall be flame-retardant and shall not support combustion as defined in ASTM Standard Test Method D635.

.2 Core and Coil Assemblies
.1 Transformer core shall be constructed with high-grade, nonaging, grain-oriented silicon steel with high magnetic permeability, and low hysteresis and eddy current losses. Maximum magnetic flux densities shall be substantially below the saturation point. The transformer core volume shall allow efficient transformer operation at 10% above

the nominal tap voltage. The core laminations shall be tightly clamped and compressed. Coils shall be wound of electrical grade aluminium with continuous wound construction.

.2 On three-phase units rated 9 kVA and below and single-phase units rated 15 kVA and below the core and coil assembly shall be completely encapsulated in a proportioned mixture of resin and aggregate to provide a moisture proof, shock-resistant seal. The core and coil encapsulation system shall minimize the sound level.

.3 On three-phase units rated 15 kVA and above and single-phase units rated 25 kVA and above the core and coil assembly shall be impregnated with non-hydroscopic, thermosetting varnish and cured to reduce hot spots and seal out moisture. The assembly shall be installed on vibration-absorbing pads.

.3 Taps

.1 Three-phase transformers rated 15 through 500 kVA shall be provided with six 2.5% taps, two above and four below rated primary voltage.

.4 .Electrostatic Shielding

.1 Where shown on the Contract Drawings, provide shielded transformers with an electrostatic shield consisting of a single turn of aluminium placed between the primary and secondary winding and grounded.

.5 Efficiency

.1 Where shown on the Contract Drawings, provide transformers that are low loss type with the minimum efficiencies per CAN/CSA C802.2 when operated at 35% of full load capacity. Transformer shall bear the Energy Stay Label.

.6 Motor Drive Isolation

.1 Where shown on the Contract Drawings, provide motor drive isolation transformers.

.2 Motor drive isolation transformers shall be designed for use with three-phase AC adjustable frequency drives 600 volts and below to provide isolation between the incoming line and drive circuitry. These drives minimize the line disturbances caused by SCR firing within the drive unit. Thermoguards shall be included in all motor drive isolation transformers to provide additional protection for the transformer from increased heating due to the non-sinusoidal characteristics of drive currents. The transformer shall provide reduced short-circuit currents and voltage line transients. The transformer shall be specifically sized to the drive kVA requirements dictated by the horsepower of the motor and, as such, will be mechanically

braced to withstand the stress of current reversals and short-circuit currents associated with the specific drive kVA rating. Transformers shall be low loss type with minimum efficiencies in accordance with CAN/CSA C802.2 when operated at 35% of full load capacity.

2.8 Wiring and Terminations

.1 Recommended external cable shall be rated 90°C (sized at 75°C ampacity) for encapsulated and 75°C for ventilated designs. Connectors should be selected on the basis of the type and cable size used to wire the specific transformer.

2.9 Finish

.1 Enclosures shall be finished with ANSI 61 colour, weather-resistant enamel.

2.10 Equipment and Identification

.1 Provide equipment identification in accordance with Section 16010 – Electrical General Requirements

2.11 Installation

.1 Locate, install and ground transformer(s) in accordance with manufacturer's instructions.

.2 Set and secure transformers in place, rigid plumb and square.

.3 Connect primary to high voltage circuit.

.4 Connect secondary to secondary switchboard.

.5 Energize transformers and check secondary no-load voltage.

.6 Adjust primary taps as necessary to produce rated secondary voltage at no-load.

.7 Use torque wrench to adjust internal connections in accordance with manufacturer's recommended values.

.8 Check transformer for dryness before putting it into service and if it has not been energized for a considerable period of time.

2.12 Field Quality Control

.1 Perform tests in accordance with Section 16010 – Electrical General Requirements.

.2 Energize transformers and apply incremental loads:

.1 0% for 4 hours
.2 10% for next 1 hour
.3 25% for next 2 hours
.4 50% for next 3 hours
.5 Full load

.6 At each load change, check temperature ambient, enclosure, ventilating air and winding.

.3 Protect transformer against moisture until energized. Method to be approved by the Consultant.

.4 Contractor to ensure that transformer and switchgear manufacturer cooperate and ensure proper fit, alignment and bolting together of the transformers, the primary and secondary equipment housing and bus connection.

2.13 Acceptable Manufacturers

.1 Federal Pioneer

.2 Hammond Manufacturing Inc.

.3 Carte International

.4 Approved equal

PART 3. EXECUTION

3.1 Factory Testing

.1 The following standard factory tests shall be performed on the equipment provided under this Section. All tests shall be in accordance with the latest version of ANSI and NEMA standards.

.1 Ratio tests at the rated voltage connection and at all tap connections

.2 Polarity and phase relation tests on the rated voltage connection

.3 Applied potential tests

.4 Induced potential test

.5 No-load and excitation current at rated voltage on the rated voltage connection.

3.2 Installation

.1 The Contractor shall install all equipment in accordance with the manufacturer's recommendations and the Contract Drawings.

.2 Where transformers are installed above floor, provide support frames and hanger rods to suit transformer installation.

3.3 Field Adjustments

.1 Adjust taps to deliver appropriate secondary voltage.

3.4 Field Testing

.1 Measure primary and secondary voltages for proper tap settings.

END OF SECTION

SECTION 16289
TRANSIENT VOLTAGE SURGE SUPPRESSION (TVSS)

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SECTION 16289
TRANSIENT VOLTAGE SURGE SUPPRESSION (TVSS)

1 GENERAL

1.1 SCOPE

.1 The Contractor shall furnish and install the Transient Voltage Surge Suppression (TVSS) equipment having the electrical characteristics, ratings and modifications as specified herein and as shown on the Contract Drawings. To maximize performance and reliability, the AC surge protection shall be integrated into electrical distribution equipment such as switchgear, switchboards, panelboards, busway and/or motor control centers.

1.2 RELATES SECTIONS

.1 Section 16050 - Basic Material & Methods - Panelboards

.2 Section 16225 – Motor Control Center

1.3 REFERENCES

.1 TVSS units and all components shall be designed, manufactured and tested in accordance with the latest CSA C22.2 standard.

.2 Submit product data in accordance with Section 01330-Submittals.

1.4 MEASUREMENT AND PAYMENT

.1 The Work outlined in this Section shall be included in the lump sum price for Section 16289 – Transient Voltage Surge Suppressions as indicated in the Bid Form.

.2 Payment will be made in accordance with Section 01025 – Measurement and Payment.

1.5 SUBMITTALS FOR REVIEW / APPROVAL

.1 The following shall be submitted to the Consultant:

.1 Verification that the TVSS device complies with the required CSA standards.

.2 Actual let through voltage test data in the form of oscillograph results for the ANSI/IEEE C62.41 Category C3 & C1 (combination wave) and B3 (ringwave) tested in accordance with ANSI/IEEE C62.45.

.3 A spectrum analysis of each unit based on the Military Standard MIL-STD-220A test procedures between 50kHz and 200kHz verifying that the device's noise attenuation equals or exceeds 50 dB at 100kHz.

.4 For retrofit mounting applications, provide electrical and mechanical drawings showing the unit dimensions, weights, installation instruction details, and the wiring configuration.

.5 Test reports in compliance with the requirements of NEMA LS1 from a recognized independent testing laboratory acceptable to the Consultant, verifying that the suppressor components can survive the published surge current rating on both a per mode and per phase basis using the IEEE C62.41. Test data on an individual module is not acceptable.

1.6 SUBMITTALS FOR CONSTRUCTION

.1 The following information shall be submitted for record purposes:

.1 Final drawings showing the exact connection/configuration of the incorporated or retrofitted TVSS system. Drawings shall reflect all of the devices that were submitted to the Consultant for approval.

1.7 QUALIFICATIONS

.1 The Contractor shall ensure that its manufacturer will have a hour response capability that can provide local field engineering personnel on Site within 24 hours of a request from the Region.

.2 The field service organization must have fully accredited power system engineers located nearby and on 24 hours notice time who are capable of performing a complete analysis, and coordination studies.

1.8 DELIVERY, STORAGE AND HANDLING

.1 Equipment shall be handled and stored in accordance with the manufacturer's instructions. One (1) copy of the manufacturer's instructions shall be included with the equipment at the time of its shipment to the Site.

1.9 OPERATION AND MAINTENANCE MANUALS

.1 Equipment operation and maintenance manuals shall be provided with each assembly shipped, and shall include instruction leaflets and instruction bulletins for the complete assembly and each major component.

2 PRODUCTS

2.1 MANUFACTURERS

.1 Manufacturers are not relieved from meeting the requirements of these Specifications in their entirety. Products that do not comply with the requirements of these Specifications will not be considered.

.2 TVSS units installed within low voltage distribution equipment shall be provided by the manufacturer of the low voltage distribution equipment in which they are installed.

2.2 VOLTAGE SURGE SUPPRESSION – GENERAL

.1 Electrical Requirements:

.1 Unit Operating Voltage – Refer to the Contract Drawings for operating voltage and unit configuration.

.2 Maximum Continuous Operating Voltage (MCOV) – The MCOV shall be greater than 115% of the nominal system operating voltage.

.3 The suppression system shall incorporate a hybrid designed Metal-Oxide Varistors (MOV) surge suppressor for the service entrance and other distribution levels. The system shall not utilize silicon avalanche diodes, selenium cell, air gaps or other components that may crowbar the system voltage that may lead to system upset or which may create any environmental hazards.

.4 Protection Modes – For a wye configured system, the device must have directly connected suppression elements between line-neutral (L-N), line-ground (L-G), and neutral-ground (N-G). For a delta-configured system, the device must have suppression elements between line to line (L-L) and line to ground (L-G).

2.3 TVSS DESIGN

.1 Balanced Suppression Platform – The surge current shall be equally distributed to all MOV components to ensure equal stressing and maximum performance. The surge suppression platform must provide equal impedance paths to each matched MOV.

.2 Electrical Noise Filter – Each unit shall include a high – performance Electromagnetic Interference (EMI)/Radio Frequency Interference (RFI) noise rejection filter. Products which are not able to demonstrate a noise attenuation of 50 dB at 100 kHz shall be rejected. Electrical Noise Filter – Each unit shall include a high – performance Electromagnetic Interference

(EMI)/Radio Frequency Interference (RFI) noise rejection filter. Products which are not able to demonstrate a noise attenuation of 50 dB at 100 kHz shall be rejected.

.3 Extended Range Filter – The Surge Protective Device shall have a High Frequency Extended Range Tracking Filter in each Line to Neutral mode in compliance with UL 1283 and NEMA LS1. The filter shall have a published high frequency attenuation rating in the attenuation frequencies.

.4 Internal Connections – No plug-in component modules or printed circuit boards shall be used as surge current conductors. All internal components shall be hardwired with connections utilizing low impedance conductors and compression fittings.

.5 Standard Monitoring Diagnostics – Each TVSS shall provide the following integral monitoring options:

.1 Each unit shall provide a green/red solid state indicator light on each phase. The absence of a green light and the presence of a red light shall indicate which phase(s) have been damaged.

.2 Remote Status Monitor – The TVSS device must include form C dry contacts (one NO and one NC) for remote annunciation of the unit status. The remote alarm shall change state if any of the three phases detect a fault condition.

.3 Audible Alarm – The TVSS shall provide an audible alarm with a reset pushbutton that will be activated under any fault condition.

.4 Event Counter – The TVSS shall be equipped with a system designed to indicate to the user how many surges, sags, swells and outages have occurred at the location. The event counter shall trigger each time under each respective category after a significant event occurs.

.5 Push to Test – The TVSS shall be equipped with a push-to-test feature, designed to provide users with real time testing of the suppressor’s monitoring and diagnostic system. By depressing the test button, the diagnostic system initiates a self test procedure. If the system is fully operational, the self test will activate all indicator lights.

.6 Voltage Monitoring – The TVSS shall display true Root Mean Square (RMS) on the L-N voltage protection mode on Wye configuration and three L-L voltage on delta configuration.

.6 Overcurrent Protection Fusing: In order to isolate the TVSS under any fault condition, the manufacturer shall provide:

.1 Individual Fusing: MOV's shall be individually fused via Copper Fuse Trace. The Copper Fuse shall allow protection during high surge (kA) events.

.2 Thermal Protection: MOV's shall be equipped with Thermal Fuse Spring (TFS) technology which allows for disconnection of the suppression component at the overheated stage common during a temporary over voltage condition. For small fault currents between 100mA and 30Amp, or if the occurrence is over a longer period of time, the TFS will disconnect first.

.3 All overcurrent protection components shall be tested in compliance with UL 1449 – Limited Current Test and the AICS rating test.

.7 Minimum Repetitive Surge Current Capability in accordance with the requirements of ANSI/IEEE C62.41 and ANSI/IEEE C62.45 – 1992:

.1 The suppression filter system shall be repetitive surge tested in every mode and it shall satisfy the requirements of ANSI/IEEE C62.41 and ANSI/IEEE C62.45

2.4 SYSTEM APPLICATION

.1 The TVSS applications covered under this Section include distribution and branch panel locations, bus plugs, motor control centres (MCC), switchgear, and switchboard assemblies. The TVSS located in the branch panel shall be tested and demonstrated to be suitable for ANSI/IEEE C62.41 Category C1 environments.

.2 Lighting and Distribution Panelboard Requirements

.1 The TVSS application covered under this Section includes lighting and distribution panelboards. The TVSS units shall be tested to demonstrate suitability for ANSI/IEEE C62.41 Category C1 environments.

.2 The TVSS shall not limit the use of through-feed lugs, Sub-feed lugs and Sub-feed breaker options.

.3 The TVSS shall be installed as indicated in the Contract Documents.

.4 The panelboard shall be capable of re-energizing upon the removal of the TVSS.

.5 The TVSS components shall be connected to the panelboard bus bar in a way which is recommended by the manufacturer.

.6 The TVSS shall be included and mounted within the panelboard by the manufacturer of the panelboard.

.7 The TVSS shall be of the same manufacturer as the panelboard. The complete panelboard, including the TVSS, shall be CSA and ULC listed.

.3 The maximum conductor lead length between the breaker and suppressor shall not exceed 350mm . Comply with the manufacturer's recommended installation and wiring practices.

.4 Locate the suppressor on the load side of the main disconnect device, as close as possible to the phase conductors and ground/neutral bar.

.5 Provide a 30-amp disconnect. The disconnect shall be directly integrated to the suppressor and assembly bus using bolted bus bar connections.

.6 The TVSS shall be integral to the switchgear, switchboard, MCC and Bus Plug as a factory standardized design.

.7 All monitoring diagnostics features shall be visible from the front of the equipment.

2.5 ENCLOSURES

.1 All enclosed equipment shall have NEMA 1 or NEMA 3R general-purpose enclosures, unless otherwise noted in the Contract Documents. Provide enclosures suitable for the locations as indicated on the Contract Drawings and as described below:

.1 NEMA 1 enclosures constructed for indoor use to provide a degree of protection to personnel against access to and contact withthe hazardous parts of the equipment and to provide a degree of protection for the equipment inside the enclosure against the ingress of solid foreign objects (falling dirt).

.2 NEMA 3R rainproof enclosures are intended for outdoor use primarily to provide protection against rain, sleet and damage from external ice formation.

.3 NEMA 12 dust-tight enclosures are intended for indoor use primarily to provide protection against circulating dust, falling dirt and dripping non-corrosive liquids (panelboards only).

.4 NEMA 4 watertight stainless steel is intended for indoor or outdoor use primarily to provide protection against windblown dust and rain, splashing rain, hose-directed water, and damage from external ice formation (side mounted units only)

3 EXECUTION

3.1 FACTORY TESTING

.1 Standard factory tests shall be performed on the equipment under this Section. All tests shall be performed in accordance with the latest version of the applicable NEMA and CSA standards.

3.2 INSTALLATION

.1 The Contractor shall install all equipment in accordance with the manufacturer's recommendations and the Contract Drawings.

3.3 WARRANTY

.1 In addition to the warranty requirements as stated in the General Conditions, the Contractor shall provide a manufacturer's extended warranty against any TVSS part failure for a period of five (5) years, commencing on the date of Substantial Performance of the Work.

END OF SECTION

SECTION 16412
MOULDED CASE CIRCUIT BREAKERS

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SECTION 16412
MOULDED CASE CIRCUIT BREAKERS

1 GENERAL

1.1 RELATED SECTIONS SUMMARY

.1 Section 16010 – Electrical General Requirements.

.2 Section 16441 – Panelboards Breaker Type.

.3 Section 16482 – Motor Control Centre.

1.2 REFERENCES

.1 CSA C22.2 No. 5-02 Moulded Case Circuit Breakers.

1.3 PRODUCT DATA

.1 Submit product data in accordance with Section 01330 – Submittal Procedures.

.2 Include time current characteristic curves for breakers with interrupting capacity of 42,000 A symmetrical (rms) and over at system voltage.

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 Plug-in moulded case circuit breaker: quick-make, quick-break type, for manual and automatic operation with temperature compensation for 40°C ambient.

.3 Common-trip breakers: with single handle for multi-pole applications.

.4 Magnetic instantaneous trip elements in circuit breakers to operate only when value of current reaches setting. Trip settings on breakers with adjustable trips to range from 3-10 times current rating.

.5 Circuit breakers with interchangeable trips as indicated.

.6 EEMAC/NEMA equipment only.

.7 All breakers shall be CSA listed for applications at 100% of their continuous ampere rating in their intended enclosure.

.8 Protective devices shall be molded case circuit breakers with inverse time and instantaneous tripping characteristics.

.9 Circuit breakers shall be operated by a toggle type handle and shall have a quick make, quick break over center switching mechanism that is mechanically trip free. Automatic tripping of the breaker shall be clearly indicated by the handle position. Contacts shall be non welding silver alloy and arc extinction shall be accomplished by means of DE-ION arc chutes. A push-to-trip button on the front of the circuit breaker shall provide a local manual means to exercise the trip mechanism.

.10 Circuit breakers shall have a minimum symmetrical interrupting capacity of 65,000A or as indicated on the drawings whic ever is greater.

.11 Circuit breakers 600 ampere frame and below shall be equipped with thermal magnetic trip units and inverse time current characteristics.

.12 Circuit breakers 800 ampere through 1200 ampere frame shall be equipped with solid state based RMS sensing trip units including ground fault protection.

2.2 VISUAL VERIFICATION

.1 Where indicated on the drawings and/or any breakers that are key interlocked, provide a clear viewing window in the front of the breaker case to suit visual verification of contact positions as required to suit Ontario Electrical Safety Code. Contacts are to be painted with a bright colour to enhance the contracts and contact positions.

.2 Provide a clear window in the respective MCC and/or Panelboard to allow for breaker contact visual verification.

2.3 THERMAL MAGNETIC BREAKERS

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

2.4 MAGNETIC BREAKER

.1 Moulded case circuit breaker to operate automatically by means of magnetic tripping devices to provide instantaneous tripping for short circuit protection.

.2 Provide a solid state electronic tripping module for timed and instantaneous overcurrent protection as indicated on the drawings.

.3 Include a solid state electronic tripping module for timed and instantaneous overcurrent and ground overcurrent protection for all breakers rated 1000A or greater.

2.5 THERMAL MAGNETIC BREAKERS WITH CURRENT LIMITING

.1 Where available short circuit currents exceed rating of standard thermal magnetic breakers range, provide a current limiter.

2.6 SOLID STATE TRIP BREAKERS

.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 inverse time current trip under overload condition, and long time, short time, instantaneous tripping for phase, ground fault short circuit protection.

2.7 ENCLOSURE

.1 Individual wall mounted breakers to be installed in a NEMA 12 enclosure complete with a hinged door and a lockable external breaker handle.

3 EXECUTION

3.1 INSTALLATION

.1 Install curcuit breakers as indicated.

END OF SECTION

SECTION 16441
PANELBOARDS BREAKER TYPE

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SECTION 16441
PANELBOARDS BREAKER TYPE

1 GENERAL

1.1 SCOPE

.1 The Contractor shall provide and install the panel-boards as specified and as shown on the contract drawings.

.2 All panelboards are to be provided with a Main Breaker to suit primary over current protection and isolation.

.3 All Panelboards enclosures are to be rated NEMA 3 complete with hinged front door, with lockable door handle and 3 point door latching mechanism. Front door shall be equipped with a continuous piano door hinge to suit the front door.

1.2 RELATED SECTIONS

.1 Section 16010 – Electrical General Requirements

1.3 REFERENCES

.1 CSA C22.2 No.29-M1989 (R2000) Panel-boards and Enclosed Panel-boards.

1.4 PRODUCT DATA

.1 Submit shop drawings in accordance with Section 01330 – Submittal Procedures.

.2 Drawings to include electrical detail of panel, branch breaker type, quantity, ampacity and enclosure dimension.

1.5 SUBMITTALS

.1 The following information shall be submitted to the Contract Administrator:

.1 Breaker layout drawing with dimensions indicated and nameplate designation.

.2 Panel Schedule in accordance with the design drawings.

.3 Circuit designations for all branch breaker applications and including spare breakers.

.4 Component list.

.5 Conduit entry/exit locations.

.6 Assembly ratings including:

.1 Short circuit rating

.2 Voltage

.3 Continuous current

.7 Cable terminal sizes.

.8 Product data sheets.

.9 Single Line Diagram.

.10 Wiring schematics to suit the TVSS connection diagram.

.11 Product data sheets to suit the respective panel component, including breakers , TVSS and NEMA 3 enclosure.

.2 Where applicable the following additional information shall be submitted to the Contract Administrator:

.1 Key interlock scheme drawing and sequence of operations.

1.6 SUBMITTALS – FOR CONSTRUCTION

.1 The following information shall be submitted for record purposes:

.1 Final as-built drawings and information for items listed in paragraph 1.4.

.2 Installation information.

.2 The final (as-built) drawings shall include the same drawings as the construction drawings and shall incorporate all changes made during the manufacturing process.

1.7 QUALIFICATIONS

.1 The manufacturer of the panel-board shall be the manufacturer of the major components within the assembly including circuit breakers and fusible switches.

.2 The following minimum mounting and installation guidelines shall be met, unless specifically modified by the above referenced standards.

.1 The Contractor shall provide equipment anchorage details, coordinated with the equipment mounting provision, prepared and stamped by a licensed civil engineer. Mounting recommendations shall be provided by the manufacturer based upon approved shake table tests used to verify the seismic design of the equipment.

.2 The equipment manufacturer shall certify that the equipment can withstand, that is, function following the seismic event, including both vertical and lateral required response spectra as specified in above codes.

.3 The equipment manufacturer shall document the requirements necessary for proper seismic mounting of the equipment. Seismic qualification shall be considered achieved when the capability of the equipment, meets or exceeds the specified response spectra.

1.8 REGULATORY REQUIREMENTS

.1 The panelboards shall be CSA labelled.

1.9 DELIVERY, STORAGE, AND HANDLING

.1 Equipment shall be handled and stored in accordance with manufacturer's instructions. One (1) copy of these instructions shall be included with the equipment at time of shipment.

1.10 OPERATION AND MAINTENANCE MANUALS

.1 Equipment operation and maintenance manuals shall be provided with each assembly shipped and shall include instruction leaflets, instruction bulletins and renewals parts lists where applicable, for the complete assembly and each major component.

2 PRODUCTS

2.1 PANELBOARDS

.1 Panel-boards: product of one (1) manufacturer.

.1 All new panel-boards shall have a main breaker.

.2 Install circuit breakers in panel-boards before shipment.

.3 ate must show fault current that panel including breakers has been built to withstand.

.2 250V and 600 V panel-boards: bus and breakers rated for 25,000 A & 42,000 A respectively (symmetrical) interrupting capacity or as indicated.

.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 Panel-boards: mains, number of circuits, and number and size of branch circuit breakers as indicated.

.5 Two (2) keys for each panel-board and key panel-boards alike.

.6 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 PANEL-BOARD ASSEMBLIES

.1 125mm relay section on 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.

.5 Isolated ground bus.

2.3 BREAKERS

.1 Breakers: to Section 16412 – 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 All breaker applications shall include the provision for lockout capability. The lockout feature shall accommodate a safety tag that can be lockout out via a safety pad lock.

2.4 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section 16010 – Electrical General Requirements.

.2 Nameplate for each panel-board size four (4) engraved as indicated.

.3 Nameplate for each circuit in distribution panel-boards size two (2) engraved as indicated.

.4 Complete circuit directory with typewritten legend showing location and load of each circuit.

2.5 RATING

.1 Panel-boards rated 240V AC or less shall have short circuit ratings as shown on the drawings or as herein scheduled, but not less than 25,000 amperes RMS symmetrical.

.2 Panel-boards rated 600V AC shall have short circuit ratings as shown on the drawings or as herein scheduled, but not less than 42,000 amperes RMS symmetrical.

.3 Panel-boards shall be labelled with a CSA short circuit rating. When series ratings are applied with integral or remote upstream devices, a label or manual shall be provided. It shall state the conditions of the CSA series ratings including:

.1 Size and type of main breaker protection.

.2 Branch devices that can be used.

.3 CSA series short circuit rating.

2.6 CONSTRUCTION

.1 Interiors shall be completely factory assembled devices. They shall be designed such that switching and protective devices can be replaced without disturbing adjacent units and without removing the main bus connectors.

.2 Trims for branch circuit panel-boards shall be supplied with a hinged door over all circuit breaker handles. Doors in panel-board trims shall not uncover any live parts. Doors shall have a semi flush cylinder lock and catch assembly. Doors over 48 inches in height shall have auxiliary fasteners.

.3 Distribution panel-board trims shall cover all live parts. Switching device handles shall be accessible.

.4 Surface trims shall be same height and width as box. Flush trims shall overlap the box by 20mm on all sides.

.5 A directory with a clear plastic cover shall be supplied and mounted on the inside of each door.

.6 All locks shall be keyed alike.

2.7 BUS

.1 Main bus bars shall be copper sized in accordance with CSA standards to limit temperature rise on any current carrying part to a maximum of 65°C above an ambient of 40°C base.

.2 A system and insulated/isolated ground bus shall be included in all panels.

.3 Full size (100% rated) insulated neutral bars shall be included for panelboards shown with neutral. Bus bar taps for panels with single pole branches shall be arranged for sequence phasing of the branch circuit devices. Neutral busing shall have a suitable lug for each outgoing feeder requiring a neutral connection. 200% rated neutrals shall be supplied for panels designated on drawings with oversized neutral conductors.

2.8 BRANCH CIRCUIT PANEL-BOARDS

.1 The minimum short circuit rating for branch circuit panel-boards shall be as specified herein or as indicated on the drawings. Panel-boards shall be fully rated.

.2 Bolt on type, heavy duty, quick make, quick break, single and multi pole circuit breakers of type specified herein, shall be provided for each circuit with toggle handles that indicate when unit has tripped.

.3 Circuit breakers shall be thermal magnetic type with common type handle for all multiple pole circuit breakers. Circuit breakers shall be minimum 100 ampere frame and through 100 ampere trip sizes shall take up the same pole spacing. Circuit breakers shall be ULC listed as type SWD for lighting circuits.

.1 Circuit breaker handle locks shall be provided for all circuits that supply exit signs, emergency lights, energy management, and control system (EMCS) panels and fire alarm panels.

.4 Circuit breakers shall have a minimum interrupting rating of 25,000 amperes symmetrical at 240V, and 42,000 amperes symmetrical at 600V, unless otherwise noted on the drawings.

2.9 DISTRIBUTION PANEL-BOARDS – CIRCUIT BREAKER TYPE

.1 Distribution panel-boards with bolt on devices contained therein shall have interrupting ratings as specified herein or indicated on the drawings. Panel-boards shall be full rated.

.2 Distribution panel-boards with plug on devices contained therein shall have interrupting ratings as indicated on the drawings. Panel-boards shall be fully rated.

.3 Where indicated, provide circuit breakers CSA listed for application at 100% of their continuous ampere rating in their intended enclosure.

2.10 TRANSIENT VOLTAGE SURGE SUPPRESSION

.1 Provide transient voltage surge protection as shown on the drawings and specified herein.

.2 Acceptable product:

.1 Cutler Hammer CPS

.3 Provide kA rating in accordance with Coordination Study.

.4 TVSS unit to be provided with premium diagnostics features, including test features system status indication, alarm indication, fault indication.

2.11 ENCLOSURE

.1 Enclosure shall be at least 500mm wide made from galvanized steel. Provide minimum gutter space in accordance with the Ontario Electrical Safety Code. Where feeder cables supplying the mains of a panel are carried through its box to supply other electrical equipment, the box shall be sized to include the additional required wiring space. At least four (4) interior mounting studs with adjustable nuts shall be provided.

.2 Enclosure shall be provided with blank ends.

.3 Where indicated on the drawings, branch circuit panel-boards shall be column width type.

2.12 APPROVED PRODUCTS

.1 Cutler Hammer – Power R Line.

.2 General Electric.

.3 Schneider Electric.

.4 Siemens.

3 EXECUTION

3.1 FACTORY TESTING

.1 The following standard factory tests shall be performed on the equipment provided under this section. All tests shall be in accordance with the latest version of CSA standards.

3.2 RELATED INSTALLATION

.1 Locate panel-boards as indicated and mount securely, plumb, true and square, to adjoining surfaces.

.2 Install surface mounted panel-boards on plywood backboards. Where practical, group panel-boards on common backboard.

.3 Mount panel-boards to height specified in Section 16010 – Electrical General Requirements or as indicated.

.4 Connect loads to circuits.

.5 Connect neutral conductors to common neutral bus with respective neutral identified.

END OF SECTION

SECTION 16450
GROUNDING - BONDING

1 GENERAL 1

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1.2 REFERENCES 1

2 PRODUCTS 2

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3 EXECUTION 2

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SECTION 16450
GROUNDING - BONDING

1 GENERAL

1.1 SCOPE

.1 Provide a complete grounding system for the new 600V distribution, including panelboards, switchboards, transformers, and all equipment supplied by the distribution system.

.2 Provide a capable grounding system to suit all low voltage 120/208V distribution including all equipment and lighting supplied by the distribution system.

.3 Bond all non current carrying metallic equipment to ground bus.

.4 Provide bonding conductors for all switchgear, distribution panelboards, and electrical equipment. Unless indicated otherwise provide a dedicated ground/bond conductor for each distribution applications, sized in accordance with Table 16 of the Ontario Electrical Safety Code.

.5 Provide separate ground electrodes to suit the Disinfection Building main service distribution panel. Electrodes shall be interconnected in accordance with section 10 of the electrical safety codes, latest revision.

.6 In addition to ground conductors, provide separate bonding conductors between all electrical distribution components and equipment supplied by the distribution system.

.7 Provide a dedicated ground/bond conductor for each power distribution, raceway application sized in accordance with Table 16 of the Ontario Electrical Safety Code.

.8 Provide a dedicated ground/bond conductor to suit each directly buried cable application sized in accordance with Table 16 of the Ontario Electrical Safety Code. Ground conductor to be buried adjacent to the current carrying conductors.

1.2 REFERENCES

.1 ANSI/IEEE 837-1988, Qualifying Permanent Connections used in Substation Grounding.

.2 IEEE Std 142™-1991 IEEE Recommended Practice for Grounding of Industrial and Commercial Power Systems

.3 IEEE 81.2-1991 EEE Guide for Measurement of Impedance and Safety Characteristics of Large, Extended or Interconnected Grounding Systems.

2 PRODUCTS

2.1 EQUIPMENT

.1 Clamps for grounding of conductor: size as required to electrically conductive underground water pipe.

.2 Copper conductor: minimum 6m long for each concrete encased electrode, bare, stranded, tinned, soft annealed, size as indicated.

.3 Rod electrodes: copper clad steel 19mm dia by 3m long.

.4 Plate electrodes: copper surface area 0.2m, 1.6mm thick.

.5 Grounding conductors: bare stranded copper, tinned, soft annealed, size as indicated.

.6 Insulated grounding conductors: green, type 4/0.

.7 Ground bus: copper, complete with insulated supports, fastenings, connectors.

.8 Non-corroding accessories necessary for grounding system, type, size, material as indicated, including but not necessarily limited to:

.1 Grounding and bonding bushings.

.2 Protective type clamps.

.3 Bolted type conductor connectors.

.4 Thermit welded type conductor connectors.

.5 Bonding jumpers, straps.

.6 Pressure wire connectors.

3 EXECUTION

3.1 INSTALLATION GENERAL

.1 Install complete permanent, continuous grounding system including, electrodes, conductors, connectors, accessories. Where a metal duct, conduit or raceway is used, run a dedicated ground wire in conduit.

.2 The grounding system shall be bonded to the buildings foundation reinforcing steel and supporting steel columns. Potable water piping, low pressure effluent water piping, separated water piping, natural gas piping, scrubber drain piping, and fire protection system piping shall be bonded to the grounding system by connecting to the first flange inside the building with a copper bar or strap. The flange shall be drilled and tapped to provide a bolted connection

.3 Install connectors in accordance with manufacturer's instructions.

.4 Protect exposed grounding conductors from mechanical injury.

.5 Make buried connections, and connections to conductive water main, electrodes, using permanent mechanical connectors or inspectable wrought copper compression connectors to ANSI/IEEE 837.

.6 Use mechanical connectors for grounding connections to equipment provided with lugs.

.7 Soldered joints not permitted to suit ground connections.

.8 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.

.9 Install flexible ground straps for bus duct enclosure joints, where such bonding is not inherently provided with equipment.

.10 Install separate ground conductor to outdoor lighting standards.

.11 Connect building structural steel and metal siding to ground by welding copper to steel.

.12 Make grounding connections in radial configuration only, with connections terminating at single grounding point. Avoid loop connections.

.13 Bond single conductor, metallic armoured cables to cabinet at supply end, and provide non-metallic entry plate at load end.

.14 Ground secondary service pedestals.

3.2 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 and/or plate electrodes and make grounding connections.

.5 Bond separate, multiple electrodes together.

.6 Use size 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.

3.3 SYSTEM AND CIRCUIT GROUNDING

.1 Install system and circuit grounding connections to neutral of primary 600V system and secondary 120/240V system.

3.4 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.

.2 Install bonding connections between distribution components and equipment in accordance with code requirements including but not limited to, primary distribution system switchgear, auxiliary MCC, distribution panel boards, transformers, packaged equipment, motor frames/housing., control panels.

3.5 GROUNDING BUS

.1 Install copper grounding bus mounted on insulated supports on wall of electrical room.

.2 Ground items of electrical equipment in electrical room to ground bus with individual bare stranded copper connections size 4/0 AWG.

3.6 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 companies, or telephone installations service providers' requirements.

.2 Fire Alarm intercommunications system as required by the equipment manufacturer.

3.7 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 16010 – Electrical General Requirements.

.2 Perform ground continuity and resistance tests using method appropriate to site conditions and to approval of the Contract Administrator and the local authority having jurisdiction over installation.

.3 The new grounding system shall be tested to determine the resistance to earth. Testing shall be performed by an independent electrical or grounding system testing organization.

.4 Testing shall be completed after not less than three full days without precipitation and without any other moistening or chemical treatment of the soil. The grounding system shall be tested for resistance to earth utilizing the three-point fall of potential test as defined by IEEE 81.

.5 The current source probe for the test shall be placed in soil at a distance of 5 to 10 times the distance of the widest measurement across the grounding system ring or grid to ensure adequate measurements outside of the grounding system's sphere of influence. Test probe measurements shall be taken at a distance of one foot from the grounding system reference connection and at each 10 percent increment from the grounding system reference connection to the current source probe location. Test results shall be documented on a graphical plot with resistance in ohms on the vertical axis and distance in feet on the horizontal axis. The results shall clearly indicate a system resistance plateau which confirms a valid test procedure

.6 Perform tests before energizing electrical system. Testing shall be completed prior to installation of the electrical distribution equipment to ensure the grounding system is isolated from the utility grounding system and the systems of other structures

.7 Disconnect ground fault indicator during tests.

END OF SECTION

SECTION 16482
MOTOR CONTROL CENTRE

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SECTION 16482
MOTOR CONTROL CENTRE

1 GENERAL

1.1 SCOPE

.1 Supply and installation of new MCC.

1.2 RELATED SECTIONS

.1 Section 16010 – Electrical General Requirements.

.2 Section 16223 – Motor Starters To 600 V.

.3 Section 16412 – Moulded Case Circuit Breakers.

1.3 REFERENCES

.1 The Motor Control Centres and all components shall be designed, manufactured and tested in accordance with the latest applicable standards of NEMA ICS2-322.

1.4 SHOP DRAWINGS

.1 Submit shop drawings in accordance with Section 01330 – Submittals.

.2 The following information shall be submitted to the Contract Administrator:

.1 Master Drawing Index.

.2 Front View Elevation (Modified Section)

.3 Floor Plan

.4 Top View

.5 Single Line

.6 Unit Wiring Diagrams Depicting Remote Devices

.7 Nameplate Schedule

.8 Starter and Component Schedule

.9 Conduit Entry/Exit Locations

.10 Assembly Ratings including:

.1 Short-circuit rating.

.2 Voltage.

.3 Continuous current.

.11 Major Component Ratings including:

.1 Voltage.

.2 Continuous current.

.3 Interrupting Ratings.

.12 Cable terminal sizes.

.3 Where applicable the following information shall be submitted to the Contract Administrator:

.1 Busway connection.

.2 Connection details between close-coupled assemblies.

.3 Composite floor plan of close-coupled assemblies.

.4 Key interlock scheme drawing and sequence of operations.

.4 Control wiring schematics for each motor starter.

.5 Submit six (6) copies of the above information.

.6 When requested by the Contract Administrator the following product information shall be submitted:

.1 Descriptive bulletins.

.2 Product sheets.

1.5 MAINTENANCE DATA

.1 Provide operation and maintenance data for motor control centre for incorporation into manual specified in Section 01330 – Submittals.

.2 Include data for each type and style of starter.

1.6 MAINTENANCE MATERIALS

.1 The following information shall be submitted for record purposes:

.1 Final as built drawings and information for items listed Section 1.4.

.2 Unit wiring diagrams.

.3 Certified production test reports.

.4 Installation information.

.5 Seismic certification and equipment anchorage details.

.2 Submit six (6) copies of the above information.

1.7 SOURCE QUALITY CONTROL

.1 Provide manufacturer's type test certificates including short circuit fault damage certification up to short circuit values specified under bus bracing.

1.8 QUALIFICATIONS

.1 The Manufacturer of the assembly shall be the manufacturer of the major components within the assembly.

.2 For the equipment specified herein, the manufacturer shall be ISO certified.

1.9 DELIVERY, STORAGE AND HANDLING

.1 Equipment shall be handled and stored in accordance with manufacturer's instructions. One (1) copy of these instructions shall be included with the equipment at time of shipment.

1.10 FIELD MEASUREMENTS

.1 Installing Contractor to verify equipment proposed shall fit into the available space. Coordinate installation with other trades and notify the approval authorities of any interferences or conflicts in the MCC system power and control wing.

1.11 EXTRA PRODUCTS

.1 Manufacturer and Contractor shall submit a renewal parts list showing the important maintenance items which will need to be available for proper maintenance and to provide normal equipment life.

2 PRODUCTS

2.1 SUPPLY CHARACTERISTICS

.1 600V, 60 Hz, 3 phase, 3 wire, grounded / neutral.

2.2 GENERAL DESCRIPTION

.1 The equipment shall conform to the applicable requirements of EEMAC Standard ICS 2-322 and shall meet the test conditions specified therein. All motor control centre cubicles shall be 508mm (20”) deep, 2286mm high and width as shown on drawings.

.2 The complete MCC, including all of its components shall have a minimum interrupting rating of 42,000 A symmetrical. Provide a greater interrupting rating in accordance with the design drawings as required.

.3 The motor control centre shall consist of vertical sections fabricated of Code gauge steel, shaped and reinforced to form a continuous rigid free standing, enclosed, completely dead front EEMAC 1, gasketted.

.4 The panels shall be Type “B” construction with all units having individual line and control leads brought to terminal boards suitably located in each starter, and wiring shall conform to EEMAC Class II requirements.

.5 The complete panels shall have adequate ventilation to limit the internal temperature rise to 55°.

.6 There shall be a continuous ground bus with accessible external connection for bonding to the station ground.

.7 All necessary control transformers, switches, indicating lights, wiring, fuses, interlocks, terminal boards, etc. shall be included to suit the power and control requirements specified herein and/or on the Drawings. All indicating light lamps shall be long life LED type, Push to Test.

.8 Compartmentalized vertical sections with common power busbars. Each vertical section of the MCC to be so designed that motor starters and control units can be readily removed or added as required.

.9 Floor mounting, free standing, dead front, completely enclosed control assembly.

.10 Accommodating combination starters and circuit breakers as shown.

.11 Front mounting.

.12 Cubicle housing the Service Entrance Main Breaker shall be provided with a full width front door complete with locking handle and shall be compartmentalized as required.

.13 Motor Controls shall be remote mounted from the MCC.

2.3 VERTICAL SECTION CONSTRUCTION

.1 Independent vertical sections fabricated from rolled flat steel sheets bolted together to form rigid, completely enclosed assembly.

.2 Each vertical section divided into compartment units, minimum 165mm high, as indicated.

.3 Each unit to have complete top and bottom steel plate for isolation between units.

.4 Horizontal wireways, equipped with cable supports, across top and bottom, extending full width of motor control centre, isolated from busbars by steel barriers.

.5 Vertical wireways complete with doors for load and control conductors extending full height of vertical sections, and equipped with cable tie supports. Installation wiring to units accessible with doors open and units in place.

.6 Openings, with removable coverplates, in side of vertical sections for horizontal wiring between sections.

.7 Incoming cables to enter at top/bottom with terminals as indicated.

.8 Provision for outgoing cables to exit via top or bottom with terminals.

.9 Removable lifting means.

.10 Provision for future extension of both ends of motor control centre including busbars without need for further drilling, cutting or preparation in field.

.11 Divide assembly for shipment to site, complete with hardware and instructions for re-assembly.

.12 Shipping splits to be coordinated by the contractor to facilitate the installation of MCC via existing building openings.

2.4 SILLS

.1 Continuous 25mm channel iron floor sills for mounting bases with 19mm diameter holes for bolts.

2.5 BUSBARS

.1 Main horizontal and branch vertical, three phase high conductivity tin plated copper busbars in separate compartment bare self-cooled, extending entire width and height of motor control centre, supported on insulators and rated:

.1 Main horizontal busbars 800A.

.2 Branch vertical busbars: 600A.

.2 Branch vertical busbars for distribution of power to units in vertical sections.

.3 No other cables, wires, equipment in main and branch busbar compartments.

.4 Brace buswork to withstand effects of short-circuit current 65kA rms symmetrical.

.5 Bus supports: with high dielectric strength, low moisture absorption, high impact material and long creepage surface designed to discourage collection of dust.

.6 Provide an insulating barrier between the bus and pull out compartments.

2.6 GROUND BUS

.1 A bare, copper uninsulated ground bus shall extend the full length of motor control centre with two (2) ground connectors, one (1) at each end suitable for size 4/0 standard stranded bare copper cable. Ground bus leads from this bus shall be brought to conveniently located terminal connectors for each motor starter to facilitate the connection of ground wire contained in cables used in all outgoing circuits.

.2 Vertical ground bus strap, full height of section, tied to horizontal ground bus, engaged by plug-in unit ground stab.

2.7 GROUND FAULT PROTECTION

.1 Provide ground fault protection, integral to the main service breaker to suit main breaker applications that are frame rated 1000A or greater.

2.8 MOTOR STARTERS AND DEVICES

.1 Refer to Section 16223 – Motor Starters to 600V.

2.9 STARTER UNIT COMPARTMENTS

.1 Units EEMAC size 5 and smaller, circuit breaker units 225A and smaller, plug-in type with self-disconnect. Guide rail supports for units to ensure that stabs make positive contact with vertical bus. Provision for units to be installed or removed, off load, while buses energized.

.2 Unit mounting:

.1 Engaged position – unit stabbed into vertical bus.

.2 Withdrawn position – unit isolated from vertical bus but supported by structure. Terminal block accessible for electrical testing of starter.

.3 Provision for positive latching in either engaged or withdrawn position and padlocking in withdrawn position.

.4 Stab-on connectors free floating tin plated clips, self-aligning, backed up with steel springs.

.3 External operating handle of circuit switch interlocked with door to prevent door opening with switch in "on" position. Provision for [3] padlocks to lock operating handle in "off" position and lock door closed.

.4 Hinge unit doors on same side.

.5 Overload relays manually reset from front with door closed.

.6 Pushbuttons and indicating lights mounted on door front.

.7 Devices and components by one (1) manufacturer to facilitate maintenance.

.8 Pull-apart terminal blocks for power and control to allow removal of starter units without removal of field wiring.

2.10 WIRING IDENTIFICATION

.1 Provide wiring identification in accordance with Section 16010 – Electrical General Requirements.

2.11 EQUIPMENT

.1 Provide equipment identification in accordance with Section 16010 – Electrical General Requirements.

.1 Motor control centre main nameplate: size No. 7.

.2 Individual compartment nameplates: size No. [5], engraved as indicated on drawings.

2.12 FINISHES

.1 Apply finishes in accordance with Section 16010 – Electrical General Requirements.

.2 Paint motor control centre exterior light gray and interiors white.

2.13 POWER FACTOR CORRECTION

.1 Provide power factor correction capacitors to correct power factor to no less than 0.90 KVAR to be matched to pump motor nameplate data.

.2 Capacitors to be installed in the MCC or alternatively in separate NEMA 12 enclosures.

.3 The Contractor is responsible for all interconnect wiring as required.

.4 Acceptable Capacitor Manufacturer:

.1 ABB.

.2 Approved equal.

2.14 ACCEPTABLE MCC SUPPLIERS

.1 Cutler Hammer

.2 Allen Bradley.

.3 Siemens.

.4 Square D.

3 EXECUTION

3.1 EXAMINATION

.1 Overload relay heater ratings must be properly sized and coordinated for each motor starter unit.

.2 Installing Contractor to verify ESA clearances as dictated on the contract drawings prior to installation. Verify CSA labelling of the assembly prior to installation.

3.2 FACTORY TESTING

.1 The motor control centres shall have been tested in a high-power laboratory to prove adequate mechanical and electrical capabilities.

.2 All factory tests required by the latest ANSI, NEMA and CSA standards shall be performed.

.3 The manufacturer shall provide three (3) certified copies of factory test reports.

.4 Factory tests as outlined above shall be witnessed by the Owner's representative.

.1 The manufacturer shall notify the Owner two (2) weeks prior to the date the tests are to be performed.

.2 The manufacturer shall include the cost of transportation and lodging for up to three (3) Owner's representatives. The cost of meals and incidental expenses shall be the Owner's responsibility.

3.3 INSTALLATION

.1 Contractor to follow the installation instructions supplied by the manufacturer.

.2 Control wiring shall be as shown on the contract drawings except as modified by the approval and submittal process. Interface all local and remote devices into the control wiring and operational systems for each load.

3.4 FIELD QUALITY CONTROL

.1 Provide the services of a qualified factory-trained manufacturer's representative to assist the contractor in installation and start-up of the equipment specified under this section for a period of five (5) working days. The manufacturer's representative shall provide technical direction and assistance to the Contractor in general assembly of the equipment, connections and adjustments, and testing of the assembly and components contained therein.

.2 The following minimum work shall be performed by the Contractor under the technical direction of the manufacturer's service representative:

.1 Rig the MCC assembly into final location and install on level surface.

.2 Check all removable cells and starter units for easy removal and insertion.

.3 Perform insulation tests on each phase and verify low-resistance ground connection on ground bus.

.4 Connect all power wiring and control wiring and verify basic operation of each starter from control power source.

.5 Torque all bolted connections made in the field and verify all factory bolted connections.

.6 Calibrate any solid state metering or control relays for their intended purpose and make written notations of adjustments on record drawings. Perform start-up of any solid state starters and adjustable frequency drives.

.3 The Contractor shall provide three (3) copies of the manufacturer's field start-up report.

3.5 FIELD ADJUSTMENTS

.1 Follow the manufacturer's instructions and the contract documents concerning any short circuit device settings, heater selection, timing relays, or start-up of components.

3.6 FIELD TESTING

.1 Follow the minimum requirements as stipulated in the manufacturer testing procedure for this type of motor control centre assembly.

.2 Generate a field report on tests performed, test values experienced, etc., and make available to Owner upon request.

3.7 MANUFACTURER'S CERTIFICATION

.1 A qualified factory trained manufacturer's representative shall certify in writing that the equipment has been installed, adjusted and tested in accordance with the manufacturer's recommendations. Equipment shall be inspected prior to the generation of any reports.

.2 The Contractor shall provide three (3) copies of the manufacturer's representative's certification.

3.8 TRAINING

.1 The Contractor shall provide a training session for Owner's representatives for two (2) normal work days at the job site or other office location chosen by the Owner.

.2 Training is separate from commissioning. Training takes place after commissioning has been completed.

.3 The training session shall be conducted by a manufacturer's qualified representative.

.4 The training program shall consist of the following:

.1 Review of the MCC one-line drawings and schedules.

.2 Review of the factory record shop drawings and placement of the various cells.

.3 Review of each type of starter cell, components within, control, and power wiring.

.4 Review contactor coil replacement and contact replacement procedures.

.5 Review the operation.

.6 Discuss the maintenance timetable and procedures to be followed in an ongoing maintenance program.

.7 Provide three-ring binders to participants complete with copies of drawings and other course material covered.

END OF SECTION

SECTION 16496
AUTOMATIC TRANSFER SWITCHES – LOW VOLTAGES

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SECTION 16496
AUTOMATIC TRANSFER SWITCHES – LOW VOLTAGE

1 GENERAL

1.1 SCOPE

.1 Furnish and install the low voltage manual transfer switches having the ratings, features/accessories and enclosures as specified herein and as shown on the Contract Drawings.

.2 The Contractor shall be responsible for ensuring compatibility of all components of the transfer switch assembly.

.3 The equipment shall be free of defects in material and workmanship.

.4 The automatic transfers switch to be supplied as part of the Motor Control Center and integrated into the MCC.

1.2 RELATED SECTIONS

.1 Section 16010 – Electrical General Requirements

.2 Section 16225 – Motor Control Centre

1.3 REFERENCES

.1 The automatic transfer switch and all components shall be designed, manufactured and tested in accordance with the latest applicable standards of,

.1 Canadian Standards Association (CSA),

.1 CAN3-C13, Instrument Transformers.

.2 CSA C22.2No.5.1 & 5.2, Moulded-Case Circuit Breakers, Molded-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 C22.2No.178, 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 MEASUREMENT AND PAYMENT

.1 The Work outlined in this Section shall be included in the lump sum price for Section 16496 – Automatic Transfer Switch – Low Voltage as indicated in the Bid Form.

.2 Payment will be made in accordance with Section 01025 – Measurement and Payment.

1.5 SUBMITTALS

.1 The following information shall be submitted prior to manufacturing the equipment:

.1 Make, model and type

.2 Master drawing index

.3 Front view and plan view of the assembly

.4 Schematic diagram

.5 Cable entry and exit locations

.6 Nameplate schedule

.7 Component list

.8 Conduit space locations within the assembly.

.9 Assembly ratings including.

1. Short-circuit rating

2. Voltage

3. Continuous current rating.

.10 Major component ratings including:

1. Voltage

2. Continuous current rating

3. Interrupting ratings

.11 Cable terminal sizes

.12 Product data sheets

.13 Single line diagram showing controls and relays

.2 The following information shall be submitted prior to commissioning:

.1 Final as-built drawings.

.2 Wiring diagrams of components, controls and relays

.3 Certified production test reports

.4 Installation information

.5 Part list with parts catalogue numbers

.6 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 ENVIRONMENTAL CONDITIONS

.1 The Transfer Switch (ATS) shall be suitable for installation in an ambient temperature between -40°C to +50°C, relative humidity 0-95% non-condensing.

1.7 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

.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.

1.8 QUALIFICATIONS

.1 The Contractor shall ensure that the manufacturer of the ATS assembly will be the manufacturer of major components and control modules installed within the assembly.

1.9 DELIVERY, STORAGE AND HANDLING

.1 Equipment shall be handled and stored in accordance with manufacturer's instructions.

.2 One (1) copy of these instructions shall be included with the equipment at time of shipment.

1.10 OPERATION AND MAINTENANCE MANUALS

.1 Equipment operation and maintenance manuals shall be provided with each assembly shipped, and shall include instruction leaflets and instruction bulletins for the complete assembly and each major component.

2 PRODUCTS

2.1 MANUFACTURERS

.1 Acceptable manufacturer:

.1 Eaton Corporation (Cutler Hammer)

.2 Thompson Technology

2.2 RATINGS

.1 The transfer switch shall be rated 400Amps, 600V, 3 phase, 3W, 60Hz.

.2 Withstand Rating shall be 42kA

.3 The transfer switch shall have equal withstand, closing and interrupting ratings.

.1 The transfer switch shall be 100% equipment rated for continuous duty.

.2 The voltage rating of the transfer switch shall be no less than the system voltage rating.

.3 The continuous current rating of the transfer switch shall be no less than the maximum continuous current requirements of the system.

.4 The transfer switch shall be 100% equipment rated for continuous duty as shown on the Contract Drawings and shall conform to the applicable CSA requirements.

.5 The transfer switches shall be fully rated to protect all types of loads, inductive and resistive, from loss of continuity of power, without de-rating, either open or enclosed.

.6 All pilot devices and relays shall be of the industrial type with self cleaning contacts and rated 10 A.

.7 Transfer shall be based on open transition.

2.3 CONSTRUCTION

.2 The switching panel shall consist of completely enclosed contact assemblies and a separate control logic panel. Control power for all transfer operations shall be derived from the line side of the source to which the load is being transferred.

.2 Each transfer switch shall be positively interlocked both mechanically and electrically to prevent simultaneous closing of both sources under either automatic or manual operation. Main contacts shall be mechanically locked in position in both normal and emergency positions.

.3 Transfer switches shall be capable of being operated manually under full rated load conditions. Manual operation shall be accomplished by integrally mounted pushbuttons. Removable manual operating handles and handles that may move in the event of an electrical operation during the manual operation, are not acceptable. Manual operators requiring source or load disconnection prior to manual operation are not acceptable.

.4 On transfer switches requiring a fourth pole for switching the neutral, the neutral shall be fully rated with equal withstand, closing and interrupting ratings to the power poles. Switched neutral poles which are add-on or overlap, or that are not capable of breaking full rated load current are not acceptable.

.5 The switch shall have a manual neutral position.

.6 The transfer switch shall be mechanically and electrically interlocked so that is shall not be possible for load circuits to be connected to the normal and emergency sources simultaneously regardless of whether the switch is mechanically or electronically operated.

.7 Provide dry contacts for external connection to close after failure of hydro supply to initiate the engine start sequence.

.8 Sending relays to arranged to prevent transfer from normal to emergency until the generator voltage and frequency have reached at least 90% of normal values.

.9 Voltage sensing relays

.1 Monitor all three phases

.2 Pick up at 90% of nominal voltage

.3 Drop out at 70% of nominal voltage

.4 Accuracy : ±2% of nominal voltage

.10 Time delay functions

.1 Normal to Emergency-TDNE; adjustable 5-60Sec, set at 10Sec

.2 Emergency to Normal: TDEM; adjustable 0-30 minutes

.3 Neutral position time delay- TDN; adjustable 0-15 sec

2.4 MICROPROCESSOR LOGIC

.1 The transfer switch shall be controlled by a microprocessor-based controller. The controller shall be hardened against potential problems from transients and surges. Operation of the transfer switch and monitoring of both sources shall be managed by the controller.

2.5 WIRING/TERMINATIONS

.1 Terminal blocks shall conform to NEMA ICS 4. Terminal facilities shall be arranged for entrance of external conductors from the top or bottom of the enclosure. The main transfer switch terminals shall be suitable for the termination of conductors shown on the Contract Drawings.

2.6 POWER SWITCHING DEVICE

.1 Protective switching devices shall be fixed insulated case circuit breakers, Eaton Corporation (Cutler Hammer) type SPB or approved equal. Frame ratings shall be 1600 amps. All breakers shall be CSA certified for application in their intended enclosures for 100% of their continuous ampere rating. Breakers shall be electrically operated.

.2 A selective override circuit shall be provided on breakers having short-time adjustments but without instantaneous adjustments that will allow selectively up to its rms symmetrical short-time rating. This selective override circuit shall allow the breaker to ride through a fully offset

(asymmetrical) fault equal to its rms symmetrical short-time rating in a system having a transformer ratio (X/R) of 6.6 with a maximum single-phase peak current of 2.3 times the rms symmetrical short-time ranging. No deviations from this specification shall be acceptable.

.3 All breakers shall be provided with a true, two-step stored energy mechanism providing a maximum of five-cycle closing. All the energy required for closing the breakers shall be completely stored and held in readiness pending a release to close action. The insulated case breakers shall have high-endurance characteristics being capable of no-load and full-load interruptions at rated current equal to or exceeding the UL endurance ratings for moulded case breakers without maintenance.

2.7 ENCLOSURE

.1 The automatic transfer switch shall be house in an MCC enclosure suitable for location as indicated on the Contract Drawings and as described below.

.1 NEMA 1A surface or flush mounted general purpose enclosures primarily intended for indoor use.

.2 Enclosure and assembly to be CSA certified

.3 Code wiring at each wire end with permanent, non aging slip on markers. Support and run wiring neatly. Protect wiring from mechanical damage by grommets and shields.

.4 Provide indicator lights on MCC front of panel

.1 Normal Power Source

.2 Emergency power source

.5 Province dry contacts for monitoring the following

.1 Normal power available

.2 Emergency power available

.3 ATS on normal

.4 ATS on emergency

.5 ATS in Auto

.6 ATS fault

.6 Terminal blocks to be coded, clamp type, serrated for positive grip and of tough non brittle, unbreakable nylon. Provide test blocks for current transformer secondary connections.

.7 Factory wire panel completely. Use min, No 14 AWG TEW 105°C and colour coded control wiring.

.1 Blue-DC control

.2 Red-AC control

.3 Orange-CT secondary's

.4 Green-Non current carrying ground

.5 White – current carrying ground

.6 Yellow-Interlocks

.7 Brown-Generator excitation

.8 Provide door detent mechanism to maintain hinged door in the open position.

2.8 FINISH

.1 NEMA 1 enclosures shall be painted ANSI 61 gray.

2.9 ACCESSORIES

3 EXECUTION

3.1 FACTORY TESTING

.1 The following standard factory tests shall be performed on the equipment provided under this Section. All tests shall be in accordance with the latest version of CSA and NEMA standards.

.1 Test fully assembled equipment including transfer mechanism, control, relays and accessories factory assembled and tested.

.2 Insulation check to ensure the integrity of insulation and continuity of the entire system.

.3 Visual inspection to ensure that the switch matches the specification requirements and to verify that the fit and finish meet quality standards.

.4 Mechanical tests to verify that the switch's power sections are free of mechanical hindrances.

.5 Check selector switch in modes of operation (Test, Auto, Manual, Engine Start) and record results.

.6 Check voltage sensing and time delay relay settings.

.7 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

.2 The Contractor shall ensure that the manufacturer will provide three (3) certified copies of factory test reports to the Consultant.

3.2 FIELD QUALITY CONTROL

.1 Provide the services of a qualified factory-trained manufacturer's representative to assist the Contractor in installation and start-up of the equipment specified under this Section. The Contractor shall ensure that the manufacturer's representative will provide technical direction and assistance to the Contractor in the general assembly of the equipment, connections and adjustments, and testing of the assembly and components contained therein. Start-up procedures shall include all necessary steps to complete and verify installation.

.2 The Contractor shall provide three (3) copies of the manufacturer's field start-up documentation to the Consultant.

3.3 MANUFACTURER'S CERTIFICATION

.1 The Contractor shall ensure that a qualified factory-trained manufacturer's representative will certify in writing that the equipment has been installed, adjusted and tested in accordance with the manufacturer's recommendations.

.2 The Contractor shall provide three (3) copies of the manufacturer's representative's certification to the Consultant.

3.4 FACTORY TESTING

.1 The transfer switch shall be factory tested prior to delivery to the Site. The Contractor shall ensure that the following tests will be conducted by qualified factory personnel:

.1 Visual Inspection: Electrical and mechanical inspections to verify installed components are of correct ratings; meet the requirements of the Specifications and to ensure regulatory and quality requirements are met.

.2 Mechanical Tests: At a minimum, the following mechanical test shall be performed on the transfer switch,

.1 Power Conductor Torque Verification

.2 Verification of MTS Mechanical Interlock

.3 Manual ATS Mechanism Operation/Adjustment

.4 All Mechanical Fasteners Wire Connections Tight

.3 Electrical Tests: At a minimum, the following electrical tests shall be performed on the transfer switch,

1. Verification of Electrical Interlock

2. Mechanism Adjustment

3. Dielectric Test

.4 Final Inspection: At a minimum, the following final inspection tasks shall be performed on the transfer switch,

1. Calibration Label/Equipment labels Installed and Correct.

2. All safety/warning labels attached.

3. All wiring straight, nearly bundled and adequately protected.

4. All options supplied as specified in the Specification.

5. Enclosure is clean, no paint imperfections.

6. Final documentation is enclosed (Drawing, O&M Manual).

3.5 FIELD TESTING/COMMISSIONING

.1 The transfer switch shall be tested once it has been installed at the Site to confirm proper operation of the system. Fourteen (14) Days advance

notice shall be provided to schedule witness testing. Witness testing activities shall be coordinated with the Contractor, Consultant and Owner as required in advance of the testing. The Contractor shall ensure that qualified local factory-trained field service representatives will conduct the following tests:

.1 Visual Inspection: Electrical and mechanical inspection to verify the installation is correct as recommended by the transfer switch manufacturer and in accordance with NEC/CEC requirements.

.2 Mechanical Tests: At a minimum, the following mechanical tests shall be performed on the transfer switch,

1. Power Conductor Torque Verification
2. Verification of Mechanical Interlock
3. ATS Mechanism Operation
4. All Mechanical Fasteners/Wire Connections Tight
5. Confirmation of correct transfer switch voltage, current and withstand ratings as is required for the application.

3.6 TRAINING

.1 The Contractor shall provide a training session for the Owners representatives.

.2 The Contractor shall ensure that the training session will be conducted by a manufacturer's qualified representative. The training program shall consist of the instruction on the operation of the assembly, circuit breakers and major components within the assembly.

3.7 INSTALLATION

.1 The Contractor shall install all equipment in accordance with the manufacturer's recommendations and the Contract Drawings.

.2 All necessary hardware to secure the assembly in place shall be provided by the Contractor.

.3 All equipment shall be installed and checked in accordance with the manufacturer's recommendations.

END OF SECTION

SECTION 16505
LIGHTING EQUIPMENT

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SECTION 16505
LIGHTING EQUIPMENT

1 GENERAL

1.1 REFERENCES

.1 Comply with the latest edition of the following statutes, codes and standards, and all amendments thereto.

.1 American National Standards Institute/Institute of Electrical and Electronics Engineers (ANSI/IEEE)

.1 ANSI/IEEE C62.41- 1991, Recommended Practices for Surge Voltages in Low-Voltage AC Power Circuits.

.2 ASTM International (ASTM)

.1 ASTM F1137, Specification for Phosphate/Oil and Phosphate/Organic Corrosion Protective Coatings for Fasteners.

1.2 MEASUREMENT AND PAYMENT

.1 The Work outlined in this Section shall be included in the lump sum price for Section 16505 – Lighting Equipment as indicated in the Bid Form.

.2 Payment will be made in accordance with Section 01025 – Measurement and Payment.

1.3 SHOP DRAWINGS AND PRODUCT DATA

.1 Submit shop drawings in accordance with Section 01300 – Submittals.

.2 Submit complete photometric data prepared by independent testing laboratory for luminaires where specified in the Contract Documents, for approval by the Consultant.

.3 Photometric data to include: VCP Table.

2 PRODUCTS

2.1 GENERAL

.1 Supply and install lighting fixtures of the type and number as shown on the lighting fixtures schedule on the Contract Drawings.

2.2 LED LIGHTING

.1 Provide LED Lighting as shown on Drawings

2.3 BALLASTS

.1 Metal halide ballast: design: to ANSI C82.4

.1 Rating: voltage as indicated, for use with 1-175 W metal halide lamp. Provide circuitry for standby quartz lamp.

.2 Totally encased and designed for 40°C ambient temperature.

.3 Power factor: minimum 95 % with 95% of rated lamp lumens.

.4 Type: solid state.

.5 Minimum starting temperature: minus 29°C at 90% line voltage.

.6 Mounting:

.7 Crest factor: 1.8 maximum current, 2.0 maximum voltage.

2.4 EMERGENCY LIGHTING

.1 Approved Suppliers:

.1 Lumacell Inc. a Division of Thomas & Betts Ltd.

.2 EmergiLite, Thomas & Betts Ltd.

3 EXECUTION

3.1 INSTALLATION

.1 Locate and install luminaires as indicated in the Contract Documents.

.2 Remove existing lighting and replace with new as shown on Contract Drawings

3.2 WIRING

.1 Connect luminaires to lighting circuits:

.1 Through rigid conduit for all luminaire designs

3.3 LUMINAIRE SUPPORTS

.1 Install lighting fixtures secured to wall or ceiling.

3.4 LUMINAIRE ALIGNMENT

.1 Align luminaires which are mounted in continuous rows to form straight uninterrupted line.

.2 Align luminaires which are mounted individually parallel or perpendicular to building grid lines.

END OF SECTION

SECTION 16670
LIGHTNING PROTECTION SYSTEM

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3 EXECUTION 2

3.1 INSTALLATION 2

SECTION 16670
LIGHTNING PROTECTION SYSTEM

1 GENERAL

1.1 SCOPE OF WORK

.1 Provide lightning protection systems for all areas and facilities containing stacks.

1.2 SUMMARY

.1 Comply with the requirements of Division 1 – General Requirements and Section 16010 – Electrical General Requirements.

1.3 REFERENCES

.1 Comply with the latest edition of the following statutes, codes and standards and all amendments thereto

.1 CAN/CSA-B72 Installation Code for Lightning Protection Systems.

.2 IEEE 80 Guide for Safety in AC Substation Grounding.

.3 CSA C22.2 No. 41 Grounding and Bonding Equipment.

1.4 MEASUREMENT AND PAYMENT

.1 The Work outlined in this Section shall be included in the lump sum price for Section 16670 – Lightning Protection as indicated in the Bid Form.

.2 Payment will be made in accordance with Section 01025 – Measurement and Payment.

1.5 SUBMITTALS

.1 Copy of Fire Marshal of Ontario issued license

.2 Dimensioned layout drawings showing details of lighting protection system

.3 Details of components and materials

.4 Two copies of Installation Certificate submitted by Contractor to Fire Marshal of Ontario.

1.6 QUALITY ASSURANCE

.1 The Contractor shall have the Fire Marshal having jurisdiction at the Site license the lightning protection system vendor.

2 PRODUCTS

2.1 APPROVED SUPPLIERS

.1 Lightning Arrestor:

.1 Dominion Lightning Rod
.2 Approved Equal

2.2 MATERIALS

.1 Materials are to comply with the requirements of the Fire Marshall of Ontario.

.2 Aerial terminals: solid copper, a minimum of 16 mm diameter, point tip, mounted on bronze bases

.3 Conductors: Stranded, bare, tinned copper for roof grid, downlead and buried connections.

.4 Thermit welds: Exothermically welded connections, compatible with materials being interconnected, designed for the specific application and grounding conductor size, Cadweld by Erico Products Inc.

.4 Compression connections: Pure wrought copper material, factory fitted with oxide inhibiting compound, by Brundy Inc., Thomas & Betts Ltd.

.5 Ground rods: 19mm diameter, 3050 mm long, copper clad steel construction with copper exterior coating permanently bonded to steel core, chamfered top, machined conical point.

3 EXECUTION

3.1 INSTALLATION

.1 Provide system to comply with codes and standards listed. The installer shall be licensed by Fire Marshall of Ontario.

.2 Provide bare copper conductor roof and downlead cables.

.3 Utilize thermit welded copper connections or mechanical connectors acceptable to the Consultant for cable to ground rod, cable to cable and cable to steel connection. Ensure clean and dry connections.

.4 Utilize bimetal connectors accepted by Consultant for copper to aluminum connections.

.5 Install ground rods.

.6 Connect downlead conductors to ground rods. Protect grounding conductors subject to mechanical damage with rigid aluminum conduit or guards bonded at ends.

END OF SECTION

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INSTRUMENTATION AND CONTROLS

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SECTION 16900
INSTRUMENTATION AND CONTROLS

1 GENERAL

1.1 GENERAL REQUIREMENTS

.1 This Section covers general and specific requirements for the supply and installation of all instrumentation and process control systems as specified herein and as shown in the Contract Drawings.

.2 General Conditions, Supplementary Conditions and Division 01 apply to this Section.

1.2 RELATED SECTIONS

.1 Section 11300 – Process Equipment and Support System

.2 Section 11311 – Odour Control Unit

.3 Section 15070 – Station Piping and Valves

.4 Section 16010 – Electrical General Requirements

.5 Section 16122 – Wires and Cables 0-1000V

.6 Section 16223 – Motor Starters to 600V

.7 Section 16321 – Natural Gas Generating Units (Radiator Cooled)

.8 Section 16450 – Grounding – Bonding

.9 Section 16483 – Motor Control Centre

.10 Section 16496 – Automatic Transfer Switches – Low-Voltage

1.3 REFERENCES

.1 All material, equipment, installation and workmanship shall meet the standard requirements established by:

.1 Ontario Electrical Safety Code (OESC)

.2 Canadian Standards Association (CSA) C22.2

.3 Canadian Electrical Manufacturers Association (CEMA)

.1 National Electrical Manufacturers Association (NEMA)

.2 Electrical and Electronic Manufacturers Association of Canada (EEMAC)

.3 International Society of Automation (ISA)

.4 Electrical Safety Authority (ESA)

.5 Electronic Industries Association / Telecommunications Industries Association (EIA/TIA 606)

.6 National Fire Code, National Fire Protection Association (NFPA): NFPA 820, Fire Protection in Wastewater Treatment and Collection Facilities, 2008 Edition.

.7 Underwriters Laboratory, Inc. (UL): 508, Standards for Safety, Industrial Control Equipment.

.8 American Petroleum Institute (API): API RP 550 P1 S1 – Revision 3, 1997

.1 All field devices shall be rated as noted on the Device Data Sheets provided in the Section 16900 SCADA and Instrumentation appendices. All field devices are to be suitable for the area classification in which they are installed.

.2 The Contractor shall refer to the Site Acceptance Testing Sheets (provided in the Section 16900 SCADA and Instrumentation appendices). Instrument and equipment testing will form a component of the Site Acceptance testing.

.3 Comply with all the applicable municipal, provincial, and federal regulations and by-laws including Ontario Building Code, Ontario Electrical Safety Code, Canadian Electrical Code and all other applicable regulations.

.4 Provide all necessary licenses, permits, approvals and certificates required to complete the work. Provide regular inspections and a final inspection with the local Electrical Safety Authority office(s).

1.1 DEFINITIONS AND ABBREVIATIONS

.1 The following terms are used in design documents to describe the scope of work associated with various devices. The terms shall have the following definitions in the context.

.1 **Abandon electrical connections:** make safe, disconnect and isolate wire ends at device, push the ends into their terminal box/conduit and seal opening with cap/cover suitable for the environment but at least watertight.

.2 **Abandon process connections:** make safe and insert a permanent isolating device, requiring tools for removal, between the process and the abandoned device/system.

.3 **Abandon:** abandon process and electrical connections, as applicable, make pertaining process and electrical systems work safely after disconnection of abandoned item(s).

.4 **Augment:** Add components, cabling, etc., as specified, to increase the capability of the device. e.g., add breakers to an existing MCC or replace PAC components in a Control Panel.

.5 **Calibrate and Re-Wire:** Calibrate equipment to specified standards and wire as appropriate to new PACs.

.6 **Device Group:** Group of devices and equipment that make up one process unit, for example one train in a process area.

.7 **Existing:** The device and the I/O wiring exist.

.8 **Extend Wiring:** Identify existing device wiring. Disconnect safe from existing Control
Panel. Re-terminate wiring to new terminal block with new wire numbers. Extend wiring from existing panel to new Control Panel.

.9 **Future:** Future installation. However the panel builder shall complete all the I/O point wiring to outgoing terminals in the PAC Panel.

.10 **Installation & Wiring:** Take custody and storage of third party delivered new item (device/assembly), include work for providing existing system with proper receptacles to receive the new item (e.g. cutting/flanging of existing pipe) and power and control wiring/conduit to the indicated destinations. Provide installation of all skid mounted equipment and loose items including Control Panel. Provide wiring from all devices to Control Panel as shown in Process and Instrumentation (P&ID) drawings and loop wiring diagrams.

.11 **Loop check:** A complete loop check shall verify from a field device to a channel in PAC Input module or from a channel in PAC Output module to a field device. A PAC Engineering Workstation shall be used for loop test to show signal flowing through loop correctly. On-site loop check shall test the entire loop, stroking motorized or actuated field equipment, monitoring and operate through PAC Engineering Workstation.

.12 **Modify Device:** alter existing device as indicated to make it suitable to be assembled with the balance of items included into the package. For example, the preparation of an existing manual valve to be equipped with a new electric actuator, or making an existing panel fit to host a new PAC, etc. Provide all I/O wiring in accordance with P&ID drawings and loop wiring diagrams. Also provide 120 VAC power circuit from the respective Control Panel for all non two-wire instruments.

.13 **Modify Wiring:** Disconnect safe from existing Control Panel. Re-terminate to new Control Panel. Carry out necessary modifications of the device wiring to accommodate changes or upgrade of other related devices.

.14 **New:** Provide new item (device/assembly), include work for receiving new items (e.g. cutting/flanging of existing pipe) and control wiring/conduit to the indicated destinations. Provide all I/O wiring in accordance with P&ID drawings and loop wiring diagrams. Also provide 120 VAC power circuit from the respective Control Panel for all non two-wire instruments.

.15 **Pre-Purchased System:** A Pre-Purchased System is a predefined, tendered and awarded system to a supplier by the Owner. It shall be excluded from this contract.

.16 **Product Data Sheets** - Appendix 1-1: Product Data Sheets for instrumentation devices only.

.17 **Provide:** Means supply, install, setup/calibrate, test and place into successful operation. Submit site configuration/setup sheet for all instruments where site configuration/setup is required. Submit factory calibration sheet for all instruments. Submit site verification report, approved and signed by Engineer, for all instruments.

.18 **Relocate:** Make safe the device, remove and install the device at the new indicated destination. Provide new wiring to the relocated device. Provide 120 VAC power circuit from the respective Control Panel for all non two-wire instruments.

.19 **Remove:** abandon and make safe all process and electrical connections, remove the item and mend the void space/process to its intended function. For example: for Venturi tubes - replace with suitable spool piece, for an MCC section – close adjacent MCC line-up and cover exposed trench with properly secured checker plate, make related process and electrical systems work safely after disconnection of removed item(s).

.20 **Replace:** verify that replacement material fits the replaced item and provide adapters as required, abandon and make safe all process and electrical connections, remove the item, provide new item with required adapters, make pertaining process and electrical systems work safely after replacing item(s). Provide all I/O wiring in accordance with P&ID drawings and loop wiring diagrams. Also provide 120 VAC power circuit from the respective Control Panel for all non two-wire instruments.

.21 **Re-terminate:** Identify existing device wiring. Disconnect safe from the existing Control Panel. Re-terminate to new Control Panel with new wire numbers.

.22 **Upgrade Device:** Existing device. Generally requires procurement of associated components like auxiliary relays, selector switches, pushbuttons, solenoid valves etc. Procurement shall be made based on information provided under respective equipment divisions. Provide I/O wiring from the device to new PAC panel as shown in the P&ID drawings and loop wiring diagrams. Also provide 120 VAC power circuit from the respective Control Panel for all non two-wire instruments.

.23 **Vendor Package / Pre-Purchased System:** Equipment/Devices identified as "Vendor Package" in the P&ID shall be provided by the general contractor. No data sheet is available for instrument/ components shown within the package. Individual components shall be procured by the general contractor through the main equipment vendor. Include work for receiving new items (e.g., cutting/flanging of existing pipe) and control wiring/conduit to the indicated destinations. Provide all I/O wiring in accordance with P&ID drawings. Also provide 120 VAC power circuit from the respective Control Panel for all non two-wire instruments. Installation, wiring, testing and commissioning is the joined responsibility of the equipment vendor and general contractor.

.24 **Wire New I/O:** make safe the device, open its junction box and supply and install new wiring and conduit to connect it to the indicated destination. Make necessary modification of the circuit where required. Also provide 120 VAC power circuit from the respective Control Panel for all non two-wire instruments.

.2 Abbreviations:

.1	AMS:	Asset Management System
.2	CP:	Control Panel
.3	CS:	Computer Subsystem.
.4	DCS:	Distributed Control Subsystem.
.5	DCU:	Distributed Control Unit.
.6	ESA	Electrical Safety Authority
.7	FAT/FDT:	Factory Acceptance Test / Factory Demonstration Test
.8	FOCS:	Fiber Optic Communication Subsystem.
.9	HMI:	Human Machine Interface, alias for OIT
.10	HVAC:	Heating, Ventilating, and Air Conditioning.
.11	I&C:	Instrumentation and Control.

.12	I/O or IO:	Input and Output.
.13	IPS:	Instrument and Panel Subsystem.
.14	ISR:	Intrinsically Safe Relays
.15	LCP:	Local Control Panel
.16	MCC:	Motor Control Center
.17	O&M:	Operation and Maintenance.
.18	OIT	Operator Interface Terminal, alias for HMI
.19	ORT:	Operational Readiness Test
.20	P&ID:	Process and Instrument Diagram.
.21	PAC:	Process Automation Controller
.22	PAT:	Performance Acceptance Test
.23	PC:	Personal Computer.
.24	PCS:	Process Control System comprising PAC's, and OIT's, communications systems and related hardware and software.
.25	PMCS:	Process Monitoring and Control Software.
.26	SAT/SDT:	Site Acceptance Test / Site Demonstration Test.
.27	SCADA:	Supervisory Control and Data Acquisition.
.28	SLDC:	Single Loop Digital Controller.
.29	SSDT:	Staging Site Demonstration Test.
.30	TS:	Telemetry Subsystem.
.31	UPS:	Uninterruptible Power Supply

1.2 GENERAL REQUIREMENTS

.1 The Contractor shall supply and install all instrumentation and control wiring.

.2 Comply with the requirements of Division 1.

.3 Refer to the Contract Drawings to ensure completeness of installation for all items and that these items are compatible with the control and operational intent of the design of this Contract.

.4 Comply with the requirements of Section 01110 – Summary of Work, Section 01310 – Project Management and Coordination.

.5 At any time, the Contractor to coordinate all ongoing construction activities with contract administrator or designated person assigned by contract administrator to ensure that all other ongoing or planned operation, maintenance, testing, commissioning and construction activities are unhampered by unnecessary delays or obstructions. The Contractor shall obtain written approval from the Owner, Plant Operations and Contract Administrator prior to implementing any modifications and/or interruptions to the existing plant instrumentation and control systems.

.6 All process control and instrumentation functionality described in the Contract Drawings and documents shall be fully implemented.

.7 Without limitation to the Sections included in this Division, the equipment supplied shall be complete with all accessory items, whether specifically mentioned or not in the Contract Documents, so as to provide completeness of installation, controls and operation as intended. All equipment installation shall be as recommended by the equipment manufacturer or as described in the manufacturer's installation drawing provided with the equipment.

.8 Demonstrate operational requirements and put all equipment into operational service to the satisfaction of the Consultant and the plant operations staff.

.9 All equipment performance requirements shall be based upon worst case scenarios.

.10 Provide all necessary equipment, tools, and labour for installing and testing all equipment supplied under this Section.

.11 Provide documentation in timely manner and as specified.

.12 Safeguard against:

.1 Problematic hardware: Unstable hardware triggered by hardware or device driver conflicts, component substitutes that deviate from specifications or fail to meet performance criteria, including unauthorized tampering with computer operating system or application setup parameters. Any of which create additional setup time for the Engineer and expand resources.

.2 Unprepared FAT: Non-compliance in panel assembly, substandard workmanship or poor preparation prompting the Engineer to reject FAT and thereby having to reschedule further sessions.

.3 Unprepared Commissioning & Site Inspection: Incomplete loop checks, instrument calibration, wire or installation, thus requiring an inordinate amount of repeat site visits causing unnecessary delays.

.4 Unresolved maintenance issues: Instruments, Control hardware, and all essential works required for the facility to run in a safe and fully automated fashion shall be kept in proper working order at all times. Resolve all maintenance obligations in a timely fashion to avoid unnecessary operator overtime incurred by the Owner, or causing the Owner or Contract Administrator to seek out direct assistance from your suppliers or local trades. This applies during initial stages of commissioning and throughout the maintenance warranty period.

1.3 SCOPE OF WORK

.1 General

.1 Major site-specific requirements to be undertaken by the Contractor are listed here. The Contractor is required to review the Contract Documents in their entirety for a complete understanding of the scope of work involved under the Contract.

.2 The Work in this Section generally consists of the supply of all labour, tools, services and provision of all products required for a complete, integrated, operational instrumentation and control system in accordance with the Contract Specifications and Drawings. Major Work Items (include but are not limited to): engineering, furnishing, installing, calibrating, adjusting, testing, documenting, starting up, and Owners' training.

.3 Provide complete and fully functional instrumentation and control system to suit process design requirements as indicated on the Contract Drawings and Specifications.

.4 The following is summary of major work:

.1 Provide, install, test and commission one PAC Control Panel (HC062CP001) equipped with Allen-Bradley CompactLogix PAC for process control upgrades as shown in this Section and Instrumentation Drawings.

.2 The PAC Control Panel will be located in the Electrical Room as shown on the Electrical Drawings.

.3 Provide and wire all analog, discrete, network inputs and outputs to the PAC as shown on the drawings and in this Section's Appendices for Panel Specifications and in accordance with the Process Control Narrative (PCN) Sewage Pumping Station I/O List.

.4 The PAC Control Panel to be connected with the SCADA Network through a new Network Access (NAC) panel (HC062 WAN Panel HC062WAN01) as shown on the drawings.

.5 Coordinate closely with Contract Administrator when carrying out work such as panel wiring, FAT, and SAT. Demonstrate overall system integrity.

.6 Sign off the check list on each device installation using Instrument Installation and Calibration Sheets. Provide detailed calibration sheet/report on each instrument to the Contract Administrator for approval.

.5 PAC, SCADA applications Software: Provided by the Consultant. Contractor's support shall include the following:

.1 Activities as specified in the Sequencing and Scheduling subsection of this Section.

.2 Assistance with On-Site checkout of applications software.

.3 Installation, testing and commissioning of equipment and instruments as detailed in other Sections of the Contract Documents.

.4 The new control platform is Allen-Bradley CompactLogix Programmable Automation Controller (PAC), where all automatic control tasks are implemented. The supervisory level is General Electric (GE) Proficy iFIX software, where functions like remote operation, monitoring and data logging are fulfilled.

.2 Design Requirements

.1 Provide all devices, components and accessory items necessary for the successful implementation and operation of the instrumentation and control systems.

.2 Complete detailed design of system drawings and selection of system components and accessories.

.3 Design as shown and specified includes:

.1 Functional requirements, and

.2 Generalized component specifications, and

.3 Detailed drawings for proposed control panel layouts, PAC I/O module wiring and panel power.

.4 The Contractor is responsible for gaining a comprehensive understanding of the process equipment and the control equipment. The Contractor shall coordinate all aspects of instrumentation and control wiring and hardware to be compatible with the process itself, and associated equipment (after optimum tuning and adjusting of mechanical, electrical, and instrumentation equipment).

.3 SCADA System and PAC Programming

.1 PAC application software programming will be completed by the Consultant. Coordinate closely with the Contract Administrator when carrying out all work to demonstrate overall system integrity, allowing two weeks' time for the essential portions of control software to be installed and tested.

.2 Provide testing and commissioning services including those associated with installing and testing software prepared by the Consultant. Assign qualified staff whenever it is required by the Consultant during PAC and SCADA software testing. Allow in the Contract Price, for any additional time deemed necessary to meet the testing and commissioning requirements.

.3 Provide FATs to demonstrate the operational functionality of PAC and SCADA hardware and communications by using suitable "dummy" or shell programs. Notify the Consultant ten (10) working days in advance of the FAT such that this test may be witnessed by Consultant and City of Hamilton SCADA representatives.

.4 New Control Panels/Consoles

.1 Install including field wiring, setup/calibrate, test, commission and place into successful operation all panels free issued as part of vendor or pre-purchased package systems.

.5 Field Devices

.1 Provide, install, wire, calibrate, test and commission all field instrumentation, PAC panel, and control system hardware including all lightning & surge protection, and all peripheral devices necessary based on the Contract Specifications and Drawings.

.2 Provide all field device tags and panel labels as required.

.3 Sign off the check list on each device installation using the Appendix 2-1 Instrument Check and Sign-Off Sheets. Provide detailed calibration sheet/report on each instrument to the Engineer for approval.

.4 Provide configuration and programming for all microprocessor based equipment including single loop or multi-loop controller, analyzer, gas detection systems and other intelligent instruments.

.5 Provide all interconnecting cabling between controllers.

.6 Install, including wiring, test and commission all instruments and equipment free-issued by pre-selected equipment vendors.

1.4 INSTRUMENTATION AND EQUIPMENT MANUFACTURERS

.1 Equipment shall be selected from an approved manufacturer indicated within this Section.

.2 When a product is specified in succeeding Sections of the Specification with a manufacturer's name and specific identification or model number, and the words "or approved equal" are not included, and acceptable manufacturers are not specified, then the specified product shall be supplied. Alternative or substitute products shall not be acceptable.

.3 Design is based on the first named manufacturer. If the Contractor proposes the use of a product other than the first named, and the submission is accepted; if some redesign is required, it shall be completed by the Contractor at no additional cost to the Contract.

.4 For the purposes of limiting support costs and maintenance costs, use one instrument manufacturer/distributor for as many products as is practical.

1.5 SYSTEM SUPPLIERS

.1 The supply and installation of instruments, PAC control panel and control system hardware, including testing, calibration, commissioning shall be performed as a complete system by an approved instrumentation and control subcontractor (System Supplier). Include for service technician qualified by the manufacturer. Unless otherwise specified, only the manufacturer’s technicians are acceptable where gas detection system, or flow meters are concerned. This includes subcontracting main suppliers and their services as necessary, and especially if called for in the Specification.

.2 All on site control and instrumentation work is to be performed under the direct supervision of a qualified and experienced supervisor employed by the instrumentation and control subcontractor.

.3 The system supplier shall be responsible for coordinating with the equipment vendor under other Sections of these Specifications and under this contract to install the vendor supplied loose instruments and devices that require field installation. The system supplier shall provide all necessary mounting hardware, piping, wiring etc. for proper operation of the vendor supplied field instruments and devices.

.4 All equipment shall be designed and installed in full conformity with the Contract Drawings, Specifications, engineering data, instructions, recommendations of the manufacturer.

.5 The system supplier shall identify the specific staff members, including system engineers, and maintenance engineers that shall be responsible for the control system works specified herein.

.6 Approved System Suppliers are:

.1 Superior Boiler Works & Welding Ltd., Stoney Creek, Ontario, (905) 643-6628, www.sbww.com

.2 Selectra Inc., Stratford, Ontario, (519) 271-0322, www.selectra.ca

.3 Summa Engineering Limited, Mississauga, Ontario, (905) 678-3388, www.summaeng.com

.4 Procon Constructors Inc., Welland, Ontario, (905) 732-0322, www.procon.ca

1.6 SUBMITTALS

.1 General

.1 Comply with requirements of Section 01330 – Submittal Procedures.

.2 Working drawings must be submitted and reviewed for all equipment specified in this Section, before ordering or fabrication.

.3 Electronic and hard copies of all shop drawings are to be provided.

.4 Drawing Index: Prepare a clear, typed index listing the number and title of all proposed Purpose-made drawings and submit for review within fourteen (14) days following the Notice to Proceed.

.5 Wherever there is a discrepancy between information provided in this Section and on a drawing, notify the Contract Administrator and request clarification.

.6 Unless otherwise specified or indicated, submit detail design drawings, shop drawings, specifications sheets or product data sheets for all instruments, devices, junction and terminal boxes. All dimensions, rating, curves, etc. to be in SI units.

.7 Milestone Schedule: Prepare and submit a proposed schedule of instrumentation and control work per General Conditions, indicating the following major milestones as a minimum:

.1 Hardware shop drawings submission – including initial issue of Product Data Sheets.

.2 Preliminary issue of operating and maintenance instruction manual.

.3 Panel inspection and factory acceptance testing (FAT).

.4 Signed calibration sheet or report on each field instrument.

.5 Report on proper site installation, inspection, and loop check.

.6 Final submission and sign-off of Product Data Sheets in accordance with this Section.

.7 Site acceptance testing (SAT).

.8 Maintenance training sessions on field instruments.

.2 Purpose-made Drawings:

.1 Prepare Purpose-made drawings neatly and accurately by means of the latest version of AutoCAD or as otherwise advised. Do not use external references or customized file extensions. Provide AutoCAD and fully portable electronic file copies of all drawings.

.2 Make electronic submissions in both AutoCAD and Portable Document Format (PDF). If necessary, hardcopy submissions to be on reproducible material such as tabloid/ledger-size paper, or legal-size paper. All (electronic and hardcopy) submissions to be complete with a title block containing the Engineer's P.E.O. number, Contract number and company logo, a drawing and Contract title as stated in the Contract drawings, and a referenced drawing number (related to a file name if applicable). Provide tabular columns to record the original submission date, a revision number, date and reason for subsequent revisions, and signature of authorized issuing staff member.

.3 Submit, as a minimum, the following Purpose-made drawings:

.1 Scaled, referenced, front of panel layouts, and general arrangement drawings.

.2 Scaled, referenced, internal panel layouts (may be combined with the above).

.3 Equipment and/or panel block wiring diagrams showing termination identification at each item of equipment, inter-wiring and cable numbering, all peripheral equipment, any PAC module DIP switch settings, pin assignments for D-shell connectors, plugs and jacks, and instrument/equipment tag numbers.

.4 Where issued, loop drawings are typical for guidance only. Submit itemized instrument wiring arm drawings for all analog process loops and discrete connections, generally in accordance with ISA 5.4 format and as a minimum incorporating the following details: PAC terminal numbers, Control Cabinet terminal numbers, field terminal numbers, wire numbers, contact orientation, power source identifications and equipment numbers. The AutoCAD files for these drawings are to be edited with “Record Drawing” detail and made accessible to the Engineer during the Contract.

.5 List of expendable materials and quantities.

.6 List of Instrument, Equipment and Panel Identification Nameplates.

.3 Vendor Equipment Shop Drawings:

.1 Submit Shop Drawings for all field and panel mounted instruments, controllers, gauges and similar products. Manufacturers' documentation shall be accepted only if the following information is clearly indicated and highlighted for the equipment proposed. Submit the following:

.1 A quotation from the proposed instrument or equipment vendor, (prices removed), including tag numbers, quantities, options being provided and a full description and performance data.

.2 Installation details depicting mounting assemblies, physical dimensions, process connection sizes (e.g. flange ratings and styles).

.3 Termination details clearly indicating the type and lengths of external wiring required and electrical connections.

.4 Power supply rating, input and output signal ranges, maximum measured process range and calibrated scale, physical, electrical and environmental requirements.

.5 Exact catalogue model numbers for each piece of equipment and its accessory options, and clearly referenced by the respective instrument or equipment tag name in accordance with the Contract Documents (improperly tagged items shall be rejected).

.6 A separate sheet with manufacturers' recommended list of spare parts including individual pricing with the shop drawings.

.2 Contractor shall note compliance and variance in writing. The Specification shall have precedence over approved vendor drawings. Stamp the shop drawings submitted as either "COMPLIES EXACTLY WITH SPECIFICATION" or "DEVIATES FROM SPECIFICATION" as appropriate. In the latter case, describe deviations exactly and indicate how they impact the specified duty of the component. The Consultant shall assess acceptability of submission.

.4 Shop Drawings for Programmable Equipment:

.1 Bill of Materials to show documentation, software, hardware including communications gear and tools as follows:

.1 For software items include: Publisher, title, version, part number, serial number, media type and size, and information contained on label. All software shall be registered to the Owner.

.2 For documentation include: Title and publisher for each item.

.3 For tools include: Documentation and appropriate hardware and software items.

.2 For Hardware:

.1 Physical, electrical and environmental requirements.

.2 Equipment layout drawings showing location of hardware, boards, jacks, cables and terminals.

.3 Show addresses for each hardware component including channel number, IP address.

.4 Network Communications wiring diagram showing all devices, ports, and cables. Identify locations of devices. Identify protocols utilized by each node/firmware and software applications including PAC modules.

.5 I/O list, including the following information at minimum:

.1 I/O type (DI, DO, AI, AO)

.2 Controller tag

.3 A description of the I/O point (e.g., Raw Sludge Pump Number 1).

.4 I/O point address including processor number, rack number, I/O module, slot, address, field interface terminal strip number and terminals.

.5 Field wire number.

.3 For networks:

.1 Submit all network testing requirements to the Consultant within four (4) weeks following receipt of the order defining required network testing of the network cabling. These tests shall be performed by Contractor's network installer demonstrating satisfactory communications connectivity.

.5 Product Data Sheets:

.1 Product Data Sheets specifying instruments and equipment are included in Appendix 1-1 of this Section. Complete these sheets with the information noted below and any other data pertinent to the equipment and the application.

.2 Initial submission for review to accompany Shop Drawings:

.1 The product manufacturer and the supplier or representative.

.2 The complete model or catalogue number(s) including any special options.

.3 The available adjustment range(s) and the contract operating range(s).

.3 Second Submission during pre-commissioning, testing and calibration period:

.1 Serial numbers, part numbers, dates of installation and calibration.

.2 Any special procedures required to duplicate calibration.

.3 This submission is for signature by the Contractor and the Engineer following acceptance of the operation of each instrument.

.4 Final Submission of signed-off Product Data Sheets included with Operating and Maintenance Instruction Manuals:

.1 All of the above information,

.2 phone and fax numbers of contact person for product support/service.

.5 Where there is any discrepancy, the description provided on the Product Data Sheet takes precedence over the model number given in the data sheet.

.6 Record Drawings

.1 Refer to Section 01780 – Closeout Submittals.

1.7 SUBMITTAL PACKAGES

.1 General

.1 Submit all documentation required as described in this Section.

.2 Submission Format:

.1 A complete set of Purpose-made Drawings, Shop Drawings, and the initial submission of the Product Data Sheets shall be bound into one volume and issued for approval before the commencement of work.

.3 Submit the following for each instrument provided:

.1 Shop Drawing Submittals:

.1 Manufacturer's design and performance specification data and descriptive literature.

.2 Complete manufacturer model number, identifying all required and optional accessories to be provided.

.3 Instrument Data Sheets with all fields completed. The Contractor shall provide Instrument Data Sheets using the typical Instrument Data Sheets, provided in this Section.

.4 Catalog literature edited to indicate specific items provided.

.5 Equipment dimensioning, installation requirements and recommendations.

.6 Mounting details for all typical installation, requirements and special details for non-typical applications.

.7 Methods and materials required for installation. Include power and signal connection details.

.8 Electrical/pneumatic signal and power connection diagrams.

.9 Other specific submittal information as specified in the particular instrument Specification Section.

.2 List of recommended spare parts and spare parts to be provided.

.1 List of optional accessories.

.3 As-Built Documentation:

.1 Operation and maintenance documentation for each type instrument after Product approval based on shop drawing review.

.2 Calibration certifications from the manufacturer for each calibrated instrument.

.3 Provide electronic configuration file for all smart instruments.

.4 Update shop drawings, Instrument Data Sheets, calibration reports and "As Built" drawings including: P&ID, control schematics and electrical Drawings as required to match field conditions.

.4 Submit the following documents prior to conducting the Instrument Acceptance Testing:

.1 Calibration Procedure(s) to be followed in the test. The calibration method and tools will not cause greater than +/- 0.5% error in any test.

.2 Any special Procedure(s) to be followed in the test.

.3 Identify site verification, set-up and calibration to be done by the equipment manufacturers.

1.8 SEQUENCING AND SCHEDULING

.1 Refer to Section 01110 - Summary of Work, Section 01310 - Project Management and Coordination, Section 01640 - Manufacturers Services, Section 01650 - Equipment Startup and Performance Testing, and Section 01660 - Commissioning, for the Contractor's scheduling requirements.

.2 The Contractor shall schedule Work with the Contract Administrator.

.3 PAC Applications Software Configuring by the Consultant at the programmer or Consultant's Office:

.1 Provide the following services to allow the programmer to carry out programming of PACs and OIT/HMIs before start-up, make the following arrangements.

.1 Expedite shop drawings for all equipment and panels with no exceptions.

.2 Following the Panel FAT Test, deliver complete PAC racks and associated PLC processors and I/O modules to the programmer's office for the Software FAT Test.

.3 Provide telephone support for the Products supplied. If the equipment malfunctions while at the programmer's office and telephone support fails to solve a problem within 24 hours, then defective equipment shall be replaced under the warranty and new equipment shall be delivered to the programmer's office.

.4 Set a test date, which is agreeable within the contract schedule. In the construction schedule, state the PAC equipment delivery date prior to Software FAT test. The complete equipment package shall be provided to the Programmer a minimum of 2 months prior to the Software FAT Test.

.5 The test plan must be approved in writing by the Consultant, prior to commencement and should show the schedule of work to include dates.

.6 When directed, pick up the equipment and deliver to the Site for installation prior to the SAT test.

.7 Provide warranty on the equipment during the period it is at the programmer's office on the same basis as if delivered to the Site.

.4 Submit testing procedures and schedules of work no less than one (1) month prior to the projected test date for the individual component. This will include specific dates for when the various test procedures are to be carried out and identified assistance from City.

.5 Prerequisite Activities and Lead Times: Do not start the following key Contract activities until prerequisite activities and lead times listed below have been completed to the satisfaction of the Contract Administrator:

.1 Submittal of Progress Schedule and Schedule of Estimated Progress Payments:

.1 Prerequisite: Detailed Progress Schedule specified in Section 01310 – Project Management and Coordination, completed.

.2 Shop Drawing Reviews by the Consultant:

.1 Prerequisite: Contract Administrator acceptance of Schedule of Estimated Progress Payments and Progress Schedule.

.2 Schedule: In accordance with completed schedule of Shop Drawing and Sample submittals specified in Section 01330 – Submittal Procedures.

.3 Tests:

.1 Prerequisite: Associated test procedures Submittals completed.

.4 Training:

.1 Prerequisite: Associated training plan Submittal completed.

.5 PAC applications software configuring and testing by the Consultant.

.1 Prerequisite: Panel FAT completed.

.2 Duration: as required within the contract schedule.

.6 PAC Shipment to Site: The following prerequisites shall be met before shipping PAC equipment to site:

.1 Approval of Shop Drawings and preliminary operation and maintenance data.

.2 FAT completed.

.3 Additional prerequisite for equipment previously shipped to the Consultant's office: Completion of PAC application software configuring and testing by Consultant.

.7 PAC Installation:

.1 Prerequisite: Equipment received at the Site.

.8 Functional Test Part One:

.1 Prerequisite: PAC installation complete.

.9 Functional Test Part Two:

.1 Prerequisite: Prerequisite: Functional Test Part One completed.

.10 Performance Test:

.1 Prerequisite: Functional Test Part Two completed and facility started up.

.11 Reliability Test:

.1 Prerequisite: Performance Test completed.

1.9 OPERATING AND MAINTENANCE MANUALS

.1 Submit Operating and Maintenance Manuals in accordance with Section 01730 – Operation and Maintenance Manuals.

.2 In addition to requirements for operating and maintenance instruction manuals specified in Section 01730 – Operation and Maintenance Manuals, include the following:

.1 Manufacturer's hardware and distribution software manuals.

.2 Special instructions or procedures, including package systems, software and instrument trouble-shooting techniques.

.3 Systematic procedures for operations personnel to start up, shut-down, manually override and locally operate all related equipment in accordingly titled manual sections.

.4 Recommendations on equipment maintenance and suggested spare parts.

.5 Final Shop Drawings and signed-off Product Data Sheets as defined in this Specification.

.6 Copies of Record drawings of all Purpose-made Drawings.

.7 Name(s), address(s) and telephone number(s) for local qualified system and/or product service representatives.

.8 Calibration certificates from the manufacturers for each calibrated instrument.

.9 Name(s), address(s) and telephone number(s) for local qualified system and/or product service representatives.

.10 Calibration certificates from the manufacturers for each calibrated instrument.

.11 Certified network test reports.

.3 Provide operating and maintenance instruction manual for Instrumentation and Controls in a separate indexed and tabbed manual, or separate indexed and tabbed section of the overall manual binder. Arrange sections in a logical, concise manner, and provide a cross-reference to enable all equipment/ instruments to be located from its correct device tag.

.4 Prior to submission of final operating and maintenance instruction manuals, and at least thirty days prior to instrumentation and control system testing and commissioning commencing, submit to and review with the Consultant, two copies of the proposed data for the instrumentation and control work Section of the operating and maintenance instruction manuals.

.5 The delivery of manuals shall be complete prior to application for a Certificate of Substantial Performance of the Work.

2 PRODUCTS

2.1 GENERAL

.1 In the event of any conflict between the applicable standards, rules, regulations, and the Contract Documents, apply the most stringent requirement.

.2 PAC and I/O block diagrams shown on the Contract Drawings are diagrammatic and supplement performance requirements. Provide a complete system working seamlessly with existing and new equipment.

.3 Furnish all materials, equipment, and software (including package software and excluding custom applications software programming), whether indicated in the Contract Documents or not, necessary to effect required instrumentation and control system, subsystem and loop performance.

.4 Generalized specifications for each type of IPS component are located in the Supplements to this Section.

.5 Supply any spare part required to commission instruments. Include five spare fuses of each type in the Control Panel.

.6 Purchase all equipment via official Ontario distribution channels that are authorized to sell, service, and support the equipment and have the responsibility to warranty its performance. Equipment that bypasses the manufacturer's authorized distribution channels is not acceptable. The contractor is responsible for any costs associated with return, repair and/or replacement of equipment later discovered to be obtained in such a fashion.

.7 Supplied equipment shall be new and of best quality. No used or reconditioned equipment shall be accepted.

.8 In addition to the insurance coverage required in the General Conditions, provide insurance coverage against theft or damage for any equipment turned over to the Consultant/Owner during transit to and from the place of delivery and for the period when the equipment remains on the Consultant's/Owner's premises. Maintain coverage until equipment returned to Contractor or installed.

.9 Replacement electronics, sensors and transmitters to be stocked locally.

.10 Non-stock hardware shall be available no longer than three days.

.11 On-site technical support shall be available within 24 hours.

.12 All hardware remains the responsibility of the contractor to provide a fully functional control system

2.2 EQUIPMENT MANUFACTURERS

.1 First Named Manufacturer: instrumentation and control system design is based on first named manufacturers of equipment, materials, and software required.

.1 If proposed item requires additional equipment and Work, including but not limited to, different installation, wiring, raceway, enclosures, intrinsically safe barriers, and accessories, provide such equipment and Work at the Contractor's own cost.

.2 Like Equipment Items:

.1 Use Products of one manufacturer and of the same series or family of models to achieve standardization for appearance, operation, maintenance, spare parts, and manufacturer's services for the purposes of limiting support costs and maintenance costs.

.2 Implement all same or similar functions in same or similar manner. For example, control logic, sequence controls, and display layouts.

2.3 SERVICE CONDITIONS AND ENVIRONMENTAL REQUIREMENTS

.1 Environmental Design Requirements: The following defines certain types of environments. PCS Subsystems refer to these definitions by name to specify the environmental requirements for individual equipment units.

.1 Computer Room, Air Conditioned:

.1 Temperature: 16 to 25 degrees Celsius.

.2 Relative Humidity: 40 to 60 per cent.

.3 CSA Classification: Non-hazardous.

.2 Inside, Air Conditioned:

.1 Temperature:

.2 Normal: 16 to 25 degrees Celsius.

.3 With Up to four Hour HVAC System Interruptions: 5 to 41 degrees Celsius.

.4 Relative Humidity:

.5 Normal: 10 per cent (winter) to 70 per cent (summer).

.6 With Up to 4 Hour HVAC System Interruption: 10 to 100 per cent.

.7 CSA Classification: Non-hazardous.

.3 Inside:

.1 Temperature: -29 to 40 degrees Celsius.

.2 Relative Humidity: 10 to 95 per cent non-condensing.

.3 CSA Classification: Non-hazardous.

.4 Inside, Corrosive:

.1 Temperature: -29 to 40 degrees Celsius.

.2 Relative Humidity: 10 to 95 per cent non-condensing.

.3 Corrosive Environment: Chlorine gas.

.4 CSA Classification: Non-hazardous.

.5 Inside, Hazardous:

.1 Temperature: -29 to 40 degrees Celsius.

.2 Relative Humidity: 10 to 95 per cent non-condensing.

.3 CSA Classification: As shown on Electrical Drawings.

.6 Outside:

.1 Temperature: -29 to 40 degrees Celsius.

.2 Relative Humidity: 10 to 100 per cent, rain, snow, freezing rain.

.3 CSA Classification: Non-hazardous.

.7 Outside, Corrosive:

.1 Temperature: -29 to 40 degrees Fahrenheit.

.2 Relative Humidity: 0 to 100 per cent, rain, snow, freezing rain.

.3 Corrosive Environment: Chlorine gas.

.4 CSA Classification: Non-hazardous.

.8 Outside, Hazardous:

.1 Temperature -29 to 40 degrees Celsius.

.2 Relative Humidity: Relative Humidity: 0 to 100 per cent, rain, snow, freezing rain.

.3 CSA Classification: As shown on Electrical Drawings.

.9 Standard Environmental Requirements: Unless otherwise noted in the Instrument Specifications located in the Supplements at the end of this Section, design IPS equipment for continuous operation in these environments:

.1 Freestanding Panel and Consoles:

.2 Inside, Air Conditioned: NEMA 1.

.3 Inside: NEMA 12.

.4 Smaller Panels and Assemblies (that are not Freestanding):

.5 Inside, Air Conditioned: NEMA 12.

.6 All Other Locations: NEMA 4X.

.7 Field Elements: Outside: NEMA 4X.

2.4 INSTRUMENT GENERAL REQUIREMENTS

.1 Supply field-mounted and panel mounted indicators calibrated in engineering units.

.2 Unless otherwise noted in the Contract Documents, supply instruments having linear 4-20 mA isolated output signals capable of driving a maximum load of 750 ohms.

.3 Unless otherwise noted in the Contract Documents, supply field-mounted instruments with NEMA 4X housings.

.4 Unless otherwise shown or specified, enclosures for all instruments located indoors in dry non-hazardous areas are to be as a minimum NEMA 12.

.5 Unless otherwise shown or specified, instruments located outdoors shall be suitable for the surrounding climate and appropriately installed with:

.1 A NEMA 4X enclosure including gasketed windows for displays, containing a thermostatically controlled heater and disconnect switch - minimum typical enclosure to be an OBrien VIPAK series, Intertec Instruments or Approved equal.

.2 A combined rain/ice/snow protection shield and sun shade for all electronic instruments which are already provided with sturdy, heated NEMA 4X enclosures by the manufacturer. Supply tip-up type hoods for access for routine calibration and maintenance.

.3 NEMA 4X must be used in corrosive areas.

.4 Electrically heat traced sensing lines for instruments with sensing lines liable to freezing.

.5 Drawing submissions shall clearly show the enclosures proposed for each instrument.

.6 Unless otherwise shown or specified, provide instruments located in hazardous areas with Canadian Electrical Code ratings for class, group, and division as shown.

.7 Unless otherwise shown or specified, provide instruments located in areas subject to flooding with submergence rated enclosures.

.8 All line voltage powered instruments are to be suitable for a 120 VAC power supply. Any line voltage AC powered instrument not CSA certified shall bear an Ontario Hydro Special Approvals Branch label.

.9 Electrical power supply is 120 VAC. Emergency power supply for instruments and control panels shall be from the associated UPS. Provide all line powered instruments suitable for use on these supplies with appropriate CSA approval.

.10 Provide all the necessary mounting hardware, electrical connections, transducer junction boxes, power supplies, and all accessory items or options required to satisfy each application.

.11 Provide equipment made of appropriate materials for the service indicated on each Product Data Sheet, and for the process fluids present, which all exposed equipment and materials shall withstand.

.12 Provide corrosion resistant stainless steel screws, bolts, fasteners etc. in all applications.

.13 Local indicators shall be provided for all transmitters. Local indicators shall read as follows:

.1	Temperature	-	Direct reading in ºC
.2	Level	-	Direct reading in m and 0 – 100 as a per cent of calibrated range
.3	Flow	-	Direct reading in L/s
.4	Pressure	-	Direct reading in kPa

.14 Supplied instruments shall be of current design. Obsolete equipment, or equipment that has been identified for withdrawal from the market by the manufacturer before date of Substantial Performance of the Work shall not be accepted.

.15 Power for all instrumentation shall be provided from the PAC Control Panel unless otherwise specified, shall be individually fused and switched, and shall be powered by UPS.

.16 HART : All instruments that can be supplied with HART communications protocol, shall be specified and supplied as such.

.17 Provide one smart instrument calibration device. Provide Rosemount model 475 HART Communicator c/w memory pack 100 and AA battery pack, ABB Mobility DHH810-MFT or Approved Equal.

.18 Provide a written confirmation from the manufacturer of each product stating that it is a current product and that it shall be supported (spare parts, software drivers, service, etc.) for a period of Five (5) years from the date of purchase. Submit confirmation with Shop Drawings.

2.5 MOUNTING SYSTEMS – GENERAL

.1 Mount electrical and electronic devices on DIN rail except where otherwise noted in the Contract Documents.

.1 Exceptions:

.1 UPSs.

.2 Devices mounted on 19 inch racks.

.2 For devices mounted on 19 inch racks, provide:

.1 Enclosure with NEMA rating to suit the area environment.

.2 Doors on front and rear.

.3 Locking handle with three point latch for each door.

.4 Front and rear door hinges on the same side of the enclosure; hinges on the side closest to the nearest wall in the vicinity.

.5 Piano type door hinges.

.6 Wire management system; spare, troughs, hooks to wrap excess length of cables.

.3 For devices mounted on a shelf:

.1 Do not stack; provide separate shelf for each device.

.2 Provide front and rear access to the device complete with a hinged shelf and slack dressed cable or an easily accessible rear door on the enclosure.

2.6 PANEL FABRICATION

.1 General:

.1 Meet all panel specific requirements set out in the Product Data Sheets.

.2 Panel Construction and Interior Wiring to be in accordance with Canada Electrical Code (CEC), provincial and local codes, and applicable sections of EEMAC, NEMA, ANSI, CSA, and ICECA.

.3 All panels shall bear CSA listing mark stating “LISTED ENCLOSED INDUSTRIAL CONTROL PANELS.”

.4 Use only panel shops that are CSA certified and ISO 9002 registered. Panels shall carry a CSA/ULC label or provide a label by the Electrical

Safety Authority (ESA, Ontario) based on the model code SPE 1000 for the field evaluation of electrical equipment.

.5 Conform to NEMA ratings as specified in the individual equipment Sections.

.6 Minimum Panel Dimensions: As shown on the Drawings.

.7 Instrument Arrangements: As shown on the Drawings.

.8 Do not mount equipment on the bottom 400 mm of sub panel space

.9 All cut-outs shall be cut, punched or drilled and finished smoothly with rounded edges.

.2 Temperature Control - Freestanding Panels:

.1 General:

.1 Provide adequate cooling to ensure the temperature within the panel does not exceed a temperature 5 degrees C below the maximum allowable operating temperature of the components within the panel.

.2 Cooling shall include natural heat dissipation, ventilation (if the NEMA rating will allow), shielding from the sun, or panel air conditioner, as required.

.3 Calculations to determine the cooling required shall be based upon a maximum ambient temperature of 40 degrees C, and shall include the heat load from equipment inside the panel or on the face of the panel, and heat load from exposure to the sun.

.2 Ventilated Panels:

.1 Furnish with louvers and forced ventilation as required to prevent temperature buildup from equipment mounted inside panel or on panel.

.2 For panels with backs against wall, furnish louvers on top and bottom of panel sides.

.3 For panels without backs against wall, furnish louvers on top and bottom of panel back.

.4 Louver Construction: Stamped sheet metal.

.3 Ventilation Fans:

.1 Furnish where required to provide adequate cooling.

.2 Create positive internal pressure within panel.

.3 Fan Motor Power: 120 VAC, 60 Hz, thermostatically controlled.

.4 Air Filters: Washable aluminum.

.4 Refrigerated System: Furnish where heat dissipation cannot be adequately accomplished with natural convection or forced ventilation.

.3 Space Heaters:

.1 Thermostatically controlled to maintain internal panel temperatures above dew point.

.4 Freestanding Panel Construction:

.1 Materials:

.1 Sheet steel unless otherwise noted in the Contract Documents.

.2 Minimum thickness of 3.6 mm, unless otherwise noted in the Contract Documents.

.2 Panel Fronts:

.1 Fabricated from a single piece of sheet steel, unless otherwise noted in the Contract Documents.

.2 No seams or bolt heads visible when viewed from front.

.3 Stiffeners: Steel angle or plate stiffeners or both on back of panel face to prevent panel deflection under instrument loading or operation.

.3 Internal Framework:

.1 Structural steel for instrument support and panel bracing.

.2 Permit panel lifting without racking or distortion.

.4 Lifting rings to allow simple, safe rigging and lifting of panel during installation.

.5 Adjacent Panels: Securely bolted together so front faces are parallel.

.6 Doors:

.1 Full height, fully gasketed access doors where shown on the Drawings.

.2 Latches: Three-point.

.3 Handles: Keylock handle.

.4 Hinges: Full length, continuous, piano type, steel hinges with stainless steel pins.

.5 Non-freestanding Panel Construction:

.1 Based on environmental design requirements and referenced in the Environmental Requirements subsection of this Section, provide the following:

.1 For panels listed as inside, air conditioned: Enclosure Type: NEMA 12, Material: Steel unless otherwise noted in the Contract Documents.

.2 For all other panels: Enclosure Type: NEMA 4X with butterfly clamp for easy opening/closing of enclosure, Material: Type 316 stainless steel unless otherwise noted in the Contract Documents.

.2 Metal Thickness: 2 mm, minimum.

.3 Doors:

.1 Rubber-gasketed with continuous hinge.

.2 Stainless steel lockable quick-release clamps.

.4 Internal Panel Lights for Freestanding Panels:

.1 Type: Switched, fluorescent back-of-panel lights.

.2 Quantity: One light for every 1.2 m of panel width.

.3 Mounting: Inside and in the top of back-of-panel area.

.4 Protective metal shield for lights.

.5 Internal Panel Lights and Service Outlets for Smaller Panels:

.1 Internal Panel Light: Switched fluorescent light.

.6 Service Outlet: Breaker protected 120 volt, 15 amp, duplex receptacle:

.1 Required for panels.

.7 Service Outlets for Freestanding Panels:

.1 Type: Three-wire, 120 volt, 15 ampere, duplex receptacles.

.2 Quantity for panels 1.2 m Wide and Smaller: One.

.3 Quantity for panels wider than 1.2 m: One for every 1.2 m of panel width, a minimum of two per panel.

.4 Mounting: Evenly spaced along back-of-panel area.

2.7 ELECTRICAL REQUIREMENTS

.1 General Electrical Requirements

.1 Instrumentation and electrical components, terminals, wires, and enclosures CSA approved, or equivalent for Ontario Electrical Safety Code.

.2 All wire and cable shall be sized and installed in accordance with the O.E.S.C. Safety Code Requirements.

.3 No control wire smaller than Number 14 gauge shall be used except where so indicated on the drawings or as specified in other Sections.

.4 Available main power shall be at a nominal 120 VAC.

.5 Cables/wiring shall be in conduits except where otherwise indicated in the Contract Documents

.6 Electrical Raceways: As specified in Section 16010 – General Electrical Requirements.

.2 Signal Characteristics

.1 Analog Signals:

.1 4 to 20 mA DC, in accordance with compatibility requirements of ISA 50.1.

.2 Unless otherwise specified or shown in the Contract Documents, use Type 2, two-wire circuits.

.3 Transmitters: Load resistance capability conforming to Class L.

.4 Fully isolate input and output signals of transmitters and receivers.

.5 Provide 250 Ω precision resistors at terminal blocks where required.

.2 Pulse Frequency Signals: DC pulses whose repetition rate is linearly proportional to process variable over 10:1 range. Generate pulses by contact closures or solid state switches.

.1 Power source: Less than 30VDC.

.3 Discrete Signals:

.1 Two-state logic signals.

.2 Utilize 24 VDC sources for control and alarm signals.

.3 Unless otherwise specified in the Contract Documents, all alarm signals shall be wired for fail-safe operation.

.3 Wires within Enclosures:

.1 AC Circuits:

.1 Type: 600 volt, Type TEW stranded copper.

.2 Size: For current to be carried, but not less than Number 12 AWG.

.2 Analog Signal Circuits:

.1 Type: 300 volt stranded copper, twisted shielded pairs.

.2 Size: Number 16 AWG, minimum.

.3 Other DC Circuits.

.1 Type: 300 volt, Type TEW stranded copper.

.2 Size: For current carried, but not less than Number 18 AWG.

.4 Special Signal Circuits: Use manufacturer’s standard cables.

.4 Wiring Identification

.1 All instrumentation and control wiring is to be identified with markers as specified. The identification is to consist of the coding as detailed on the drawings and as specified herein.

.2 Tag field wires with the field device tag and terminal information:

.1 For devices connected to control panels, show field source and destination information.

.2 For devices connected to other panels (e.g., MCC) show field source information.

.3 Wire number shall not change unless there is a function change in the wire run i.e. a fuse, a relay, etc. Wires passing through a junction box without a change in function would retain the same wire number

.3 Field source information consists of the following

.1 In most cases, the device type and loop number make up the device tag information needed on the labels.

.2 Add a number or character (+,-) to each wire from the field device to make the field information unique for each wire

.4 The destination information consists of the following

.1 Use the rack, slot and point information for PACs and termination strip and terminal number for control panels

.2 Inside a PAC panel, the wires and terminals are numbered by rack, slot and point/terminal

.5 Cable Numbers

.1 Field cables shall be tagged with the field device tag information at both ends

.2 Where cables carry wires from multiple field devices, the cable tag shall use the device tag of the junction box.

.3 For cables tags, use P or C or I added to the device tag for Power, Control and Instrument respectively as some devices such as valves have all three cables.

.4 Cable numbering shall show the Junction Box relevant numbers in that a cable runs to a JB, but the wiring itself would not have such designation

.5 For example, in the case of a Cable from a Junction Box to a PAC panel, assign a unique "loop/device number" to the Junction Box and treat it as a Device.

.6 Wire Markers

.1 Wire markers available from Brady, Phoenix, or approved equal. Allow more than one line of characters if required but one line shall be used if possible.

.2 Wire markers shall be kept to a minimum for ease of installation and readability.
A single line of text shall be used, minimizing the characters as much as possible.

.5 Terminal Blocks for Enclosures:

.1 Quantity:

.1 Accommodate present and spare indicated needs.

.2 Wire spare PAC I/O points to terminal blocks.

.3 One wire per terminal for field wires entering enclosures.

.4 Maximum of two wires per terminal for Number 18 AWG wire for internal enclosure wiring.

.5 Spare Terminals: 20 per cent of all connected terminals, but not less than 5 per terminal block type.

.2 General:

.1 All terminals shall be easily accessible with ample room for termination of field and panel wiring.

.2 Common connection of wires at terminal blocks to be by jumper bar unless otherwise specified.

.3 Use European style DIN rail mount terminal blocks only

.4 Connection Type: Screw compression clamp.

.5 Current Bar: Copper or treated brass.

.6 End Stops: Minimum of one at each end of rail.

.7 Wire Preparation: Stripping only permitted.

.8 Jumpers: Allow jumper installation without loss of space on terminal or rail.

.9 Test Plugs: Soldered connections for 18 AWG wire.

.10 Pin Diameter: 2 mm.

.3 Compression Clamp:

.1 Complies with DIN VDE 0611.

.2 Hardened steel clamp with transversal grooves that penetrate wire strands providing a vibration-proof connection.

.3 Guides strands of wire into terminal.

.4 Screws: Hardened steel, captive, and self-locking.

.4 Insulation:

.1 Thermoplastic rated for minus 55 to plus 110 degrees Celsius.

.2 Two funneled shaped inputs to facilitate wire entry.

.5 Mounting:

.1 Standard DIN rail.

.2 Terminal block can be extracted from an assembly without displacing adjacent blocks.

.6 Marking System:

.1 Terminal number shown on both sides of terminal block.

.2 Allow use of preprinted and field marked tags.

.3 Terminal strip numbers shown on end stops.

.4 Mark terminal block and terminal strip numbers as shown on panel control diagrams and loop diagrams.

.5 Fuse Marking for Fused Terminal Blocks: Fuse voltage and amperage rating shown on top of terminal block.

.7 Terminal Block, General Purpose:

.1 Rated Voltage: 600 VAC.

.2 Rated Current: 30 amp.

.3 Wire Size: 24 to 10 AWG.

.4 Rated Wire Size: 10 AWG.

.5 Color: Gray body.

.6 Spacing: 6.35 mm, maximum.

.7 Test Sockets: One screw test socket 2 mm -diameter.

.8 Terminal Block, Ground:

.1 Wire Size: 24 to 12 AWG.

.2 Rated Wire Size: 10 AWG.

.3 Color: Green and yellow body.

.4 Spacing: 6.35 mm, maximum.

.5 Grounding: Electrically grounded to mounting rail.

.9 Terminal Block, Fused, 24VDC:

.1 Use: Provide for each analog input and discrete input point

.2 Rated Voltage: 600VDC.

.3 Rated Current: 25 amp.

.4 Wire Size: 22 to 10 AWG.

.5 Rated Wire Size: 10 AWG.

.6 Color: Gray body.

.7 Fuse: 6.35 mm x 32 mm.

.8 Indication: LED diode 24VDC.

.9 Spacing: 13 mm, maximum.

.10 Terminal Block, Fused, 120 VAC:

.1 Use: Provide on each discrete output point

.2 Rated Voltage: 600 VAC.

.3 Rated Current: 25 amp.

.4 Wire Size: 22 to 10 AWG.

.5 Rated Wire Size: 10 AWG.

.6 Color: Gray body.

.7 Fuse: 6.35 mm x 32 mm.

.8 Indication: Neon lamp, 120 VAC.

.9 Leakage Current: 1.8 mA, maximum.

.10 Spacing: 13 mm, maximum.

.11 Terminal Block, Blade Disconnect Switch:

.1 Use: Provide one for each input and output field interface wire. May be omitted where a fuse or circuit breaker is used.

.2 Rated Voltage: 600 VAC.

.3 Rated Current: 10 amp.

.4 Wire Size: 22 to 10 AWG.

.5 Rated Wire Size: 10 AWG.

.6 Color: Gray body, orange switch.

.7 Spacing: 6.35 mm, maximum.

.6 Terminal Block, Fused, 120 VAC, High Current:

.1 Use: Power circuit

.2 Rated Voltage: 600 VAC.

.3 Rated Current: 35 amps.

.4 Wire Size: 18 to 8 AWG.

.5 Rated Wire Size: 8 AWG.

.6 Color: Gray.

.7 Fuse: 6.35 mm x 32 mm.

.8 Spacing: 24.13 mm, maximum.

.7 Intrinsic Safety Barriers (Galvanically isolated):

.1 Use safety barriers as required based on the classification of the equipment installation areas:

.2 Monitor discrete signals that originate in hazardous area and are used in a safe area.

.3 Interface analog signals as they pass from hazardous area to safe area.

.8 Analog Signal Isolators:

.1 Provide signal isolation for analog signals that are sent from one enclosure to another.

.2 Do not wire instruments on different panels, cabinets, or enclosures in series.

.9 Electrical Transient Protection

.1 General:

.1 Function: Protect elements of PCS against damage due to electrical transients induced in interconnecting lines by lightning and nearby electrical systems.

.2 Surge suppressors are not shown for external analog transmitters. Determine quantity and location, and show in Shop Drawings. Refer to example wiring in the PAC Panel wiring diagrams in the Drawings.

.3 Construction: First-stage high energy metal oxide varistor and second stage bipolar silicon avalanche device separated by series impedance. Includes grounding wire, stud, or terminal.

.4 Response: Five nanoseconds maximum.

.5 Recovery: Automatic.

.6 Temperature Range: Minus 20 degrees Celsius to plus 85 degrees Celsius.

.2 Suppressors on 120 VAC Power Supply Connections:

.1 Occurrences: Tested and rated for a minimum of 50 occurrences of IEEE C62.41 Category B test waveform.

.2 First-Stage Clamping Voltage: 350 volts or less.

.3 Second-Stage Clamping Voltage: 210 volts or less.

.4 Continuous Operation: Power supplies for one four-wire transmitter or receiver: Five amps minimum at 130 VAC. All other applications: 30 amps minimum at 130 VAC.

.3 Suppressors on Analog Signal Lines:

.1 Test Waveform: Linear Eight microsecond rise in current from Zero amps to a peak current value followed by an exponential

decay of current reaching one-half the peak value in 20 microseconds.

.2 Surge Rating: Tested and rated for 50 occurrences of 2,000 amp peak test waveform.

.3 DC Clamping Voltage: 20 to 40 per cent above operating voltage for circuit.

.4 DC Clamping Voltage Tolerance: Less than plus or minus ten per cent.

.5 Maximum Loop Resistance: 18 ohms per conductor.

.4 Physical Characteristics:

.1 Mounted in Enclosures: Encapsulated inflame retardant epoxy.

.2 Field Mounted at Two-Wire Instruments: Encapsulated in stainless steel pipe nipples.

.3 Field Mounted at Four-Wire Instruments: With 120 VAC outlet, AC circuit breaker, and Ten ohm resistors on signal lines, all in enclosure.

.4 NEMA 4X fiberglass or Type 316 stainless steel with door

.5 Maximum Size: 300 x 300 x 200 mm deep.

.10 Uninterruptible Power Supply (UPS)

.1 All control panels having a PAC, I/O rack, HMI, OIT, and/or data communications equipment shall be equipped with a UPS. This includes control panels supplied with packaged systems.

.2 The UPS shall provide uninterrupted power to, at minimum, the PAC/RTU, its I/O, field instruments.

.3 The UPS shall be sized to ensure the control panel continues to perform communications, data manipulation, calculations, monitoring and process data archiving for a minimum of 60 minutes following the loss of supply power.

.4 When sizing the UPS, all critical loads shall be identified and power calculations shall be provided. Provide additional battery cabinets to allow for load/time requirements if necessary.

.5 Where possible, install the UPS in a control panel. The UPS shall not block access to any panel mounted equipment.

.6 Enclose any unit not mounted in a control panel within a vented enclosure with a NEMA rating suitable for its mounting location.

.7 Installation shall include an external maintenance bypass switch.

2.8 CONTROL PROCESSORS – PAC

.1 General

.1 Provide and install Programmable Automation Controllers (PACs) as specified on the Contract Drawing.

.2 Procurement of PACs shall be from the following manufacturer:

.1 Allen-Bradley Logix Family – ControlLogix (by Rockwell Automation Inc.).

.3 All Control related equipment is to be housed in NEMA enclosures suitable for the application and environment, and as a minimum are to be NEMA 12, as described in previous subsections.

.4 Provide all cables, line extenders and connection devices required for the connection of the system and for connection of any associated programming or operator interface devices. Provide double insulated cables unless otherwise specified. Select and provide connectors with electrical contact surfaces gold-plated, and D-shell connectors with metal or metalized plastic (shielded type) hoods.

.5 Provide components rated for continuous service under the following conditions:

.1	Temperature	-	0 to 50°C
.2	Relative Humidity	-	5 to 95 per cent
.3	Vibration	-	0.25G from 5 to 100 Hertz
.4	MTBF/MTTR	-	> 100,000 hours/3 hours

.6 Provide a written confirmation from the manufacturer of each product stating that it is a current product and that it will be supported (spare parts, software drivers, service, etc.) for
a period of not less than Five years from the date of purchase. Submit confirmation with Shop Drawings.

.7 Provide FAT to demonstrate the operational functionality of PAC and SCADA hardware and communications by using suitable dummy or shell programs. Notify the Contract Administrator ten working days in advance of FAT such that this test may be witnessed by the appropriate parties.

.8 For all motor Start/Stop commands and actuator Open/Close commands use only individually isolated relay output modules.

2.9 EXPENDABLE MEDIA

.1 For any instrument or system peripheral which uses expendable media such as analyzer reagents & membranes, filters, etc., supply enough media sufficient for one (1) year of operation from the date of Substantial Performance of the Work and deliver the media to the Contract Administrator prior to application for the Certificate of Substantial Performance.

2.10 PRODUCT DATA SHEETS

.1 Product Data sheets are issued with, and form a part of, this Section. See Appendix 1-1 of this Specification.

3 EXECUTION

3.1 COORDINATION

.1 Carefully examine and monitor for compatibility, any instrumentation and control work provided and ensure that all trades involved are aware of any coordination problems or details.

.2 Incompatible work, such as instrument process connections, mounting of equipment, analogue, discrete or communication wiring, voltages, or inconsistencies resulting from insufficient coordination of other related work, is to be satisfactorily resolved at no additional cost to the Contract.

.3 When scheduling site inspection, FAT, commissioning, or SAT with the Contract Administrator, allow minimum ten (10) working days' advance notice.

3.2 MANUFACTURER'S SERVICES AND CERTIFICATION OF INSTALLATION

.1 Comply with the requirement of Section 01640 - Manufacturers Services, Section - 01650 – Equipment Startup and Performance Testing, and Section 01660 - Commissioning.

.2 Allow in the Tender Price for all the necessary services and expenses of a trained, qualified manufacturer's representative for each device as specified in the Specification sheet, to ensure correctness of installation, testing, start-up, commissioning and training. The qualified representative is to:

.1 Provide on-site supervision of installation for the initial and critical stages of the work as agreed to with the manufacturer/supplier and as required by the Contract Administrator.

.2 Supervise testing of equipment. Supervise retesting of equipment at no additional cost to the Contract.

.3 Provide written certification stating that the work has been completed satisfactorily.

.4 Provide a complete Installation, Start-up Checklist and sign off on the start-up work completed.

.5 Provide operation and maintenance instruction to the Owner's operating staff.

.3 Provide supervision of installation as required by the manufacturers for all equipment in this Division. The Owner/Contract Administrator may order additional supervision at no additional cost to the Contract if, in their opinion, installation procedures are compromised.

.4 Provide all materials, labour and equipment to make any adjustments to the installation as required by the manufacturer or the Contract Administrator to effect performance.

.5 On completion of installation and testing, obtain certification from the manufacturers that the equipment is installed correctly, is in full operating condition, and is operating in accordance with its design rating. Submit the original certificate to the Contract Administrator.

.6 Include the service of the trained personnel to inspect and commission the equipment when ready for starting and to instruct the operating personnel in the operation and maintenance of the equipment. Time spent on site by the trained personnel shall be witnessed by the Contract Administrator.

.7 Include above services for all equipment specified in relation to this Section and as a minimum provide commissioning and training as follows:

.1 Major process equipment - See the list below. Split the specified time into three stages: inspection during installation, start up and commissioning, staff training.

.2 Two (Eight hours) days for all other process instrument, where not specially mentioned, of which half day minimum dedicated to training.

.8 As a minimum requirement, allow for in the Tender Price, the following days for the service of a manufacturer's representative. Not all days shall necessarily be concurrent. If additional days are required to complete the work, include these additional days and trips in the Tender Price.

.1	Magnetic Flow Meter	Two Days
.2	Ultrasonic Level Transmitters	Two Days

3.3 SOURCE QUALITY CONTROL

.1 General:

.1 The Engineer may actively participate in many of the tests.

.2 The Engineer reserves right to test or retest all specified functions.

.3 The Engineer's decision shall be final regarding acceptability and completeness of all testing.

.4 Procedures, Forms, and Checklists:

.1 Except for Unwitnessed Factory Test, conduct all tests in accordance with, and documented on, Engineer accepted procedures, forms, and checklists.

.2 Describe each test item to be performed.

.3 Have space after each test item description for sign off by appropriate party after satisfactory completion.

.5 Required Test Documentation: Test procedures, forms, and checklists, signed by the Engineer and the Contractor.

.6 Hardware Delivery: Completed when hardware has been delivered to the Site and inventoried by the Owner.

.2 Conducting Tests:

.1 Provide special testing materials and equipment.

.2 Wherever possible, perform tests using actual process variables, equipment, and data.

.3 If not practical to test with real process variables, equipment, and data, provide a suitable means of simulation.

.4 Define simulation techniques in test procedures.

.5 Test Format: Cause and effect.

.1 Person conducting test initiates an input (cause).

.2 Specific test requirement is satisfied if correct result (effect), occurs.

.6 For Subsystems for which Engineer provides applications software, provide sufficient temporary software configuring to allow FAT and SAT testing of these subsystems. Exercise the hardware (i.e., I/O.

communications, panel mounted instruments, etc.) with appropriate software in place to demonstrate/monitor operation of all connected equipment and wiring.

.3 Unwitnessed Factory Test:

.1 Scope: Inspect and test system to ensure it is operational, ready for FAT.

.2 Location: Vendor or System Supplier's factory.

.3 Integrated Test:

.1 Interconnect and test system, except for primary elements and smaller IPS panels.

.2 Exercise and test all functions.

.3 Provide standalone testing of smaller IPS panels.

.4 Simulate inputs and outputs for primary elements, final control elements, and IPS panels excluded from test.

.5 Submit internal QA/QC reports to the Contract Administrator for approval.

.4 Panel Inspection & Factory Acceptance Testing (FAT)

.1 Make all of the necessary arrangements with equipment supplier(s) for panel inspection and FAT prior to delivery.

.2 Install and verify all free issued equipment to be located in the respective control panels prior to the FAT.

.3 Schedule the FAT session(s) with the Contract Administrator a minimum of 20 working days in advance. Allow enough time for thorough testing and corrections to take place.

.4 All Pre-FAT submittals as described in the Submittals subsection of this Section shall be submitted at the time of scheduling. Acceptance of the test date is contingent upon the acceptance of the FAT documentation.

.5 Panel inspection and FAT is to be performed in the presence and to the satisfaction of the Engineer, and is to include all devices necessary to simulate actual operating conditions.

.6 Make the following documentation available to Engineer at the test site both before and during FAT:

.1 Drawings, Specifications, Addenda, and Change Orders.

.2 Master copy of FAT procedures.

.3 List of equipment to be tested including make, model, and serial number.

.4 Approved hardware Shop Drawings for equipment being tested.

.5 Approved preliminary software documentation Submittal.

.7 Daily Schedule for FAT:

.1 Begin each Day with a meeting to review the Day's test schedule.

.2 End each Day with a meeting to review the Day's test results and to review or revise next Day's test schedule.

.8 Scope:

.1 Test the entire system, with the exception of primary elements, final control elements, and certain smaller IPS panels, to demonstrate that it is operational.

.2 FAT is required for all panels.

.9 Loop-Specific Functions: Demonstrate functions shown on P&IDs, control diagrams, and loop specifications:

.1 One of each type function; e.g., if there are pump sequence controls for several identical pumps, demonstrate controls for one pump.

.2 One of each type of function in each IPS panel; e.g., but not limited to annunciator operation, controller operation, and recorder operation.

.3 All required and shown functions for 100 per cent of loops.

.10 Non-loop Specific Functions:

.1 Capacity: Demonstrate that Subsystems have required spare capacity for expansion. Include tests for both storage capacity and processing capacity.

.2 Timing: Include tests for timing requirements.

.3 Diagnostics: Demonstrate online and offline diagnostic tests and procedures.

.11 Deficiencies

.1 Make the necessary corrections as indicated by the tests, or as directed by the Engineer. Shipment of equipment to site is contingent on the Engineer's approval.

.12 Failed Tests:

.1 Repeat and have witnessed by the Engineer.

.2 With the approval of the Engineer, certain tests may be conducted by the Integrator and witnessed by the Engineer as part of the Functional Test.

.5 Site Acceptance Test (SAT):

.1 When initial site inspections and commissioning of the instrumentation and the control system is satisfactorily complete, schedule with the Contract Administrator /Owner to demonstrate the entire system is ready for the Engineer to start control application program commissioning.

.2 Include for the presence of qualified instrument technicians and equipment manufacturers' representatives to supervise the test if requested by the Engineer. Testing is to demonstrate the proper operation of all field physical input and output signals of the PAC system under actual operating conditions to the satisfaction of the Engineer. This includes proper operations and communications between PACs, and all peripheral devices. Supply all labour, instruments and materials to perform the testing.

.3 SAT test plan shall be developed and submitted to the Engineer for approval no later than ten (10) working days prior to the schedule start of SAT.

.1 Roles and responsibilities of SAT team participants.

.2 SAT schedule.

.3 Any safety or process-related considerations.

.4 Procedure for performing tests.

.4 Scope:

.1 General

.1 Demonstrate that specified equipment and standard software has been properly installed at the staging site and is fully functional.

.2 Verify all data communications required for plant SCADA operation.

.3 Control Panels

.5 Demonstrate that specified subsystem equipment and standard software has been properly installed at the staging site and is ready for application software development by the Engineer.

.6 No later than five working days after the completion of SAT, a SAT test report shall be submitted to the Owner. At minimum, the SAT test report shall include:

.1 Description of any deviation from the SAT test plan.

.2 Summarize test results.

.3 Explain any deficiencies and plans for corrective action.

.7 Deliver all testing software, panel keys etc. to the Contract Administrator.

.8 Deficiencies

.1 SAT Deficiencies shall be corrected and successfully retested prior to applying for a Certificate of Substantial Performance.

3.4 GENERAL INSTALLATION REQUIREMENTS

.1 Unless otherwise specified, install and calibrate instrumentation and control system hardware in strict accordance with the manufacturer's instructions and/or recommendations.

.2 Advise the Contract Administrator of any perceived problems regarding implementation of installation details or standard practices for the particular application in sufficient time to avoid delays to the Contract.

.3 If any requirements of this Specification, or a drawing detail, contradicts the equipment manufacturer's instructions or recommendations in a manner, which could be detrimental to its operation, including the possibility of inducing adverse side effects elsewhere to the system, immediately notify the Contract Administrator in writing and refrain from installing until the problem is resolved.

.4 Confirm the correct locations for equipment with the Contract Administrator prior to installation and/or roughing-in.

.5 Supply any materials and/or test facilities necessary for commissioning.

.6 Prior to the shutdown of any operating equipment, provide a written notice 48 hours in advance to the Owner/ Contract Administrator. Shut down of equipment is limited

to a length of time determined by the Owner. Make all arrangements to minimize down time.

3.5 INSTALLING INSTRUMENTS

.1 Install, test, calibrate and commission instruments in accordance with this Specification, drawings for construction and any special details where they apply. Where installation details are not indicated, conform to the manufacturer's instructions and/or API RP 550 recommendations.

.2 For all instruments, submit completed instrument calibration form.

.3 Unless otherwise shown or specified, all required mounting hardware, enclosures, terminations, junction boxes, etc., are to be provided. Refer to the Contract drawings and the manufacturer's documentation to confirm the necessary hardware and construction for specific mounting assemblies where such details are not specified herein.

.4 Use field junction boxes suitable for the area classification to "marshal" groups of signals of the same type in an area and cable back to buildings and local control panel with multicore cables.

.5 Junction boxes may be FRP (fibreglass reinforced plastic) or similar material suitable for the area and rust and weather resistant. Terminals inside field junction boxes are to be DIN rail mounted.

.6 Provide suitable mechanical shields, mounting plates to properly secure and protect transducers. Provide stilling wells wherever turbulence can adversely affect measurement.

.7 Prepare metal surfaces and paint supports or frames the same colour as the member the complete assembly is mounted on.

.8 Instrument support brackets may not be welded to process piping or equipment, but shall generally be pedestal or wall mounted.

.9 For location, power, mounting and other related details, refer to the manufacturer’s installation details and to the instrument and electrical drawings issued for construction.

.10 Do not mount instruments on vibrating structures (e.g., handrails), or on piping or near equipment that induces vibration. Do not mount instruments below or directly adjacent to lines conveying corrosive chemicals or near sources of leakage or spillage.

.11 Position instruments so that they do not block or obstruct walkways or access points and provide adequate space around installation for removal of covers, etc.

.12 Locate instruments and their associated sensors, local isolation valves, isolation switches and other related accessories so that they are readily accessible for operation, maintenance or removal. Ensure that instrument displays are properly oriented so as to be easily viewed. Unless otherwise shown or specified, mount instruments 1.4 m above finished floors, grade or platforms. Allow for cabinet plinth/floor-pad heights when locating panel instruments. Any instrument that is not easily accessible for operation or maintenance, or any indicator that is not easily and readily visible shall be relocated as directed by the Contract Administrator at no charge to the Contract.

.13 Where manual operation of valves is required, based on a transmitter signal value, the indicator shall be located adjacent to the valve or equipment local control panel.

.14 Confirm instrument mounting locations with Contract Administrator to ensure accurate field measurements.

.15 When drilling or installing conduit entry points in instruments, protect internally mounted equipment from vibration, shock and metal filings. Conduit entries shall maintain the equipment or panel NEMA rating.

.16 Standard instrument process connections of half inch NPT female are to be provided (Pressure gauges normally half inch NPT male).

.17 Locate all drain plugs below the lowest tube fitting, union or valve. Slope horizontal tubing toward drain plug by minimum 1 cm per meter. Provide drain plugs on all tubed instrument systems.

.18 Run field cables for analogue signals in separate conduit from 120 VAC / 24 VDC control or 120 VAC (or higher voltage) power supply cables, separated a minimum distance of 300 mm.

.19 All instrument transmitters connected to the PAC shall be powered by UPS.

.20 Once an instrument has been inspected by the Engineer and initially calibrated, it is to remain powered up at all times unless servicing the instrument itself. Immediately install keepers on all panel circuit breakers powering instruments.

.21 Instrument calibration, setpoints and other programmable parameters are to be confirmed with the Engineer during on-site inspection as soon as site conditions are sufficiently ready. Final calibration values may be different than nominal values specified in the Product Data Sheets at no additional cost to the Contract.

.22 Provide, install, coordinate, and inspect grounding of surge suppressors at:

.1 Connection of AC power to PCS equipment including panels, consoles assembles, and field mounted analog transmitters and receivers.

.2 At the field and panel, console, or assembly connection of signal circuits that have portions of the circuit extending outside of a protective building.

.23 Field measure lengths for instrumentation communication cables, transducer cables, and power cables. Provide in field measured lengths without joins as required by manufacturer. Allow adequate cable to allow removal of instrument/transducer from process.

.24 Mechanically protect cables and adequately secure in place to eliminate sagging.

.25 All instruments shall be provided with process devices. Isolation valves shall be utilized on all instrument lines for easy removal without disruption to the process.

3.6 INSTRUMENT AND SENSING/SAMPLING TUBING CONNECTIONS TO PROCESS LINES

.1 It is assumed that the first sensing/sample line (root) isolation valve is part of Division 11 work. Where an instrument is distant (> 5 m) or not visible from the process tapping point, provide isolation valves local to the instrument, appropriate for the process fluid.

.2 Provide process sensing/sampling lines of 316 stainless steel 12 mm (half inch) tubing, adequately supported and protected throughout its length. Compensate for relative movement between process pipe and instrument via a coiled or flexible sensing installation where application requires this (vibration, high temperature, etc.).

.3 Provide tubing and compression type tube fittings.

.4 Field measure lengths for process sensing/sampling lines and capillary tubing. Provide in field measured lengths to minimize fittings and unions as much as possible. Allow adequate sensing/sampling lines and capillary tubing, to allow removal of instrument/transducer from process.

.5 Provide mechanical protection for capillaries and adequately secure to eliminate sagging throughout their length without sagging, by using painted/galvanised angle iron and clips. Avoid sharp bends in capillary and coil any excess close to the sensor end. Protect the coiled capillary by clipping to a steel plate or other safe method.

.6 Install process sample piping and sensing lines to avoid accumulation of vapour or gas in liquid service, and to avoid accumulation of liquid or condensate on vapour or gas service, as appropriate. Instruments on liquid service shall be mounted below sensing lines, with process tapping points taken from the side of the process line. Instruments on gas service shall be mounted above the sensing lines, with process tapping points taken from the top of the process line.

.7 Electrically heat trace instrument sensing and sample lines liable to freezing.

.8 Provide test/calibration connection with isolating valves and removable end-caps between pressure sensing instruments and root isolation valves. Test/calibration connection shall be easily accessible.

3.7 INSTALLING CONTROL EQUIPMENT

.1 Install, test, and commission controllers in accordance with requirements of this Specification, drawings for construction, and any special details as they apply. Where installation details are not indicated, conform to the manufacturer's instructions and/or API RP 550 recommendations.

.2 Install PAC and other related peripherals in NEMA panels as indicated on the drawings.

.3 Mount freestanding panels on a 100 mm (4 inches) concrete pad if stand-alone, at the same height as other panels if part of an existing suite or MCC installation. Provide spacing of 50 mm minimum between rear of panels and external walls, to avoid effects of possible condensation. All freestanding units to have stainless steel spacers between panel and wall.

.4 Locate and install controllers and panels so as to be easily accessible for maintenance and readability of displays.

.5 Displays and keyboards are to be protected during the construction and commissioning period, but remain readily accessible on the panel's exterior.

.6 When drilling conduit entry points in panels, protect internally mounted equipment from vibration, shock or metal filings. Panels and conduit installations made to them shall maintain their appropriate NEMA rating. Confirm panel location with Contract Administrator /Owner prior to fixing.

.7 Following Site Acceptance, provide to the Contract Administrator a minimum of six identified control panel keys for each panel.

.8 Wire all spare I/O to terminal strips and terminate according to the Manufacturer’s recommendations.

.9 If single ended analogue signal modules are used, group signals in such a way that signals of the same power supply are connected to one card. Otherwise, use signal isolators.

.10 Follow the Manufacturer’s recommendations for loading resistors on digital outputs to limit the affect of leakage currents through triac and relay outputs.

.11 Follow the Manufacturer’s recommendations for surge suppression on inductive loads.

.12 Once PAC Panel’s are installed and sufficient field wiring is in place to power up the PAC’s, immediately install keepers on any lighting panel or MCC circuit breaker feeding the PAC Panel. Unless otherwise authorized by the Contract Administrator, the PAC Panel is to remain powered up at all times.

.13 Once PAC's are installed at site and sufficient field wiring is in place to begin commissioning software, take the necessary steps to prevent hardware failure or unauthorized tampering with running control programs. Ensure PAC Panels are not inadvertently switched off or crashed by unsanctioned activity.

.14 Take the necessary precautions to ensure computers installed at site are not inadvertently switched off, crashed by unsanctioned activity or tampered with in any way. That means do not alter settings or chance interrupting programs that are supposed to be left running. If a latent hardware problem develops on a computer and requires to be sent back for repair, or any illicit activity that results in file corruption, additional setup time shall be required of the Engineer to ready the system again. Take every step necessary to minimize this risk and prevent disruption to plant operation.

3.8 SYSTEM WIRING REQUIREMENTS

.1 Provide all required system wiring. All wiring shall conform to the latest revision of the O.E.S.C and to the Electrical Area Classification for Hazardous Locations where applicable.

.2 Where specific wiring types are not specified (except AC power wiring) provide types of wiring as recommended by the system component manufacturers.

.3 Provide conduit for all system wiring, except for power cords with integral plugs, and except where duct, tray or similar raceway are indicated, in accordance with Section 16010 – General Electrical Requirements. Unless otherwise specified, conduit and wiring requirements specified in previous Sections of Division 16 apply to the work of this Section.

.4 Unless otherwise specified, install analogue signal cabling, including transducer cables and network cables in separate dedicated R.S. conduits away from AC power and other EMF sources. Ultrasonic sensor cabling shall be installed strictly in accordance with manufacturer's instructions.

.5 Seal all conduit terminations to prevent moisture penetration.

.6 Communication and analog signal conductor shields shall be isolated and taped back at one end and terminated at a single ground point at the other as shown on the loop drawings. If the correct grounding information is unclear, confirm exact shield termination and isolation details with the equipment manufacturer and the Engineer.

.7 Install lightning and surge protection on all analogue signal cabling entering or exiting buildings. Provide two spare units.

.8 Install signal isolators (24 VDC externally powered if not loop-powered devices) on all analogue loops with signal cabling running outside buildings, speed control signals into variable frequency drives, and any situation where potential EMF could damage electronic equipment. Provide two spare isolators.

.9 Unless specifically shown otherwise, wire all digital alarm contacts “normally open”, “close to trip”.

.10 Use only manufacturer molded cable assemblies between computer and peripherals, such as printers, RS-232, Ethernet, etc. Unless otherwise approved by the Engineer, do not supply custom-made cables. Where custom cables are allowed, connectors shall be complete with proper shells and able to withstand physical bending and twisting.

.11 Provide adequate slack on cable harnesses to permit easy removal of I/O and other printed circuit cards and/or modules and instruments during service or repair.

.12 All feeders shall be run in continuous lengths between power supply point and the load with no splices.

.13 Unless specifically required, wiring of devices (e.g., switches) in series to a single relay is not permitted.

.14 Wires entering or leaving enclosures, terminate and identify as follows:

.1 Analog and discrete signal, terminate at numbered terminal blocks.

.2 Special signals terminated using manufacturer’s standard connectors.

.15 Signal Distribution:

.1 Within Panels: 4 to 20 mA DC signals may be distributed as 1 to 5VDC.

.2 Outside Panels: Isolated 4 to 20 mA DC only.

.3 All signal wiring shall be twisted shielded pairs.

.16 Signal Switching:

.1 Use dry circuit type relays or switches.

.2 No interruption of 4 to 20 mA loops during switching.

.3 Switching Transients in Associated Signal Circuit:

.1 4 to 20 mA DC Signals: 0.2 mA, maximum.

.2 1 to 5VDC Signals: 0.05V, maximum.

.17 Wiring Interface:

.1 For analog and discrete signal: Terminate at numbered terminal blocks.

.2 Power (240 volts or greater): Terminate at manufacturer’s standard connectors.

.3 For panel: Terminate at equipment on/with which it is mounted.

.4 Wiring for Special Signals: Terminate communications, digital data, and multiplexed signals using manufacturer's standard connectors for the device to which the signals terminate.

3.9 IDENTIFICATION AND TAGGING

.1 Tags - Comply with the requirements as shown on the Contract Drawings.

3.10 MODIFICATIONS TO EXISTING EQUIPMENT

.1 The Specifications and Drawings have been developed on a conceptual basis. Provide all hardware, wiring etc. to connect the instrumentation added, moved or modified under this and other Divisions for a complete, operating system. Verify the actual site conditions and modify the proposals to effect the desired result without additional charge to the contract.

.2 Utilize existing panel spare space to provide new PAC modules, circuit protection, terminal blocks, I/O cards and other accessories as they are required by the Contract drawings.

.3 During the tendering period, visit the site and ascertain the actual conditions and the extent of the work, particularly in the following area:

.4 Spare capacity of control panels to be modified under this contract

.5 Do not remove existing equipment from service without written approval.

.6 Removal of equipment and/or wiring means the disconnection and complete removal of related cables, conduit and wiring from the equipment, shut off related power sources and capping resulting holes or openings, blanking off any panel openings, etc. Provide tags at the power sources indicating "Not Used".

.7 Leave in place existing wiring and equipment not required to be modified, whether or not it meets current codes unless, there is a definite safety hazard. Draw to the attention of the Engineer any such condition.

.8 Equipment taken out of service shall be removed and delivered to the Owner or left in place as directed by the Contract Administrator.

3.11 INSTRUMENTATION & CONTROLS FIELD PRE-COMMISSIONING

.1 Comply with the requirement of Section 01110 - Summary of Work, Section 01640 - Manufacturers Services, Section 01650 – Equipment Startup and Performance Testing and Section 01660 - Commissioning.

.2 All field testing, calibration procedures, commissioning procedures, calibration schedule, calibration form etc. shall be submitted and be approved by the Engineer.

.3 Supply all materials, equipment and labour necessary for testing, calibration, commissioning and repair and be prepared to present proof of recent calibration on testing equipment.

.4 Before requesting witnessed loop checks, carry out Contractor's own field and loop check tests to verify that the equipment operates as intended. Correct any problems or deficiencies prior to requesting witnessed checks. Submit completed I/O check sheets for review 10 days prior to witnessed testing

.5 For Control Loop Checkout/Verification, arrange for the Contractor, electrical, instrumentation and control sub-contractors to test loop wiring between PAC and field devices, advise the Engineer to be present for the procedure.

.6 Demonstrate instrument calibration and loop checks. Each loop check shall be witnessed by, and successfully demonstrated to the Engineer and Plant Operations staff for sign-off approval.

.7 When testing instrumentation loops, perform the testing of each loop in sequence and in groups. The testing of instrument loops shall be graded on a pass/fail basis. If more than two instrument loops within a group fail the loop checkout, the entire group of loops shall be deemed to have failed the checkout. When the failed loops have been repaired, the entire group shall be retested.

.8 Prepare Instrument Calibration Forms for every field instrument and Loop Check Sheets for every control loop.

.9 Prior to installation of application programs for automatic control by others, all installations shall be proved correct and fully operational as outlined below.

.10 After the instrumentation and control system has been initially visually inspected for proper installation, including any specified vendor inspection, but prior to any introduction of process fluids/materials to the facility (if retrofit on existing process, submit proposed testing method), energize the system loop by loop and:

.1 Check and test the operation of each and every system component, and adjust or repair as necessary.

.2 Confirm all instrument calibration parameters, i.e., 4-20 mA span and displayed ranges, with the Engineer.

.3 Check the calibration of each instrument, and where necessary, re-calibrate in accordance with the manufacturer's instructions.

.4 Ensure that calibration and commissioning work is carried out by qualified technicians. Provide the services of qualified manufacturers' service representatives for installation, setup, calibration, testing, and commissioning of instruments.

.5 Prepare typewritten record on each Instrument Calibration Form of the calibration, repair or replacement work performed and submit to the Engineer. Enter the calibration information and any other relevant details about each instrument on the Product Data Sheets.

.6 Loop check all field signal wiring for continuity and correct contact polarity. Ringing wires from terminal strips is insufficient. Check each loop by interrogating the controller I/O via on-line utilities and exercising field equipment to confirm correct field operation. Field actions include power-up instruments, set-up calibration, energize MCC starters (disabling power feeds as appropriate) testing Hand-Off-Auto switches, tripping field pressure, float and level switches etc.

.7 Do not perform insulation tests or “megger” tests on any instrument wiring connected to field or panel equipment.

.8 When the inspection, testing, and calibration is complete, submit Instrument Calibration Forms, Loop Check Sheets and Product Data Sheets and advise the Engineer in writing that all equipment has been checked and is ready for introduction of process fluids or material.

.11 Once process fluid or material have been introduced to the facility, or part of process:

.1 Repeat the above checks to confirm that the equipment operates correctly when actuated by actual process fluid or material: e.g., that high level alarm float switches are actuated at the correct height by a rising fluid, and low-level switches operate correctly on a falling fluid level.

.2 Forward to the Contract Administrator a letter certifying that the instrumentation and control system is complete, operational, and ready for site acceptance, and ready to load control program.

.12 Every Instrument calibration, Final Loop Check and equipment operation checks shall be witnessed by the Engineer. Upon satisfactory demonstration of instrument and/or loop operation, the Engineer shall sign off the Product Data Sheets, Calibration Forms and Control Loop Check Sheets. The instrumentation and control system shall then be considered ready for testing control software, and finally Site Acceptance Testing.

.13 Instruments, loops and equipment which are found to be inoperable or improperly calibrated, shall immediately be rejected. The associated equipment shall be rectified, re-calibrated and sheets revised and resubmitted as soon as the problem is resolved.

.14 If three or more such instances occur, the Contractor shall be requested to repeat all pre-commissioning checks.

.15 When all equipment, instruments and systems have been demonstrated and Product Data Sheets, Instrument Calibration Forms and Loop Check Sheets have all been signed off, forward a complete set of the signed sheets to the Engineer.

3.12 CONTROLLER APPLICATION PROGRAM INSTALLATION, TESTING AND CONTROL SYSTEM COMMISSIONING

.1 Comply with the requirement of Section 01110 - Summary of Work, Section 01640 - Manufacturers Services, Section 01650 – Equipment Startup and Performance Testing and Section 01660 - Commissioning.

.2 When field pre-commissioning of the instrumentation and control system has been completed as specified above, inform the Contract Administrator that the system is ready to load control application program.

.3 Include for the presence of qualified instrument technicians and component manufacturers representatives to assist the Engineer in testing of the Control Application Program.

.4 Coordinate all commissioning activities with the Contract Administrator as required. Supply all labor and materials required to coordinate instrument and controls commissioning with other trades.

.5 Provide Site Acceptance Testing (SAT) to demonstrate the correct operational functionality of all field wiring and communications with PAC system with connection of all site devices. Notify the Contract Administrator and Plant Operations staff ten working days in advance of SAT such that this test may be witnessed by Engineer and Owner representatives.

.6 Provide all labour and materials necessary to commission and operate the system for the test. During this time all equipment is expected to run in automatic mode.

.7 Perform the commissioning activities associated with operation of the plant under control by the software program, as directed by the programmer from the Engineer.

.8 Provide clear signs/marking as to required status on the equipment that is to remain powered up, left in Auto, or remain Off etc., during the commissioning period. Agree with the Contract Administrator /Owner on the method for achieving this and ensure safe and compliant operation of the facility and equipment at all times.

.9 Take all necessary steps to ensure that all equipment or parts of the system successfully tested and deemed ready for their intended use remain in operation. Ensure other ongoing activities, in close proximity or otherwise, do not disturb or interrupt the operation of the existing systems or the work already commissioned or placed into operation. Should any such activity pose a risk to this work or to the system operation, advise the Contract Administrator and the Owner immediately.

.10 Adopt a recognized lock-out policy and agree to it with the Contract Administrator. Coordinate the requirement for lock-out for safety reasons with the scheduled commissioning program so that all equipment needed to commission a process/area is available concurrently.

.11 Make minor corrections/additions to wiring, terminations, instrument calibrations and settings as normally expected necessary to resolve operational problems during commissioning at no additional cost to the Contract.

3.13 OPERATIONS AND MAINTENANCE MANUALS

.1 Comply with the requirements of Section 01730 – Operation and Maintenance Manuals.

3.14 TRAINING

.1 Comply with the requirements of Section 01820 – Demonstration and Training.

3.15 PROCESS PERFORMANCE OPERATION

.1 Provide all labour and materials necessary to support the process and the instrumentation and control system for the duration of the contract performance run. During this operation all equipment is expected to run in automatic mode.

3.16 WARRANTY AND GUARANTEE PERIOD ACTIVITIES

.1 During the warranty period, hardware service shall be provided by a factory trained service representative who shall be on-site within 24 hours of a service request, 7 days/week, including weekends and holidays. The service representative shall be equipped with all necessary tools, testing equipment, spare parts, and expertise to perform the service in one visit.

.1 For each service call submit a report giving the following information:

.1 Part numbers, description and prices for items replaced.

.2 Revised hard copy/soft copy listings of program changes.

.3 Hours worked by maintenance personnel.

.4 Reason for the service call, and whether preventative, unscheduled or corrective maintenance was carried out.

.5 Name of Owner’s technician present during repairs. Explain the problem and solutions to the Owner’s technician(s).

.6 Description of problem as discovered on arrival at site and itemized report of activities performed to isolate and correct problem.

.7 Identification of any required actions to prevent similar future occurrence.

.8 Name of attending operations representative, time of call and time of arrival on site.

.2 A single contact point shall be provided for all hardware such that the Owner's representative need only call a single phone number irrespective of which piece of hardware has failed.

.3 Spare Components / Firmware and Software Upgrades:

.1 The supplier shall have access to a dedicated spare parts inventory for each component provided. Parts shall be available within 24 hours of a service parts request, Seven days/week.

.2 Include key spare parts that are not normally available immediately from stock, in the Recommended Spare Parts List.

3.17 SUPPLEMENTS

.1 The Supplements listed below, follow the “End of Section,” are part of this Specification.

.1 APPENDIX 1-1 PRODUCT DATA SHEETS

.2 APPENDIX 2-1 INSTRUMENT CHECK AND SIGN-OFF SHEETS. Refer to Section 01650 – Equipment Startup and Performance Testing, and Section 01660 – Commissioning.

END OF SECTION

SECTION 16900
APPENDIX 1-1
PRODUCT DATA SHEETS

SECTION 16900, APPENDIX 1-1A
PAC CONTROL PANELS

1 SPECIFICATIONS

1.1 GENERAL

.1 The design guidelines expressed in this document defines additional requirements and deviations from the requirements set forth in the General Instrumentation Standard.

1.2 PERFORMANCE

.1	Location:	Industrial, dusty and humid areas
.2	Ambient Temperature:	0 to 50 °C Indoor Nominal -30 to 50 °C Outdoor Nominal
.3	Humidity:	0 to 95% Non-condensing

2 PRODUCTS

2.1 PANEL FABRICATION

.1 Specify only panel shops that are CSA certified and ISO 9002 certified. Panels shall carry a CSA/ULC label.

.2 Assemble and test panels in the panel shop before shipping to site. Compile all factory test results and deficiencies as a Factory Test Report. Retain copies for reference during field commissioning.

.3 Panel shop must be CSA C22.2 No.14 (Industrial Control equipment) certified.

.4 Panel shop is responsible for complete panel factory acceptance testing including all necessary software and documentation required for the successful completion of the test.

.5 Provide all NEMA 4 panels fabricated of high grade cold rolled steel (CRS), 14 gauge and paint with ANSI 61 Light Grey baked enamel inside and outside. Sub-panels to be on 12 gauge CRS finished with White baked enamel.

.6 Provide all screws, bolts, fasteners, hinges, door handles, etc., of corrosion resistant stainless steel

.7 Provide dead front type doors with door mounted equipment designed for flush mounting, properly sealed to retain the panel's EEMAC / NEMA rating.

.8 Provide structural reinforcing bracing on the backs of the doors for rigidity and to prevent distortion or damage during shipping, installation and operation.

.9 Provide doors with a continuous hidden piano hinge with removable pin, an oil resistant neoprene gasket secured by gasket retainers, and a ground strap.

.10 Provide recessed type door handles, lockable with key numbers coordinated by area to reduce the quantity of keys.

.11 Provide all panels and cabinets with interior back and side sub-panels for mounting equipment, a 300 mm (minimum) print pocket mounted on inside of panel door, and a drip shield across the top of the panel.

.12 Provide self-regenerating desiccant with vapour corrosion inhibitors for moisture and corrosion protection suitable for two (2) years operation. Mark the date installed on the package.

.13 Size panels to allow for:

.1 20% future terminal blocks

.2 20% spare terminal blocks of each type

.3 20% spare I/O of each type

.14 Do not allow panel floor mounted equipment (i.e. UPS) to block access to panel back plane mounted equipment.

.15 Provide a 100 mm concrete base with vibration dampening pads for floor mounted panels unless otherwise indicated.

.16 Provide spacing of 50 mm minimum between rear of floor and wall mounted panels and external walls, complete with stainless steel spacers, to avoid effects of possible condensation.

.17 Place knockouts for the wiring at the bottom or sides of the panel. Seal all conduits and gaps, panels shall maintain their appropriate EEMAC / NEMA rating.

.18 Fabricate face-of-panel cut outs with a uniform appearance, smooth finish with rounded edges. Put touch up paint on cut outs.

2.2 TERMINAL BLOCKS AND WIRE

.1 All terminals shall be easily accessible with ample room for termination of field and panel wiring. Supply terminal block partitions for separating instrument loop (4-20 mA, etc.) from 120 VAC terminals. Arrange terminal strips so that power, control wiring, instrument wiring and ground points are partitioned by terminal

block barriers. In panels with large numbers of terminals provide separate rails for 120 VAC blocks.

.2 Common connection of wires at terminal blocks to be generally by jumper bar.

.3 Isolate 24 VDC digital and analog signals from 120 VAC power or signal wiring as much as is reasonably possible.

.4 Group markers to be used for major groups (e.g. all signals from an MCC starter).

.5 Provide “knife-switch field terminal blocks on all analog 4-20 mA loops to permit easy electrical isolation of loop and connection of ammeter into loop. WTR4 Series by Weidmuller Ltd., 1492-J Series by Allen-Bradley, UT Series by Phoenix Contact, WK 4/TKM Series by Wieland Electric Ltd, or approved equal.

.6 Provide fused terminal blocks with LED or neon “fuse blown” indicator on a knife switch for all digital loops to electrically isolate the loop. Allen-Bradley 1492-H Series, Weidmuller W Series, or approved equal. Supply five (5) spare fuses of each fuse type rating in DIN rail mountable utility box with each Control Panel.

.7 Provide non-fused terminal blocks where required. Allen-Bradley 1492-J series, Weidmuller WDU4 series, Phoenix Contact UT series, Wieland Electric WK 4/TKM series, or approved equal.

.8 Provide individual terminal block type mini-circuit breakers to isolate field devices powered from the panel. Allen-Bradley 1492-SP, ABB, Weidmuller or Phoenix.

.9 Provide intrinsically safe barrier relays (ISR) as shown on the Contract Drawings. ISR’s are to be DIN rail mounted with all intrinsically safe wiring isolated from all other panel wiring and must leave the control panel in its own conduit. ISR to be Pepperl+Fuchs KFA5-SR2-EX2.W, Phoenix Contact, or approved equal.

.10 Reserve one side of each terminal strip for field incoming conductors. Do not make common connections and jumpers required for internal wiring on the field side of the terminal.

.11 Provide 250 ohm precision resistors at terminal blocks where required.

.12 All wire and cable shall be sized and installed in accordance to the latest revision of the Canadian Electrical Code (Ontario Supplement).

.13 All spare I/O points are to be wired to outgoing terminal blocks.

.14 All wiring to be done in a qualified panel shop.

.15 Provide panel single conductor 120 VAC power wiring not less than 14 AWG 600 V stranded copper with TEW insulation. Run wires in continuous lengths from terminal to terminal; do not splice/Marrette wires.

.16 Provide interconnection cabling of all Ethernet devices internal to the control panel. CAT6 patch cables are to be factory made, ruggedized with protective connector boot.

.17 Provide panel single conductor control wiring not less than 16 AWG 600 V stranded copper with TEW insulation. Run wires in continuous lengths from terminal to terminal; do not splice/Marrette wire.

.18 Supply instrument single pair shielded cables with 300 V insulation, No. 18 AWG twisted, stranded copper.

.19 Supply ground wiring with not less than No. 14 AWG for internal panel grounding and not less than No. 4 AWG for panel to ground grid wiring.

.20 Colour code wiring insulation as follows:

.1 Line and load circuits AC power-1 phase: Black

.2 AC control circuits: Red

.3 DC control circuits: Blue

.4 Current carrying neutral conductor: White

.5 DC signal grounding conductors: Green with yellow tracer

.6 Equipment grounding conductors: Green

.7 Foreign source interlock control circuits: Yellow

.8 Analog pair: Black for feed (+), White for return (-)

.9 Intrinsically safe circuits: Blue with white tracer

.21 Provide panel wiring neatly dressed and run in plastic duct with AC, DC, analog, and communications conductors in separate ducts. All ducts to be white, narrow slot, Panduit Type F series or approved equal, and include a snap cover. Wiring ducts to be filled to a maximum of 50% at completion of the installation. Minimum duct width to be 2” and minimum duct depth to be 3”. Field wiring ducts are not to contain any internal panel wiring, and internal panel wiring ducts are not to contain any field wiring.

.22 Provide adequate slack on cable harnesses to permit easy removal of I/O and other printed circuit cards and/or modules and instruments during service or repair.

.23 All wiring to instruments mounted on doors shall be TEW wire, extra flexible, minimum 49 strands, twisted into one bundle in plastic spiral wrap and shall cross from the cabinet to the door at a shallow angle with sufficient slack to allow the door to be fully opened.

.24 Velcro cable ties (Hubbell, Panduit or ABB) are to be used for bundling and securing all wiring not enclosed in duct.

.25 All wiring to be identified with heat shrinkable slip-on markers c/w type written tag numbers. Brady 'PermaSleeve' markers, Panduit, or approved equal. Slip-on markers shall be sized to suit wire size and type. See Contract Loop Drawings for tagging requirements.

2.3 POWER DISTRIBUTION AND GROUNDING

.1 Supply power to instruments from the control panels. Protect each instrument power circuit with a panel mounted terminal block type circuit breaker sized to suit.

.2 Provide a surge protection/power filter device, rated 20A minimum, to protect control panel components. This power filter is to be placed in circuit prior to UPS connection point. Acceptable Surge protection is Phoenix Contact SFP 1-20/120AC, Cutler-Hammer AEGIS or approved equal.

.3 PAC Control Panel UPS is to be minimum 2000VA. The UPS is to be sized appropriately to provide a minimum of 1 hour of back-up power at full load in the event of a power failure. Install additional extended battery modules, as required, to meet the above requirement. The UPS is to be supplied complete with the following features:

.1 On-line, double conversion type

.2 Ethernet/SNMP interface module complying with RFC1628 SNMP MIB standards

.3 Alarm/Relay interface module, configured to provide UPS Fault/Low Battery dry contact

.4 Digital display

.5 Alarm Silence Feature

.6 External Maintenance bypass switch

.4 Acceptable UPS: PowerWare (Eaton) 9130 Tower

.5 Provide two (2) 120 VAC/24 VDC (2 A min.) redundant power supplies c/w power distribution block. Size so that one power supply can handle the total 24 VDC load, minimum size to be 5A. Provide fused terminal blocks to distribute the 24 VDC power. Provide power supply failure alarm contacts for each power supply, SPDT contact form. Phoenix Contact QUINTPS/ 1AC/24VDC# with QUINT-ORING/24DC/2X20/1X40 redundancy module, Allen-Bradley 1606-XLS###E with 1606-XLPRED redundancy module, or Weidmuller T Series with CP T RM 10 or CP T RM 20 redundancy module.

.6 Provide power fail relay, wired as shown on the Contract Drawings.

.7 Put panel lighting and service outlets on separate, 120 VAC circuits supplied by a separate power feeder to the panel. Do not mix with internal panel circuits or loads.

.8 Analog I/O wiring shields for all instruments/devices shall be grounded in the panel to terminals connected to the isolated ground bar in the panel, which is connected to the building ground system via a separate ground cable. Analog I/O wiring shields are not to be grounded at the field end under any circumstances and the isolated ground in the control panel is not to be left floating. A separate ground cable of the same gauge as the electrical ground is to be run from the isolated ground bar to the same ground point as the panel electrical ground.

.9 Provide vinyl insulated ring type crimp connectors for all ground connections.

2.4 PANEL EQUIPMENT

.1 Provide all PAC racks and I/O modules, as per technical specification data sheet “SECTION 16900, APPENDIX 1-1B: PROGRAMMABLE CONTROLLERS”

.2 Provide NEMA 4 & 13, 30.5 mm mounting diameter, oil-tight selector switches, pushuttons, and indicating lights. Use heavy-duty type contact blocks rated 10 A at 120 VAC on selector switches and push-buttons. Where the contact blocks switch analog (4 to 20 mA) and 24 VDC or less, provide contact material of gold or gold flashing over silver and rated 0.5 A at 120 VAC. Allen-Bradley 800T, Cutler Hammer or Square D.

.3 Provide incandescent indicating light units which allow light removal and replacement through the front of the unit, and have a push-to test feature.

.4 Provide self-regenerating desiccant with vapor corrosion inhibitors for moisture and corrosion protection suitable for two (2) years operation. Mark the date installed on the package.

.5 Install lightning and surge protection on all analog signal cabling entering or exiting buildings. Provide two spare units.

.6 Install signal isolators (24 VDC externally powered if not loop-powered devices) on all analog loops and LAN systems with cabling running outside buildings, speed control signals into variable frequency drives and soft starts, and any situation where potential EMF could damage electronic equipment. Provide two spare isolators.

.7 Provide interposing relays, as required, for retransmission of digital signals. Relays shall be 6A (minimum), 120 VAC, SPDT or DPDT with LED status light. Allen-Bradley 700-HLT1U1, Phoenix Contact PLC-RSC-120UC/21AU, ABB R500 Series D2.5/5-OBIA-0030-115ac, or Weidmuller MRS 120VUC 1CO RC.

.8 Provide a switched full-length fluorescent interior light.

.9 Provide Communication/Programming port mounted on the outside front door of PAC panel that provides a combination 120VAC/5A NEMA 5-15R receptacle, RJ-45 Ethernet port and USB port. Acceptable manufacturers are Phoenix Contact (5526291), Grace Engineered Products, Hubbell, or approved equal.

2.5 TAGGING

.1 Follow ISA-RP60.6-1984, Recommended Practice for Nameplates, Labels and Tags for Control Panels where specifications do not identify requirements.

.2 Using suitable permanent wire markers and terminal block tags, number all PAC terminal blocks as indicated on the electrical drawings.

.3 All terminal blocks including those on PAC terminals shall be uniquely identified and permanently marked.

.4 Provide engraved gravoply laminated (lamacoid) nameplates with white letters on a black background to identify each device mounted on the panel exterior and interior. Include device identification number as well as a descriptive name to match identification shown on drawings. Provide name plate lettering no smaller than 12 mm.

.5 Provide additional hardware as indicated on the drawings or as required.

2.6 SHIPPING AND HANDLING

.1 Design control panels to allow lifting without racking or distortion.

.2 Provide removable lifting rings to allow rigging and lifting of the panel during transportation and installation. Provide water tight plugs to fill the lifting ring holes after installation.

.3 Provide suitable wooden crating to transport control panels to the construction site.

.4 Wrap control panels in industrial shrink-wrap to prevent dust and water from entering the control panel during shipping and during storage at the construction site.

2.7 SPARE PARTS

.1 Provide consumables and spare parts to allow commissioning and start-up of the control panel.

3 INSTALLATION

3.1 GENERAL

.1 The following installation requirements are in addition to or deviations from the requirements set forth for instrumentation in the General Instrumentation Standard.

.2 When drilling conduit entry points in panels, protect internally mounted equipment from vibration, shock or metal filings.

.3 Panels and conduit installations made to them shall maintain their appropriate NEMA rating.

.4 Have the Contractor confirm the panel location with the Site Engineer prior to installation and/or roughing-in. Pay particular attention to the requirements for conduits embedded in concrete, for cable drop holes to the floor below, and the requirement for panels to be 50 mm (2”) from a back wall.

.5 Construct a 100 mm high concrete housekeeping pad, with dimensions as specified or noted in the panel Drawing on which to install floor mounted control panels

.6 Where two or more enclosures are shown mounted immediately adjacent to one another on the Drawings, install both of them securely together with their front faces parallel.

.7 After setting panel in place, remove the lifting rings and fill the lifting ring holes with the manufacturer supplied plugs.

.8 Mount power supplies such that dissipated heat does not adversely affect other components.

.9 Wire the input to the primary control device (i.e. controller or PAC) for 4-20 mA, input to any peripheral equipment such as recorders shall be 1-5 V DC. This allows the peripheral equipment to be removed from service without taking the control loop off line.

.10 Terminate field wiring at terminal blocks with no more than two wires on each side of the block.

.11 Where two or more enclosures are shown mounted immediately adjacent to one another, bolt them securely together with their front faces flush.

.12 Bond each control panel to the building ground system.

.13 Provide a complete wiring diagram of the control panel in the print pocket.

4 PAC CONTROL PANEL LIST

DEVICE TAG	LOCATION	ENCLOSURE	APPROVED PANEL MANUFACTURERS
HC062CP001	Electrical Room	Free-standing NEMA 12	Hammond Hoffman Ralston Eurobex

SECTION 16900, APPENDIX 1-1B
PROGRAMMABLE CONTROLLERS

1 SPECIFICATIONS

1.1 GENERAL

.1 The design guidelines expressed in this document defines additional requirements and deviations from the requirements set forth in Section 16900 – Instrumentation and Controls.

1.2 PERFORMANCE

.1	Controller Redundancy:	As noted
.2	Power Supply Redundancy:	As noted
.3	Operating Temperature:	0 to 60 °C
.4	Relative Humidity:	5 to 95% non-condensing
.5	Vibration:	2 g @ 10 to 500 Hz
.6	Operating Shock:	30 g

2 PRODUCTS

2.1 CONTROLLER

.1	Type:	Chassis based
.2	User Memory:	8 MB
.3	Non-Volatile Memory Storage:	SD Card
.4	Built-in Communication:	1 USB Port
.5	Supported Programming Languages:	- Relay ladder - Structured text - Function block - Sequential Function Chart
.6	Additional Features:	- Online Editing - Tag based programming

		- User-defined data types. Remote programming capabilities via the data communication network. - PID control function (routine). - Online Editing
2.2	POWER SUPPLY	
.1	Input Voltage	85 to 265 Volt AC
.2	Input Frequency	47 to 63 Hertz
.3	Input Power	Max 100 VA
.4	Output Voltages	1.2 Volt, 3.3 Volt, 5.1 Volt and 24 Volt DC
.5	Output Power	Max 75 W
2.3	DISCRETE INPUT	
.1	Voltage	24 Volt DC sourcing
.2	Inputs:	16
.3	Backplane Current:	110 milliamp at 5.1V
2.4	DISCRETE OUTPUT	
.1	Outputs:	16 N.O. Individually Isolated
.2	Operating Voltage:	10 to 240 Volt AC, 5 to 125 Volt DC
.3	Backplane Current:	150 milliamp at 5.1 V
2.5	ANALOG INPUT	
.1	Inputs:	8 differential voltage or current
.2	Additional Features	Individually isolated
2.6	ANALOG OUTPUT	
.1	Outputs:	8 analog outputs, 0 – 20mA DC

.2 Additional Features Individually isolated

3 INSTALLATION

3.1 GENERAL

.1 Provide PAC I/O as identified on the Contract Drawings.

.2 The following requirements are in addition to or deviations from the requirements set forth for instrumentation in the General Instrumentation Standard:

.1 Supply 20% spare I/O or one spare I/O module of each type (minimum).

.2 Provide interposing relays for outputs connected to field devices.

.3 Provide PAC manufacturer's approved cables, connectors, batteries and accessories for a complete system.

.4 Provide necessary Lighting Protection Units as recommended by the PAC Manufacturer for incoming and outgoing communication cables.

.5 Submit a System Wiring/Block Diagram approved by the PAC Manufacturer with the shop drawings complete with PAC model numbers and cable model numbers.

.6 Supplied software and firmware version shall be confirmed during the shop drawing review. Provide update support for the one year warranty period.

.7 Supplied Hardware shall be from same manufacturer, unless otherwise specified, and based on current available technology from the approved supplier.

.8 PAC equipment shall be CSA approved for its application.

.3 Refer to the panel drawings for part numbers and quantities.

.4 ACCEPTABLE MATERIAL

.1 Acceptable Material: Allen-Bradley ControlLogix manufactured by Rockwell Automation, www.rockwellautomation.ca.

DESCRIPTION	MODEL
Controller with Non Volatile RAM	1756-L73

Power supply	1756-PA75
Network Interface - Modbus	Prosoft MV156E-MNET
Network Interface – Ethernet/IP	1756-EN2TR
Analog Input Module, Individually Isolated	1756-IF8I
Analog Output Module, Individually Isolated	1756-OF8I
Digital Input Module	1756-IV16
Digital Output Module	1756-OW16I

SECTION 16900, APPENDIX 1-1C
TEMPERATURE TRANSMITTERS

1 SPECIFICATIONS

1.1 GENERAL

.1 The design guidelines expressed in this document defines additional requirements and deviations from the requirements set forth in Section 16900 – Instrumentation and Controls.

1.2 PERFORMANCE

.1	Accuracy:	± 1 Deg. C
.2	Repeatability:	± 0.1 % of span
.3	Stability:	+/- 0.1% of range at constant temperatures
.4	Drift:	+/- 0.25% of range
.5	Linearity:	+/- 0.25% of range
.6	Response time:	Less than 10 seconds

2 PRODUCTS

2.1 SENSOR

.1	Type:	2-wire sensor
.2	Mounting:	Standard Electrical Outlet Box

2.2 TRANSMITTER

.1	Temperature:	0 to 50 Deg.C
.2	Display:	None

.3 Additional Features:

.1 Manual Calibration capability

3 PRODUCT DATA SHEETS

Device Tag:	HC062STN01TIT01
Location:	Inside PAC Panel
P&ID	I-002
Service:	PAC Panel Inside Temperature
Process:	
Gas:	Ambient Temperature
Temp min/max:	0 to 50 °C
Transmitter:	
Signal:	4-20mA
Power Supply:	24 VDC Loop-Powered
Calib.Range:	0 to 50 °C
Accuracy:	+/- 50 °C
Electrical:	
Approval:	CSA
Class/Div/Group:	Unclassified
Acceptable Models:	
1:	Pribusin TWTS-3
2:	Omega EWS-TX

SECTION 16900, APPENDIX 1-1D
FLOW TRANSMITTERS – MAGNETIC

1 SPECIFICATIONS

1.1 GENERAL

.1 The design guidelines expressed in this document defines additional requirements and deviations from the requirements set forth in Section 16900 – Instrumentation and Controls.

1.2 PERFORMANCE

.1	Range:	As Noted.
.2	Rated accuracy:	± 0.5% of measured value, maximum error over entire velocity range.
.3	Installation requirements:	Not less than 5 pipe diameters upstream and 2 pipe diameters downstream to obtain rated accuracy.
.4	Repeatability:	± 0.1 percent of stated accuracy.
.5	Turn Down Ratio:	40:1
.6	Response time:	<1 second for 2 m/s step change
.7	Warm up time:	<10 minutes from cold start to stated accuracy.
.8	Velocity range:	0.3 to 5 m/s under normal flow conditions.
.9	Electronics Temperature:	-20 to 70 °C
.10	Additional Features:	N/A

2 PRODUCTS

2.1 SENSOR (PRIMARY ELEMENT)

.1	Type:	Pulsed D.C. Coils

.2	Flow Tube:	Type 316Lstainless steel with an internal diameter matching the internal diameter of the connecting upstream and downstream piping.
.3	Maximum fluid pressure:	Entire flow tube must meet the ratings of the flanges.
.4	Minimum Conductivity:	General Application 5 µS/cm

2.2 TRANSMITTER

.1	Local Indication:	LCD indication of current flow and totalized flow
.2	Signal Cable:	Provide one continuous spool of manufacturer's recommended sensor signal cable, sufficient length to allow 15 m for each instrument.

.3 Additional Features:

.1 Empty Pipe Detection.

.2 Coated Electrode Detection.

.3 Continuous on-line self-diagnostics.

2.3 CALIBRATION VERIFICATION TOOL

.1 One dedicated verification tool for in situ calibration verification shall be provided for the suppliers listed in the flowmeter data sheet. The tool shall allow for the calibration of flowmeters without the need for "wet calibration". The tool shall include appropriate operation manuals and shall be included in the training requirements. The tool shall be complete, newly purchased for this project, and shall be in like-new condition when turned over to the Owner at completion of start-up.

.2 Supplier to provide calibration certificates proving that flow meter accuracy can be maintained given the location of the flowmeters as shown on the Contract Drawings.

2.4 ELECTRICAL

.1	Cable Entry:	1/2" NPT
.2	Class/Div /Group:	As noted

3 INSTALLATION

3.1 GENERAL

.1 The following installation requirements are in addition to or deviations from the requirements set forth for instrumentation in Section 16900 – Instrumentation and Controls.

.1 Install the flow meter in accordance with the manufacturer's instructions and recommendation.

.2 Install flow tube downstream of pumps.

.3 Install flow tube upstream of control valves.

.4 Where flowmeters are not shown on Contract Drawings, install meters with a minimum of five pipe diameters straight run upstream and two pipe diameters straight run downstream of fittings (e.g., valves, tees, elbows).

.5 Install flowmeters in vertical pipes where flow is upward where possible.

.6 Where flowmeters are not shown on Contract Drawings, install meters where the pipe remains full at all times.

.7 Provide direct connection from sensor to instrument without joints or splices.

.8 Install separate conduits for signal and power wiring to the meter and between the transmitter and control panel.

.9 Ground the meter in accordance with manufacturer's instructions. Grounding with ground rings to be used for metal pipelines with internal coating or non-conductive pipelines.

.10 When flow sensor is installed in an environment with risk of flooding, ratings of the flow sensor is to be maintained through potting with dialect gel, plugging of conduit port openings and appropriately rated conduit and conduit glands.

.11 Transmitter unit is to be mounted at grade in a readily accessible location to facilitate maintenance and calibration. Remote transmitter unit to be mounted at 1.8m off the floor for ease of reading.

4 INSTRUMENT DATA SHEETS

Device Tag:	HC062DHD01FIT01	HC062DHD02FIT01
Location:	SLP01 discharge	SLP02 discharge
P&ID:	I-001	I-001
Process:		
Fluid:	Combined sewer flow with high grit content	Combined sewer flow with high grit content
Temp min/max:	0 to 40 °C	0 to 40 °C
Press min/max:	0 to 1050 kPa	0 to 1050 kPa
Typical Flow min/max:	6.5 L/s	6.5 L/s
Bi-directional Flow:	No	No
Flow Tube:		
Line Size:	250mm	100mm
Body Material:	Stainless Steel 316L	Stainless Steel 316L
Lift Lugs	Two (2) to suit vertical installation	Two (2) to suit vertical installation
Process Connection:	SS 316L Class 150 Flanges. Drilling to ASME B16.47 Class 150 Series “A”.	SS 316L Class 150 Flanges. Drilling to ASME B16.47 Class 150 Series “A”.
Liner Material:	Hard Rubber	Hard Rubber
Electrode Material/Type:	Alloy C22 Bullet Nose	Alloy C22 Bullet Nose
Grounding Rings:	Yes	Yes
Housing:	NEMA 4X	NEMA 4X
Transmitter:		
Enclosure:	NEMA 4X	NEMA 4X
Integral/Remote:	Remote Wall Mounting	Remote Wall Mounting
Power Supply:	120 VAC 60 Hz	120 VAC 60 Hz
Sensor Cable:	15 meters	15 meters
Signal:	4-20mA isolated (600Ω)	4-20mA isolated (600Ω)
Pulse Output:	No	No
Calibr. Range:	0 – 10 L/s	0 – 10 L/s
Accuracy:	± $^{1}/_{2}$% of Rate	± $^{1}/_{2}$% of Rate
Electrical:		
Approval:	Hazardous area	Hazardous area
Acceptable		
1:	Krohne Optiflux 2000 with IFC 300	Krohne Optiflux 2000 with IFC300
2:	Rosemount 8705	Rosemount 8705
3:	ABB (including calibrator)	ABB (including calibrator)
4:	E+H Promag 400 (including calibrator)	E+H Promag 400 (including calibrator)

Device Tag:	HC062STN01FIT01	
Location:	Service Water	
P&ID:	I-002	
Process:		
Fluid:	Service Water	
Temp min/max:	0 to 40 °C	
Press min/max:	0 to 700 kPa	
Typical Flow min/max:	50 L/s	
Bi-directional Flow:	No	
Flow Tube:		
Line Size:	100mm	
Body Material:	Stainless Steel 316L	
Lift Lugs	Two (2) to suit vertical installation	
Process Connection:	SS 316L Class 150 Flanges. Drilling to ASME B16.47 Class 150 Series “A”.	
Liner Material:	Hard Rubber	
Electrode Material/Type:	Alloy C22 Bullet Nose	
Grounding Rings:	Yes	
Housing:	NEMA 4X	
Transmitter:		
Enclosure:	NEMA 4X	
Integral/Remote:	Remote Wall Mounting	
Power Supply:	120 VAC 60 Hz	
Sensor Cable:	15 meters	
Signal:	4-20mA isolated (600Ω)	
Pulse Output:	No	
Calibr. Range:	0 – 50 L/s	
Accuracy:	± $^{1}/_{2}$% of Rate	
Electrical:		
Approval:	Hazardous area	
Acceptable		
1:	Krohne Optiflux 2000 with IFC 300	
2:	Rosemount 8705	
3:	ABB (including calibrator)	
4:	E+H Promag 400 (including calibrator)	

SECTION 16900, APPENDIX 1-1E
LEVEL TRANSMITTERS – ULTRASONIC

1 SPECIFICATIONS

1.1 GENERAL

.1 The design guidelines expressed in this document defines additional requirements and deviations from the requirements set forth in Section 16900 – Instrumentation and Controls.

1.2 PERFORMANCE

.1	Range:	As Noted
.2	Sensor Relative Humidity:	100% condensing
.3	Sensor Operating Temperature:	-45 to 90 °C
.4	Accuracy:	± 0.25 percent of full scale
.5	Repeatability:	± 0.5 percent of full scale
.6	Linearity:	± 0.5 percent of full scale
.7	Minimum Blanking Distance:	300 mm

2 PRODUCTS

2.1 TRANSDUCER

.1 Type: Ultrasonic pulse transceiver with temperature compensation, approved by FM and CSA for Class I and Class II Division 1 hazardous locations.

.2 Material: Encapsulated enclosure housing of PVC, Kynar, or chemical resistant, durable corrosion resistive material

.3 Cable: Provide signal cable of required length with sealed watertight attachment to field mounted junction box to allow for sensor removal and replacement.

.4 Additional Features: Submergence Shield

2.2 TRANSMITTER

.1 Display: Level display in Engineering Units

.2 Additional Features:

.1 Automatic False-Echo Suppression for fixed obstruction avoidance

.2 Front panel keypad for parameter selection

.3 Local backlit LCD display level with additional indicators for alarms and status conditions.
Minimum 12 mm high characters

.4 Continuous on-line self-diagnostics

.5 Dual, high and low alarms with adjustable set-points; isolated output SPDT contacts, 5 amp
120 Vac, and Loss of Echo - Fail to "Hold Last State" position after five (5) minutes

.6 Smart Transmitter Type, complete with HART protocol

2.3 ELECTRICAL

.1 Cable Entry: 1/2” NPT

.2 Class/Div /Group: As noted

3 INSTALLATION

3.1 GENERAL

.1 Install the transmitter in accordance with the manufacturer’s instructions and recommendation.

.2 Provide manufacturer's recommended model sensor appropriate for mounting location, depth, and media application.

.3 Provide all stainless steel mounting hardware for surface, panel or handrail mounting as required by location.

.4 Allow adequate clearance for conical beam ultrasonic signal over total range.

.5 Follow manufacturer's recommendation for the minimum separation between the sensor and maximum expected media level.

.6 Mount the sensor away from sidewalls to avoid signal interference.

.7 When located outdoors, provide protection from wind interference, snow, and direct sunrays by means of shield or enclosure for sensor.

.8 Provide R.S. conduit for cable between sensor and transmitter.

4 PRODUCT DATA SHEETS

Device Tag:	HC062WWL01LIT01	HC062STK01LIT01
Location:	Wet Well	Sanitary Holding Tank
P&ID:	I-001	I-001
Process:		
Fluid:	Raw Sewage	Raw Sewage/StormWater
Temp min/max:	0 to 40 deg. C	0 to 40 deg. C
Press min/max:	Ambient	Ambient
Transducer:		
Sensor Type:	Ultrasonic	Ultrasonic
Remote Element:	Yes	Yes
Signal Cable:	Belden 8760 (1Pr Inst.)	Belden 8760 (1Pr Inst.)
Blanking:	300 mm (12")	300 mm (12")
Temp. Compensation:	Built In	Built In
Cable Length:	To fit application	To fit application
Submergence Shield:	Yes	Yes
Transmitter:		
Signal:	4-20mA isolated (600Ω)	4-20mA isolated (600Ω)
Power Supply:	100-230 VAC	100-230 VAC
Enclosure:	Remote, Panel Mount, NEMA 4X	Remote, Panel Mount, NEMA 4X
Indication:	Local Back Lit LCD, Eng units	Local Back Lit LCD, Eng units
Calibrator:	Yes	No
Calibration Range:	0 - 2 meters	0 - 9 meters
Accuracy:	0.25% of range or 6 mm ($^1/_4$")	0.25% of range or 6 mm ($^1/_4$")
Output Relays:	6 Relays (4 Form A, 2 Form C), 250 VAC	6 Relays (4 Form A, 2 Form C), 250 VAC
Options:	Synchronized acoustic signal	Synchronized acoustic signal
Electrical:		
Approval:	General Purpose CE, FM, CSA, UL Listed	General Purpose CE, FM, CSA, UL Listed
Class/Div/Group:	Class I Division 1	Class I Division 1
Acceptable Models:		
1:	Pulsar (Ultra5, db40)	Pulsar (Ultra5, db40)
2:	Siemens (Multiranger 200)	Siemens (Multiranger 200)
3:	Endress + Hauser	Endress + Hauser

SECTION 16900, APPENDIX 1-1F
LEVEL SWITCHES - FLOAT

1 SPECIFICATIONS

1.1 GENERAL

.1 The design guidelines expressed in this document defines additional requirements and deviations from the requirements set forth in Section 16900 – Instrumentation and Controls.

1.2 PERFORMANCE

.1	Repeatability:	± 25 mm of float setting
.2	Deadband:	100 mm (4”)
.3	Operating Temperature:	0 to 60 °C

2 PRODUCTS

2.1 SENSOR (PRIMARY ELEMENT)

.1	Type:	Float
.2	Housing:	Constructed of moulded polypropylene or approved equivalent.
.3	Cable:	Suitable for continuous submergence in the process fluid. Cable length to suit the installation.
.4	Switch / Contact Form:	SPDT switch, 10 A, 120 VAC, mercury-free dry contact
.5	Degree of Protection:	IP68, 20 m
.6	Minimum Conductivity:	General Application 5 µS/cm

2.2 ACCESSORIES

.1	Hanger Bracket:	Provide 304 SS horizontal level regulator hanger bracket to support up to six floats, complete

with squeeze connectors, nuts and bolts.

.2 Sway Control Ring: Provide 304 S/S sway control ring for each float switch to prevent cables from entangling together.

2.3 ELECTRICAL

.1 Approval: CSA

.2 Class/Div/Group: As noted.

2.4 ACCEPTABLE MATERIAL

.1 Flygt ‘ENM-10’

.2 GEMS Sensors, LS1900 Series

.3 Approved equal

3 INSTALLATION

3.1 GENERAL

.1 The following installation requirements are in addition to or deviations from the requirements set forth for instrumentation in the Section 16900 Instrumentation and Control.

.1 Isolate the switch from vibration and possible physical damage.

.2 Mount float switches such that the float contacts only the fluid to be measured.

.3 Provide mounting hardware including sway control rings, hanger brackets, and pipe-mounting hardware. All mounting hardware to be stainless steel.

.4 Mount switch such that it is easily removable for maintenance or cleaning, without emptying the tank or sump in which it is mounted.

.5 Mount sway control rings and hanger brackets using cinch anchors.

.6 Wire the switch using the manufacturer’s recommended flexible cable to a junction box close to the switch to facilitate removal for maintenance. Terminate float switch cables on terminal strips mounted in a NEMA 4X junction box located for ease of maintenance. Locate weatherproof cable connectors on the bottom of the junction box.

.7 Strain relief to be provided for cable anchoring point.

.8 Cable insulation suitable for continuous submergence in water or hydrocarbons. Conductors shall be minimum 14 AWG stranded copper. Cable length to suit the installation.

.9 Provide galvanically isolated intrinsic barriers in electrically hazardous applications.

.10 Install EYS seals as required to comply with OESC when mounting float switch in hazardous applications.

4 PRODUCT DATA SHEETS

Device Tag:	HC062WWL01LSH01	HC062WWL01LSL01	HC062WWL01LSH2
Location:	Wetwell	Wetwell	Wetwell
P&ID	I-001	I-001	I-001
Service:	High Level Switch Pump Start	Low Level Switch Pump Stop	Emergency Relief Switch
Process:			
Liquid:	Raw Sewage	Raw Sewage	Raw Sewage
Temp min/max:	5 to 40 °C	5 to 40 °C	5 to 40 °C
Specific Gravity:	0.95 to 1.1	0.95 to 1.1	0.95 to 1.1
Cable:			
Cable Length:	To fit installation	To fit installation	To fit installation
Accessories:			
Sway Control Rings:	Yes	Yes	Yes
Hanger Bracket / Material:	Yes / Stainless Steel	Yes / Stainless Steel	Yes / Stainless Steel
Local Junction Box:	Yes	Yes	Yes
I.S. Relay:	Yes	Yes	Yes
Electrical:			
Approval:	CSA	CSA	CSA
Class/Div/Group:	Class I Division 1 Group C & D	Class I Division 1 Group C & D	Class I Division 1 Group C & D

SECTION 16900, APPENDIX 1-1G
PRESSURE GAUGES

1 SPECIFICATIONS

1.1 GENERAL

.1 The design guidelines expressed in this document defines additional requirements and deviations from the requirements set forth in Section 16900 – Instrumentation and Controls.

1.2 PERFORMANCE

.1	Repeatability:	As noted.
.2	Accuracy:	± 1.0 % of span or better for normal pressure gauges. ± 2-1-2% for low pressure gauges.
.3	Operating Temperature:	-40 to 60 °C where indicated Out-Door, otherwise -20 to 60°C.

2 PRODUCTS

2.1 GAUGE

.1	Type:	Bourdon Tube for normal pressure gauges. Bellows for low pressure gauges.
.2	Wetted Parts:	316L Stainless Steel.
.3	Process Connection:	As noted, bottom connection.
.4	Gear Mechanism:	316 Stainless Steel.
.5	Case:	NEMA 4X
.6	Dampening:	Liquid filled (silicone where indicated Out-Door, otherwise glycerine), or dampening via other means (e.g. Ashcroft Plus! Option).
.7	Dial:	102 mm (minimum) Black markings in kPa and PSI on white dial (mm H2O and inches H2O for low pressure gauges). Indicator rests at approximately 50% range under normal operating conditions.

.8	Additional Features:	All pressurized joints welded. Blowout protection. Shatter-proof Window.

2.2 DIAPHRAGM SEAL (WHERE INDICATED)

.1	Type:	Diaphragm Seal.
.2	Diaphragm:	316L Stainless Steel.
.3	Housing:	316L Stainless Steel.
.4	Gauge Connection:	1/2" NPT.
.5	Process Connection:	1/2" NPT.
.6	Wetted Parts:	316 Stainless Steel
.7	Fill/Bleed Connection:	1/4” NPT
.8	Gear Mechanism:	316 Stainless Steel.
.9	Case:	NEMA 4X
.10	Additional Features:	(Flushing Connection NOT Required). Factory-assembled to pressure gauge and pre-filled. Removal of top housing and diaphragm will not cause loss of fill fluid. Continuous duty.

2.3 ACCEPTABLE MATERIAL (GAUGE)

.1 Type ‘1259’ or ‘1279 Duragauge’ for normal pressure gauges, type ‘1188’ for low pressure gauges, manufactured by Ashcroft.

.2 Type’233.53’ for normal pressure gauges, type ‘632.34’ for low pressure gauges, manufactured by WIKA.

2.4 ACCEPTABLE MATERIAL

.1 ‘Type 201’ manufactured by Ashcroft.

.2 ‘Type L990.10’ manufactured by WIKA.

.3 Or approved equal.

3 INSTALLATION

3.1 GENERAL

.1 Install with required accessories, including isolation ball valves, nipples, reducers and process connection to main piping.

4 PRODUCT DATA SHEETS

Tag No.	Diaph. Seal Req'd	Gauge Range	Process Fluid	Process Conn.	P&ID	Out-Door
DHD01PSG01	Yes	0 to 1000 kPa	Raw Sewage	25mm NPT	I-001	No
DHD01PSG02	Yes	0 to 1000 kPa	Raw Sewage	25mm NPT	I-001	No

SECTION 16900, APPENDIX 1-1H
RAIN GAUGE

1 SPECIFICATIONS

1.1 GENERAL

.1 The design guidelines expressed in this document defines additional requirements and deviations from the requirements set forth in Section 16900 – Instrumentation and Controls.

1.2 PERFORMANCE

.1	Accuracy:	±1% to 250mm/hr; ±3% to 500mm/hr
.2	Closure Timing:	50 milliseconds

2 PRODUCTS

2.1 RAIN GAUGE

.1	Type:	Syphon controlled tipping bucket rain gauge.
.2	Receiving Collector:	Diameter of 203 ± 0.2mm.
	Accuracy:	±1% to 250mm/hr; ±3% to 380mm/hr
.3	Bucket Capacity:	0.5mm
.4	Closure Timing:	100 ± 50 milliseconds 0.75 milliseconds max bounce time
.5	Materials:	Corrosion resistant materials.
.6	Termination:	Screw Termination ($2.5mm^2$)
.7	Switch Rating:	50V ac/dc at 0.5 non-inducive.
.8	Installation:	Mounting pedestal.
.9	Operating Temperature:	-30°C to 60°C
.10	Additional Features:	Heater with electronic thermostatic control operation.

2.2 ELECTRICAL

.1 Approval: CSA.

.2 Class/Div/Group: As noted.

2.3 ACCEPTABLE PRODUCTS

.1 Rimco 7499

.2 Approved equal.

3 INSTALLATION

3.1 GENERAL

.1 Install the rain gauge in accordance with the manufacturer's instructions and recommendations.

4 PRODUCT DATA SHEETS

Device Tag:	HC062RGA0100000
Location:	Rooftop of Building
P&ID	I-002
Service:	Outdoors
Process:	
Resolution:	0.5mm
Temp min/max:	-30°C to 60°C
Cable:	
Cable Length:	To fit installation
Accessories:	
Heater:	Yes
Mounting Pedestal:	Yes
Electrical:	
Approval:	CSA

SECTION 16900, APPENDIX 1-1I
DOOR SENSOR – MAGNETIC CONTACT

1 SPECIFICATIONS

1.1 PERFORMANCE

.1	Sensing Distance:	1-1/4” (32mm).
.2	Operating Temperature:	-20 to 60 °C.

2 PRODUCTS

2.1 SENSOR

.1	Type:	Magnetic Contact Switch (door/hatch sensor).
.2	Approvals:	Approved for hazardous location or in conjunction with CSA approved galvanically isolated barriers when hazardous location indicated in schedule.
.3	Housing:	Thermoplastic polyester, aluminum, stainless steel or nickel plated brass.
.4	Switch / Contact Form:	Form A (SPDT) Reed, 100mA, 28VDC.
.5	Installation:	Surface mount.

2.2 ELECTRICAL

.1	Approval:	CSA.
.2	Class/Div/Group:	As noted.

2.3 ACCEPTABLE PRODUCTS

.1 Honeywell Sensors

.2 General Electric

.3 Approved equal.

3 INSTALLATION

3.1 GENERAL

.1 The following installation requirements are in addition to or deviations from the requirements set forth for instrumentation in the Section 16900 Instrumentation and Control.

.1 Provide galvanically isolated intrinsic barriers in electrically hazardous applications.

4 PRODUCT DATA SHEETS

Device Tag:	HC062STN01ESW01	HC062STN01ESW02	HC062STN01ESW03	HC062STN01ESW04	HC062STN01ESW05
Location:	Main Entrance Door	Odour Control Room Overhead Door	Odour Control Room Door	Electrical Room Door No. 1	Electrical Room Door No. 2
P&ID	I-002	I-002	I-002	I-002	I-002
Service:	Man Door Switch	Overhead Door Switch	Man Door Switch	Man Door Switch	Man Door Switch
Process:					
Liquid:					
Temp min/max:	5 to 40 °C	5 to 40 °C	5 to 40 °C	5 to 40 °C	5 to 40 °C
Cable:					
Cable Length:	To fit installation	To fit installation	To fit installation	To fit installation	To fit installation
Accessories:					
Local Junction Box:	Yes	Yes	Yes	Yes	Yes
I.S. Relay:	Yes	Yes	Yes	No	No
Electrical:					
Approval:	CSA	CSA	CSA	CSA	CSA
Class/Div/Group:	Class I Division 1 Group C & D	Class I Division 1 Group C & D	Class I Division 1 Group C & D	n/a	n/a

Device Tag:	HC062STK01ESW01	HC062STK01ESW02	HC062STK01ESW03	HC062STK01ESW04	HC062STK01ESW05
Location:	Storage Tank Access Hatch No. 1	Storage Tank Access Hatch No. 2	Storage Tank Access Hatch No. 3	Storage Tank Access Hatch No. 4	Storage Tank Stair Access Hatch No. 5
P&ID	I-002	I-002	I-002	I-002	I-002
Service:	Hatch Door Switch	Hatch Door Switch	Hatch Door Switch	Hatch Door Switch	Hatch Door Switch
Process:					
Liquid:					
Temp min/max:	5 to 40 °C	5 to 40 °C	5 to 40 °C	5 to 40 °C	5 to 40 °C
Cable:					
Cable Length:	To fit installation	To fit installation	To fit installation	To fit installation	To fit installation
Accessories:					
Local Junction Box:	Yes	Yes	Yes	Yes	Yes
I.S. Relay:	Yes	Yes	Yes	Yes	Yes

Electrical:					
Approval:	CSA	CSA	CSA	CSA	CSA
Class/Div/Group:	Class I Division 1 Group C & D	Class I Division 1 Group C & D	Class I Division 1 Group C & D	Class I Division 1 Group C & D	Class I Division 1 Group C & D

Device Tag:	HC062WWL01ESW01	HC062WWL01ESW02	HC062WWL01ESW03
Location:	Wetwell Access Hatch No. 1	Wetwell Access Hatch No. 2	Wetwell Access Hatch No. 3
P&ID	I-002	I-002	I-002
Service:	Hatch Door Switch	Hatch Door Switch	Hatch Door Switch
Process:			
Liquid:			
Temp min/max:	5 to 40 °C	5 to 40 °C	5 to 40 °C
Cable:			
Cable Length:	To fit installation	To fit installation	To fit installation
Accessories:			
Local Junction Box:	Yes	Yes	Yes
I.S. Relay:	Yes	Yes	Yes
Electrical:			
Approval:	CSA	CSA	CSA
Class/Div/Group:	Class I Division 1 Group C & D	Class I Division 1 Group C & D	Class I Division 1 Group C & D

SECTION 16900, APPENDIX 1-1J
SMOKE DETECTORS

1 SPECIFICATIONS

1.1 PERFORMANCE

.1	Operating Temperature:	0 to 38 °C.
.2	Ambient Temperature:	0 to 49 °C.
.3	Humidity Range:	10 to 93% RH, non-condensing
.4	Sensitivity:	1-3.18%/ft

2 PRODUCTS

2.1 SENSOR

.1	Type:	Photoelectric
.2	Approvals:	Approvals for hazardous location where noted; CSA, ULc approved.
.3	Housing:	Thermoplastic polyester, Polycarbonate, aluminium, or stainless steel.
.4	Installation:	Surface mount.

2.2 ELECTRICAL

.1	Approval:	CSA or UL_C.
.2	Class/Div/Group:	As noted.
.3	Power Supply:	24VDC
.4	Switch / Contact:	Form C SPDT, 5 amperes at 30 VDC

2.3 ACCEPTABLE PRODUCTS

.1 Honeywell

.2 Det-Tronics

.3 System Sensor

.4 Approved equal.

3 INSTALLATION

3.1 GENERAL

.1 The following installation requirements are in addition to or deviations from the requirements set forth for instrumentation in the Section 16900 Instrumentation and Control.

.1 Install the smoke detector in accordance with the manufacturer's instructions and recommendation.

4 PRODUCT DATA SHEETS

Device Tag:	HC062STN01SKD01XA_	HC062STN01SKD03XA_	HC062STN01SKD04XA_	HC062STN01SKD05XA_
Location:	Electrical Room	Odour Control Room	Odour Control Room	Odour Control Room
P&ID	I-002	I-002	I-002	I-002
Service:	Electrical Room	Odour Control Room	Odour Control Room	Odour Control Room
Process:				
Liquid:				
Temp min/max:	0 to 49 °C	0 to 49 °C	0 to 49 °C	0 to 49 °C
Cable:				
Cable Length:	To fit installation	To fit installation	To fit installation	To fit installation
Accessories:				
Local Junction Box:	n/a	n/a	n/a	n/a
Electrical:	24 VDC	24 VDC	24 VDC	24 VDC
Approval:	CSA	CSA	CSA	CSA
Class/Div/Group:	n/a	Class I Division 1 Group C & D	Class I Division 1 Group C & D	Class I Division 1 Group C & D

Device Tag:	HC062STN01SKD06XA_	HC062STN01SKD07XA_	HC062STN01SKD08XA_	HC062STN01SKD09XA_
Location:	Lower Level	Lower Level	Stairwell	Lower Level
P&ID	I-002	I-002	I-002	I-002
Service:	Lower Level	Lower Level	Stairwell	Lower Level
Process:				
Liquid:				
Temp min/max:	0 to 49 °C	0 to 49 °C	0 to 49 °C	0 to 49 °C
Cable:				
Cable Length:	To fit installation	To fit installation	To fit installation	To fit installation
Accessories:				
Local Junction Box:	n/a	n/a	n/a	n/a
Electrical:	24 VDC	24 VDC	24 VDC	24 VDC
Approval:	CSA	CSA	CSA	CSA

Class/Div/Group:	Class I Division 1 Group C & D	Class I Division 1 Group C & D	Class I Division 1 Group C & D	Class I Division 1 Group C & D

Device Tag:	HC062STN01SKD10XA_
Location:	Lower Level
P&ID	I-002
Service:	Lower Level
Process:	
Liquid:	
Temp min/max:	0 to 49 °C
Cable:	
Cable Length:	To fit installation
Accessories:	
Local Junction Box:	n/a
Electrical:	24 VDC
Approval:	CSA
Class/Div/Group:	Class I Division 1 Group C & D

SECTION 16900, APPENDIX 1-1K
HEAT DETECTORS

1 SPECIFICATIONS

1.1 PERFORMANCE

.1	Activation rating:	90 to 95 °C.
.2	Rate of rise:	8.33 to 13.88 °C/ minute.
.3	Ambient Temperature:	0 to 66 °C.
.4	Humidity Range:	10 to 95% RH, non-condensing

2 PRODUCTS

2.1 SENSOR

.1	Type:	Resettable Fixed Temperature and Rate-of-rise
.2	Housing:	Thermoplastic polyester, Polycarbonate, aluminium, or stainless steel.
.3	Installation:	Surface mount.
.4	Indication:	Alarm indicating LED

2.2 ELECTRICAL

.1	Approval:	CSA or UL_C
.2	Class/Div/Group:	As noted.
.3	Power Supply:	24VDC
.4	Switch / Contact:	Form C SPDT, 3 amperes at 28 VDC

2.3 ACCEPTABLE PRODUCTS

.1 Simplex

.2 Det-Tronics

.3 System Sensor

.4 Approved equal.

3 INSTALLATION

3.1 GENERAL

.1 The following installation requirements are in addition to or deviations from the requirements set forth for instrumentation in the Section 16900 Instrumentation and Control.

.1 Install the smoke detector in accordance with the manufacturer's instructions and recommendation.

4 PRODUCT DATA SHEETS

Device Tag:	HC062STN01SKD02XA_
Location:	Generator Room
P&ID	I-002
Service:	Generator Room
Process:	
Liquid:	
Temp min/max:	0 to 66 ˚C
Cable:	
Cable Length:	To fit installation
Accessories:	
Local Junction Box:	n/a
Electrical:	24 VDC
Approval:	CSA
Class/Div/Group:	n/a

SECTION 16900
APPENDIX 2-1
INSTRUMENT CHECK & SIGN-OFF SHEETS

CITY OF HAMILTON
NEW PIER 8 WWPS, FORCEMAIN, SEWER, AND STORAGE TANK
FIELD INSTRUMENT, CONTROL DEVICE, AND MECHANICAL EQUIPMENT CONTROL CIRCUIT VERIFICATION

#	Equipment	TAG NUMBER	EVALUATION, RECOMMENDATION & COST										DOCUMENT VERIFICATION & INITIAL EVALUATION															FIELD VERIFICATION PROCEDURE																			
			Recomm.				*Comments/ Reasons*					*Cost Estimate*	*Records Available*					*Initial Evaluation & Recommendation*										*Test Date*	*Results*										*Reason & Proposed Modification*								
			Reuse	Repair/ Modify Wiring	Replace	Other	Partial Instrument/Control Device Repair	Wiring Replacement	Damaged/ Non Functional	Out of Range	Other (Please Specify)		Technical Manufacturer Data Sheet	P&ID, Control Schematic, Electrical dwgs	Contract Specifications	Calibration Reports	Maintenance Reports	Product Meets Design Requirements	Calibrated Range Meets Design Requirements	Accuracy Meets Design Requirements	Installation and Application Meets Design Requirements	Wiring and I/O Meets Design Requirements	Recommend Replacing in Entirety	Recommend Replacing all associated wiring	Proceed with Field Verification	Other Recommendation (Please specify)		Installation & Application Meets Design	Loop Drawings and Control Schematics Verified	Functions Properly	Instrument/Device Output Measured at Controller (mA)	Output in Engineering Unit	Local Indication	Maximum Calibrated Range (Engineering Units)	Plant Reported Engineering Reading	Error of Instrument Signal	Error Accepted (A)/Rejected(R)	Recommend Replacing in Entirety	Recommend Replacing all associated wiring	Recommend Minor Modifications	No Modifications Recommended	Other (Please Specify)
1																																													
2																																													
3																																													
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TOTAL Page 1												$0.00																																		

Contractor _____ Date _____ Consultant _____ Date _____ Owner/Operator _____ Date _____

CITY OF HAMILTON
NEW PIER 8 WWPS, FORCEMAIN, SEWER, AND STORAGE TANK
INSTRUMENT TESTING LOG

INSTRUMENT	TAG NUMBER	STATUS				DOCUMENTS					TEST AND CALIBRATION															
		New	*Existing*			*Records Available*					*Results*															
			Re-Used	Re-Calibrated	Repaired	Technical Manufacturer Data Sheet	P&ID, Control Schematic, Electrical dwgs	Contract Specifications	Origional Calibration Reports	Maintenance Reports	Test Date	Installation & Applicaation Meets Design & Manufacturers Recommendation	Calibrated Range-Lower Limit In Engineering Units	Calibrated Range-Lower Limit In (m/A)	Calibrated Range-Upper Limit In Engineering Units	Calibrated Range-Upper Limit In (m/A)	Span in Engineering Units	Regional Standard's Accuracy	Manufacturer's Accuracy	Instriment Individual Test's Accuracy	Proposed Loop Compensation	Accuracy With Loop Compensation	Accepted (A) / Rejected (R)	Comments	Reason(s) Of Non-Acceptance
			N/A	N/A	N/A																					
			N/A	N/A	N/A																					
			N/A	N/A	N/A																					
			N/A	N/A	N/A																					
			N/A	N/A	N/A																					
			N/A	N/A	N/A																					
			N/A	N/A	N/A																					
			N/A	N/A	N/A																					
			N/A	N/A	N/A																					
			N/A	N/A	N/A																					
			N/A	N/A	N/A																					
			N/A	N/A	N/A																					

Contractor _____ Date _____ Consultant _____ Date _____ Owner/Operator _____ Date _____

		DEVICE INSPECTION					STATUS													SOFTWARE ALARMS								CONTROLS																	COMPLIANCE			
							CONTROLLERS (RPU) INPUTS										FIELD											CONTROLLERS (RPU) INPUTS						FIELD														
DEVICE EQUIPMENT	IDENTIFICATION	PRODUCT ACCEPTANCE	INSTALLATION ACCEPTANCE	DEVICE TAG NAME	CALIBRATION ACCEPTANCE	LOCAL PANEL SWITCHES	LOCAL/REMOTE CONTROL	RUNNING / OPEN	CLOSED	ANALOG INPUT1	ANALOG RANGE OK	ANALOG INPUT1	ANALOG RANGE OK	FIELD ALARMS	OTHER	OTHER	LOCAL INDICATORS	REMOTE INDICATORS	OTHER	SCADA MANUAL	CENTRAL MANUAL	AUTO	FAILED TO START/OPEN	FAILED TO STOP/CLOSE	UNCOMMANDED START	UNCOMMANDED STOP	OTHER	START / OPEN	STOP	CLOSE	SETPOINT 1	SETPOINT 2	OTHER	LOCAL HANDSWITCHES	REMOTE HANDSWITCHES	OTHER	SCADA MANUAL	CENTRAL MANUAL	ALARM MANAGEMENT	AUTO LOGIC		TESTED	ACCEPTED	INITIALLED	P&ID	PROCESS NARRATIVE	COMMENTS	REASON(S) FOR NON-ACCEPTANCE

Hamilton	**INSTRUMENTATION CHECKLIST** **Calibration**	**Cost Centre**: **Contract #**: **Project #**: **Project Name**:

File:	**Date:**
Description:	**Tag:**

Tag Number	Serial Number	Data Sheet Number	Calibrated per Data Sheet	Checked by (Initial)	Date

Approvals: The signatures below do NOT absolve the contractor from any of his contractual obligations.

Authority	Name	Signature	Date
Contractor			
CONSULTANT			
_____Maintenan			
_____E & S			

Hamilton	**INSTRUMENTATION CHECKLIST** **Termination and Continuity**	**Cost Centre**: **Contract #**: **Project #**: **Project Name**:

File:	**Date:**	
Description:		**Tag:**

Tag Number	Loop Drawing Number	Terminations per Drawing	Continuity Checked	Checked by (Initial)	Date

Approvals: The signatures below do NOT absolve the contractor from any of his contractual obligations.

Authority	Name	Signature	Date
Contractor			
CONSULTANT			
_____			
_____ E & S			

Hamilton	**INSTRUMENT INSTALLATION CHECKLIST** **Float Switch**	**Cost Centre**: **Contract #**: **Project #**: **Project Name**:

Description:		**Tag**:	
Manufacturer:		**Model No**:	
Serial No:		**Data Sheet**:	
P&ID:		**Loop Drawing**:	
Location Drawing:		**Installation Detail**:	
Checklist		**Initial**	**Date**
SENSOR	Mounted per installation details		
	Model number matches Spec		
	Certification on Instrument Label		
	Proper tagging and number		
	Hardware appropriately tightened		
	Proper liquid tight seal on cable		
	Signal wiring per Specification		
	Elevation matches installation		
	Signal output tested		
	No paint splatter		
	Mounting elevation		
	Must provide this elevation!		

Approvals: The signatures below do NOT absolve the contractor from any of his contractual obligations.

Authority	Name	Signature	Date
Contractor			
CONSULTANT			
_____ E & S			

Hamilton	**INSTRUMENT INSTALLATION CHECKLIST** **Flow Transmitter-Magnetic**	**Cost Centre**: **Contract #**: **Project #**: **Project Name**:

Description:	**Tag**:
Manufacturer:	**Model No**:
Serial No:	**Data Sheet**:
P&ID:	**Loop Drawing**:
Location Drawing:	**Installation Detail**:

	Checklist	Initial	Date
SENSOR	Flow element clean, no scratches		
	Mounted per installation details		
	Direction of flow correct		
	Flange gasket properly centered		
	Signal cable properly prepared		
	Proper liquid tight seal on cable		
	Proper torque on flange bolts		
	Proper grounding of flow tube		
	No paint splatter		
TRANSMITTER	Model numbers match Spec		
	Calibration matches installation		
	Mounted per installation details		
	Transmitter display in clear view		
	View from Man. Control Station		
	Power wiring per specification		
	Signal wiring per specification		
	Signal shield properly terminated		
	No vibration being transmitted		
	Power applied to instrument		
	Signal output tested		
	Proper tagging and number		
	Certification on instrument label		
	Cover lanyard cable in place		

Approvals: The signatures below do NOT absolve the contractor from any of his contractual obligations.

Authority	Name	Signature	Date
Contractor			
CONSULTANT			
_____ E & S			

Hamilton	**INSTRUMENT INSTALLATION CHECKLIST** **Pressure Gauge - Local**	**Cost Centre**: **Contract #**: **Project #**: **Project Name**:

Description: Pressure Gauge	**Tag**:
Manufacturer:	**Model No**:
Serial No:	**Data Sheet**:
P&ID:	**Installation Detail**:
Location Drawing:	

	Checklist	Initial	Date
SENSOR	Installation location correct per P&ID		
	Isolation valve installed		
	Chemical seal installed [if specified on P&ID]		
	Model number matches data sheet		
	Range matches data sheet		
	Tag correct and secure		
	Gauge easily read from floor or access platform		
	No paint spatter		
	Calibration: Attach manufacturer's certificate if applicable		

Approvals: The signatures below do NOT absolve the contractor from any of his contractual obligations.

Authority	Name	Signature	Date
Contractor			
CONSULTANT			
_____ E & S			

REF. NO. _____

EQUIP. NO. _____

INSTALLATION CHECKLIST

EQUIPMENT – ELECTRICAL

CONTRACT : _____

_____

E.O. _____

EQUIPMENT : _____ **DATE INSTALLATION COMPLETE :** _____

SERIAL NO. : _____ **MAKE & MODEL NO. :** _____

PRE-STARTUP	CHECKED BY (Initial)*	DATE	REMARKS
Device/Motor Data :			
- Size (HP/KW)			
- HP FLA			
- MEGGER			
- Rotation			
Other -			
Supply/Starter Data :			
- Fuse Size			
- O/L Size			
- Feeder Size			
Other -			
Control :			
- Interlock Check			
- Local Run			
- Remote Run			
STARTUP Run Under Load			

***** - Indicate [N/A] if not applicable

DEFICIENCIES NOTED:

NAMEPLATES:

STARTER: _____ **CABLES:** _____

EQUIPMENT: _____

OTHER NOTES: The signatures below do NOT absolve the contractor from any of his contractual obligations.

SIGNATURES FOR EQUIPMENT CHECKOUT COMPLETE AND READY FOR SERVICE		
CONTRACTOR	**OWNER**	**CONSULTANT**
Date:	**Date:**	**Date:**

REF. NO. _____

EQUIP. NO. _____

INSTALLATION CHECKLIST

INSTRUMENTS

CONTRACT : _____

_____

E.O. _____

EQUIPMENT : _____ **DATE INSTALLATION COMPLETE :** _____

SERIAL NO. : _____ **MAKE & MODEL NO. :** _____

PRE-STARTUP	CHECKED BY (Initial)*	DATE	REMARKS
Installation/Mounting Sensor/Transmitter			
Wiring/Conduit Termination and Seal			
Check Fuse Ratings (Supply & Internal)			
Tagging/Nameplate			
Compliance Section 16			
Testing (Ground Loop, Continuity & Installation)			
Power Supply			
Check Instrument Air, Adjust Filter/Regulator			
Check Temperature Control (Internal/Heat Tracing)			
Configure Calibration			
Tailback Lights			
STARTUP Verify Operation Under Max. Process Conditions			
Correct Quantities of Expendable Material			
COMMISSIONING Record below the loop characteristics which apply to this instrument			
Manuf./Vendor inspection certificate/letter			
Contacts - correct sense on operation			
Contacts - correct status at PAC			
Analog - correct polarity at PAC			
Analog - correct polarity with respect process			
Analog - Correct span at instrument			
Analog - Correct span at PAC & display			
Analog - Correct eng. Units at PAC & display			

OTHER NOTES : The signatures below do NOT absolve the contractor from any of his contractual obligations.

***** - Indicate [N/A]above if not applicable

SIGNATURES FOR EQUIPMENT CHECKOUT COMPLETE AND READY FOR SERVICE		
CONTRACTOR	**OWNER**	**CONSULTANT**
Date:	**Date:**	**Date:**

REF. NO. _____

EQUIP. NO. _____

INSTALLATION CHECKLIST

PANEL / PAC / COMPUTER

CONTRACT : _____

_____

E.O. _____

EQUIPMENT : _____ **DATE INSTALLATION COMPLETE :** _____

SERIAL NO. : _____ **MAKE & MODEL NO. :** _____

PRE-STARTUP	CHECKED BY (Initial)*	DATE	REMARKS
Installation and Mounting			
Location to Equipment Equipment (Electrical Interference)			
Wiring/Conduit Termination and Seals			
Tagging Nameplate			
Compliance Section 16			
Test (Ground Loop, Continuity, Installation)			
Check Fuse/Breaker Ratings			
Communications Test: Peer Link			
Remote I/O			
PAC - PC			
Cable Integrity			
Termination Connectors			
Telephone/Link Modem			
Rack/PAC Switch Settings			
Computer Installation			
Anciliary Equipment Installation			

***** - Indicate [N/A]above if not applicable

OTHER NOTES :
The signatures below do NOT absolve the contractor from any of his contractual obligations.

SIGNATURES FOR EQUIPMENT CHECKOUT COMPLETE AND READY FOR SERVICE		
CONTRACTOR	**OWNER**	**CONSULTANT**
Date:	**Date:**	**Date:**